Introduction

Skeletal metastases are common in many types of cancer, and their incidence varies with the primary site. The majority of patients with skeletal metastases experience pain; nevertheless, modern sophisticated imaging and improved assessment have led to the detection of more patients with asymptomatic bone metastasis. The rationale and decision to utilize radiation therapy in the management of skeletal metastases are evolving. Although conventional short-course external-beam radiation therapy (EBRT) still plays an important role in controlling pain and palliating symptoms, the ability to deliver an ablative radiation dose to the vertebrae with image-guided radiation therapy allows select patients to achieve improved pain control and local tumor control.

Conventional Radiation Therapy for Skeletal Metastasis

Both bone destruction and structural instability caused by skeletal metastasis can result in pain. Destruction of bone leads to increased pain, fractures, and other skel-
et al events, causing significant morbidity and impaired quality of life. If structural instability is suspected or found, orthopedic and/or neurosurgical oncologists should be involved to assess the need for surgical stabilization. To palliate painful bone metastasis without structural instability, EBRT is particularly effective. Pain relief via EBRT is achieved by decreasing the tumor size and inflammation; it may also promote pain relief by stimulating reossification of lytic bone lesions.

In the setting of significant lytic destruction, which places patients at high risk of pathological fracture, prophylactic fixation followed by postoperative EBRT should be strongly considered. Townsend et al\(^2\) reported that only 3% of patients who received postoperative radiation therapy required a second surgical procedure compared with 15% of patients treated with surgery without postoperative radiotherapy. Lytic skeletal metastasis in the weight-bearing skeleton places patients at increased risk of pathological fracture, and thus orthopedic oncologic evaluation should be integrated into the patient’s management plan.

Skeletal metastasis to the vertebrae can contribute to significant neurologic complications and morbidity, especially in the setting of spinal cord compression due to epidural extension of skeletal metastasis. In this instance, emergency therapy should be instituted to prevent or reverse neurologic compromise, and immediate intervention with radiotherapy (either alone or in conjunction with surgical decompression) should be utilized. In operable patients with spinal metastases and spinal cord compression, decompressive surgery followed by EBRT constitutes optimal treatment for neurologic function. The randomized trial reported by Patchell et al\(^3\) assigned patients with spinal metastases causing spinal cord compression (at a single area of the cord) to surgery followed by radiotherapy (30 Gy in 10 fractions) vs radiotherapy alone (same dose schedule). An early stopping rule was met at an interim analysis when it was observed that surgery plus radiotherapy was superior in terms of the ability to walk after treatment (84% vs 57%) and the time interval retaining the ability to walk (122 days vs 13 days). Thirty-two patients who entered the study unable to walk fared significantly better with surgery plus radiotherapy in terms of regaining the ability to walk (62% vs 19%). Other endpoints significantly favoring surgery plus radiotherapy vs radiotherapy alone included the need for corticosteroids and opioid analgesics.

Although the Patchell trial described above establishes the utility of surgery in addition to EBRT for patients with spinal metastases that cause spinal cord compression, patients with metastatic cancer who are operable represent a select and favorable subgroup. Invasive surgery is not feasible for many patients with a terminal metastatic cancer diagnosis. In these circumstances, radiotherapy alone is used. Furthermore, the benefit of surgery plus radiotherapy over radiotherapy alone is observed only in the setting of spinal cord compression, and radiotherapy alone is standard for patients who require treatment for pain, cauda equina compression, or radicular symptoms without spinal cord compression.

Radiotherapy design requires a thorough review of all appropriate diagnostic tests to define the target volumes for EBRT. Bone metastasis is frequently associated with soft-tissue masses, and such lesions are best assessed by computed tomography (CT) or magnetic resonance imaging (MRI). Appropriate margins should be applied to the target volume. For vertebral metastasis, at least one vertebral body above and below the treatment volume is commonly included; the lateral margins are either 1 to 2 cm from the vertebrae or the extent of extraosseous metastasis.

A variety of radiation dose fractionation schedules to treat skeletal metastases are commonly used and range from 8 Gy in 1 fraction, 20 Gy in 5 fractions, 30 Gy in 10 fractions, 37.5 Gy in 15 fractions, and 40 Gy in 20 fractions, with the most common fractionation being 30 Gy in 10 fractions. For those who require repeat radiotherapy to the same site, all previous treatment ports and radiation records should be reviewed. In the postoperative setting, radiation therapy usually is begun 2 to 4 weeks after fixation. The dose administered does not differ, and 30 Gy divided into 10 fractions over a 2-week period is most commonly used. The radiation field should include the original site of disease and the entire implant or fixation instrumentation. A margin of 1 to 2 cm is commonly applied.

**Outcomes With Different Conventional Radiotherapy Schedules**

For palliation of pain, the optimal prescription for radiation therapy has long been debated.\(^1,4\) An abundance of data from multiple randomized clinical trials and meta-analyses has demonstrated that prolonged fractionated radiation therapy is not superior to a shorter treatment course. An early randomized study from the Radiation Therapy Oncology Group (RTOG) between 1974 and 1980 included 266 patients with solitary metastasis who were randomly assigned to treatment with 40.5 Gy in 15 fractions or 20 Gy in 5 fractions; another 750 patients with multiple metastases were randomly assigned to 30 Gy in 10 fractions, 15 Gy in 5 fractions, 20 Gy in 5 fractions, or 25 Gy in 5 fractions.\(^5\) Quantitative measurement of pain was the endpoint. Overall, 85% of the patients achieved partial pain relief and 54% of the patients obtained complete pain relief. There were no significant differences between the treatment assignment in either the single- or multiple-metastases groups. The median duration of minimal pain relief was 20 weeks and that of complete pain relief was 12 weeks. Some pain relief was experienced within the first 4 weeks in most patients who reported pain relief,
but in about half of the patients, complete pain relief was reported at least 4 weeks after the start of treatment.

Rades et al. retrospectively reported on 1,304 patients with spinal metastasis irradiated with several schedules: 8 Gy in 1 fraction, 20 Gy in 5 fractions, 30 Gy in 10 fractions, 37.5 Gy in 15 fractions, and 40 Gy in 20 fractions. Motor function improved in 26% to 31%, and posttreatment ambulatory rates were 63% to 74% in the different radiotherapy schedule groups, without significant differences among them. However, in-field recurrences were significantly more common after 8 Gy in 1 fraction and 20 Gy in 5 fractions (approximately 12% in these groups) than with the other radiotherapy schedules (approximately 4%). Myelopathy was not observed in any radiotherapy schedule group, with a median follow-up of 14 months.

Randomized trials of different radiotherapy schedules for painful skeletal metastases have similarly observed that 8 Gy in 1 fraction initially is equally efficacious as more protracted schedules with a higher total dose; however, the patients who received 8 Gy in 1 fraction had inferior long-term control of pain and were more likely to require reirradiation.1,4,7

Hartsell et al. led an RTOG study from 1998 to 2001 that randomized 898 patients with bone metastasis from prostate cancer and breast cancer to receive 8 Gy in 1 fraction vs 30 Gy in 10 fractions. The Brief Pain Inventory assessment was available for 66% of the patients. The complete response rate was 15% in the 8-Gy group compared with 18% in the 30-Gy group; the partial response rate was 50% in the 8-Gy group compared with 48% in the 30-Gy group ($P = .06$). At 3 months, about

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**Fig 1A-D.** — A representative intensity-modulated stereotactic body radiation therapy plan with a radiation isodose curve for a patient with renal cell carcinoma who presented with a lytic metastatic lesion at the T5 vertebra destructing the left transverse process. (A) The beam arrangement and target are shown. (B-D) The red isodose line represents the prescription isodose of 16 Gy, and the yellow isodose line represents the 10-Gy isodose curve.
one-third of the patients in each group no longer required narcotic medications. Approximately 5% of patients in each group had a pathological fracture in the treatment field. Although there is no statistical difference in the risk of fracture, there is a greater need for re-treatment following single-fraction treatment; the 3-year re-treatment rate was 18% vs 9% (P < .001). Grades 2–4 acute toxicity occurred more frequently in the 30-Gy group than in the 8-Gy group (17% vs 10%; P = .002); the incidence of late toxicity did not differ (4% in both groups).

Emerging Data on Image-Guided Ablative Therapy for Skeletal Metastasis

Although palliative radiation therapy is well accepted as an effective treatment to improve pain and the quality of life of patients with metastatic disease, radical radiation therapy using image guidance to deliver an ablative radiation dose has been actively investigated in recent years. As better and novel systemic therapeutic regimens improve survival of patients with stage IV disease and modern sophisticated imaging modalities allow better and earlier detection of bone metastasis, aggressive local therapy for bone metastasis can potentially impact local tumor control and possibly survival. Hellman and Weichselbaum described the potential that a subgroup of patients may have oligometastasis, defined as distant deposits intermediate between completely absent and widely metastatic. If some patients have only a limited number of metastases, local therapy might definitively eradicate these areas and potentially convert the therapy to curative intent. In select cases with small-volume skeletal metastasis, limited metastatic tumor burden, and a good performance status, a new treatment technique termed stereotactic body radiation therapy (SBRT), which uses image-guidance technology for treatment delivery, provides a way to deliver a single fraction or a small number of high-dose radiation therapy fractions. An example of radiotherapy treatment planning and isodose distribution for spinal SBRT is shown in Fig 1.

Excellent treatment outcome of a metastatic vertebral metastasis treated with spinal SBRT is pictured in Fig 2. SBRT offers the patient a short course of outpatient, noninvasive ablative therapy. The ability to deliver a high dose of radiation to the tumor-bearing target conformally, from 2 to 7 times the standard palliative daily dose of 3 Gy, relies on modern radiation oncology techniques that provide a steep dose gradient between the tumor and normal tissue. This technique allows relatively small targets to be irradiated to ablative doses using small safety margins, as extensive imaging will be done prior to each treatment to ensure reproducibility. Motion of the spine caused by respiration is minimal compared with that of lung and liver tumors, but because the treatment target at which high-dose radiation is aimed is located only a few millimeters from the spinal cord, deviations of the target position (even by 1 or 2 mL) may potentially increase the risk of radiation-induced spinal cord injury by exposing the spinal cord to a higher dose of radiation. Therefore, a robust, noninvasive immobilization system with reliable image-guided treatment delivery is critical for targeting accuracy for spinal SBRT. The BodyFIX system (Medical Intelligence, Schwabmuenchen, Germany) has been tested for its reproducibility for spinal SBRT. This system is a standard immobilization device for spinal SBRT at our institution. Other commercial devices are available, and treatment systems with real-time intrafractional image guidance such as CyberKnife (Accuray, Sunnyvale, CA) do not require rigid immobilization because the target position is precisely tracked in real time during treatment.

In addition to immobilization, verification of the target position immediately prior to or during treatment delivery is crucial. On-board image guidance with either a stereoscopic x-ray system or a CT scan ensures that the intended target is in the same position prior to or during each treatment as it was at the time of treatment planning. CyberKnife (Accuray, Sunnyvale, CA) and ExacTrac X-Ray (BrainLAB, Feldkirchen, Germany) systems use...
in-room radiographic systems capable of generating orthogonal pairs of kilovoltage images for real-time monitoring and tracking during or immediately prior to treatment. With these systems, translation and rotation deviations are calculated by comparing reconstructed radiographs from planning CT with the real-time x-ray films to determine the need for fine adjustments to offset these deviations. For the CyberKnife system, a computer-controlled robotic arm moves the mobile linear accelerator to make such an adjustment. For the Novalis BrainLAB linear accelerator treatment system, a robotic couch allows adjustment with 6° of freedom movement to correct translation and rotation deviations.

Three-dimensional imaging techniques have also been used as on-board imaging for image-guided radiation therapy to improve accurate targeting of tumor. TomoTherapy (Accuray, Sunnyvale, CA) uses megavoltage CT imaging technology built in the linear accelerator gantry for precise localization of treatment targets. However, its suboptimal soft-tissue imaging quality and inability to manage target motion efficiently hinder its ability to treat targets that move due to organ motion. Kilovoltage cone-beam CT is the latest volumetric imaging technology for image-guided radiation therapy and provides efficient and superior soft-tissue image quality. This is particularly useful for SBRT to paraspinal disease, with significant soft-tissue and visceral infiltration.

**Single-Fraction Spinal SBRT**

In the past few years, investigators at several institutions reported their clinical experience with single-fraction SBRT for spinal metastasis. Overall, these reports demonstrated the efficacy of single-fraction radiosurgery for pain control and improvement of neurologic function with epidural compression. Rapid pain relief has been demonstrated, with a median time to pain relief of 2 weeks and pain control in some patients as early as within 24 hours. The median duration of pain control of 13.3 months was reported, and local tumor control was excellent, at 85% or higher.

Gerszten et al from the University of Pittsburgh reported the largest prospective experience with 393 patients with 500 lesions prospectively treated to a mean dose of 20 Gy in 1 fraction (range, 12.5 to 25 Gy). Approximately 75% of the lesions (344) had previously received conventional radiotherapy, with schedules ranging from 30 Gy in 10 fractions to 35 Gy in 14 fractions. With a median follow-up of 21 months, the authors noted long-term pain improvement in 86% of patients, and long-term tumor control was seen in 90% of lesions treated with radiosurgery as the primary modality and in 88% of lesions treated for radiographic tumor progression. Among 32 cases with a progressive neurologic deficit before treatment, 27 patients (84%) experienced at least some clinical improvement. No radiosurgery-related neurologic toxicity was reported.

In separate reports, Gerszten et al analyzed results of spinal radiosurgery for 4 specific pathological types: renal cell carcinoma, breast cancer, lung cancer, and melanoma. These reports represent a subanalysis from its larger cohort study. The outcomes were similar among these four groups; symptom response rates were 96% for patients with melanoma, 89% for those with renal cell carcinoma, 89% for patients with lung cancer, and 96% for those with breast cancer.

Yamada et al from the Memorial Sloan-Kettering Cancer Center reported their experience treating 93 patients with 103 lesions who had no prior radiotherapy or high-grade epidural compression with image-guided radiosurgery. The authors used a higher dose of 18 to 24 Gy (median, 24 Gy) while constraining the maximal cord dose to 14 Gy. With a median follow-up of 15 months, the overall actuarial local tumor control rate was 90%, and the median time to local treatment failure was 9 months from the time of treatment. All patients without local treatment failure reported durable palliation of symptoms. No radiculopathy or myelopathy was reported. However, in a subsequent analysis, post-treatment fracture was found in 39% of the treatment sites. Lesions located in the lower spine (between T10 and the sacrum), lytic lesions, and a high percentage of vertebral body involvement (> 40%) predicted a higher rate of fracture progression independently in the multivariate analysis. Potentially, these high-risk patients would benefit from prophylactic vertebroplasty or kyphoplasty, and vertebral augmentation should be considered in high-risk patients.

In addition to several publications that contributed to the growing literature of spinal radiosurgery (including one of the first feasibility studies), Ryu et al from the Henry Ford Hospital further explored radiosurgical decompression of metastatic epidural compression. They examined 62 patients with 85 lesions of epidural compression diagnosed by MRI with almost no neurologic symptoms. The patients were treated with a median dose of 16 Gy (range, 12 to 20 Gy) in 1 fraction. The mean epidural tumor volume reduction was 65% at 2 months, and the authors concluded that this technology may be a viable noninvasive treatment option. Although these data are encouraging, it should be noted that surgical decompression followed by radiotherapy is the current standard of care, and further evaluation of radiosurgical decompression should be conducted. In medically inoperable patients with nearly no neurologic symptoms who do not have rapid neurologic disease progression, radiosurgical ablation for spinal cord decompression should be used with caution and examined further in the setting of a prospective clinical trial.

The RTOG is currently conducting a phase II/III study to investigate the efficacy of SBRT in pain control in patients with localized spinal metastasis with significant pain, involving up to 3 separate sites, and...
no history of radiotherapy or surgery. This trial evaluates pain response after a single fraction of 16 Gy with SBRT and compares it with a single fraction of 8 Gy with conventional radiotherapy. This is the first multicenter prospective clinical trial to assess the role of this emerging technology. Outcomes from this clinical trial will help define the role of SBRT in spinal metastasis.

**Fractionated Spinal SBRT**

Reports regarding fractionated schedules are less abundant than those on single-fractionation schedules, and smaller numbers of patients have been treated with this technique. Chang et al reported on a phase I clinical trial that included 15 patients with spinal metastasis from various histologies who underwent fractionated SBRT at a dose of 30 Gy in 5 fractions. Five patients received conventional radiotherapy prior to SBRT. No neurotoxicity or radiation-induced spinal cord injury or other myelopathy was reported.

Chang et al from MD Anderson Cancer Center conducted a subsequent phase I/II study that included 63 patients with 74 lesions of various histologic types. Patients were treated with either 30 Gy in 5 fractions or 27 Gy in 3 fractions. Of the 63 patients, 35 had prior radiotherapy. The authors reported a significant decline in narcotic use at 6 months (from 60% to 36%), local tumor control in 57 of 74 patients, and a 1-year freedom from disease progression rate of 84%.

Yamada et al from the Memorial Sloan-Kettering Cancer Center reported results in hypofractionated SBRT in 35 patients, some previously irradiated. For those previously irradiated, the mean prior radiotherapy dose was 30 Gy in 10 fractions, and the median SBRT dose was 20 Gy in 5 fractions (range, 20 to 30 Gy). For those not previously irradiated, the median SBRT dose was 70 Gy (range, 59 to 70 Gy). More than 90% of the patients had palliation from pain, weakness, and paresthesia. The local tumor control rate was 75% in previously irradiated patients and 81% in patients who were not previously irradiated. No myelopathy or radiculopathy was observed.

With a growing body of literature demonstrating that single-fraction SBRT for spinal metastasis is safe and feasible, fractionated SBRT may be reserved for patients with a large tumor volume and/or when the dose to the spinal cord cannot be kept under the accepted published dose constraint with single-fraction SBRT. Furthermore, fractionated SBRT is an emerging treatment of choice for select patients with recurrence in the area that was previously treated with radiotherapy.

**Postoperative Spinal SBRT**

Few studies have investigated the role of spinal SBRT in the postoperative setting. A higher ablative radiation dose can potentially improve local tumor control, especially for patients with a radioresistant histology. With conventional radiotherapy, durable tumor control is suboptimal despite surgery. Klekamp and Samii demonstrated that following surgery and postoperative conventional radiation therapy, the local recurrence rate was 58% at 6 months and 69% at 1 year.

Gerszten et al used single-fraction SBRT at a mean dose of 18 Gy (range, 16 to 20 Gy) after kyphoplasty for compression fracture. Among the 26 patients, 24 (92%) had pain control and radiographic local tumor control. The immediate fracture fixation and high-dose tumoricidal radiation dose had minimal morbidity, and spinal canal compromise was not reported.

Moulding et al reported a retrospective review of 21 patients treated with surgical decompression and instrumentation followed by single-fraction SBRT, with a mean dose of 24 Gy. The 1-year local tumor control rate was 81%, and local tumor control was achieved in 81% of the patients until death. In addition, a dose-response relationship was demonstrated; the patients who received 24 Gy had better local tumor control than did those who received 18 or 21 Gy.

These preliminary reports indicate that postoperative spinal SBRT is promising as a safe and effective treatment modality. Studies to evaluate improvement of local tumor control with this approach should be conducted to confirm these findings.

**Reirradiation Using Spinal SBRT**

Traditionally, radiation therapy to the vertebral body is limited by the tolerance of the spinal cord. Reirradiation to the same vertebra that was previously treated is discouraged due to the potential for spinal cord injury. With the availability of image-guided single-fraction or fractionated SBRT, retreatment with a higher biologically equivalent dose is achievable.

Garg et al from MD Anderson Cancer Center prospectively evaluated 58 patients who were reirradiated with SBRT to a peripheral dose of 30 Gy in 5 fractions (8 patients) or 27 Gy in 3 fractions (50 patients). With a mean follow-up of 17.6 months, actuarial 1-year radiographic tumor control and overall survival rates were both 76%. The majority of the tumors that progressed posttreatment were within 5 mm of the spinal cord prior to treatment. Two patients experienced mild to moderate lumbar plexopathy but remained ambulatory-independent and free of pain. Ninety-two percent of patients were free from neurologic deterioration at 1 year.

Sahgal et al treated 39 patients (60 metastases) with spinal SBRT for spinal/paraspinal metastases, of which 37 of 60 tumors had been radiated previously. With a median dose of 24 Gy in 3 fractions prescribed to 67% and a 60% isodose for the unirradiated and the reirradiation cohorts, no difference in progression-free probability was found between the two cohorts. The 1-year progression-free probability was 96% after salvage SBRT. Based on these data, the authors concluded that
Toxicity After SBRT to the Spine

Overall toxicity after spinal SBRT is rare. Major late toxicity associated with spinal SBRT includes radiation myelopathy due to spinal cord necrosis, vertebral body compression fracture, and brachial plexopathy. In most cases, progressive neurologic deficits are usually due to tumor progression. Myelopathy due to a radiation injury is uncommonly reported in the literature.

Benzi et al. treated 31 patients with 35 metastatic lesions; 2 patients had transient radiculitis. Gibbs et al. reported the Stanford experience with 74 patients and 102 lesions; 50 patients had prior radiotherapy. Patients were treated variably with 16 to 25 Gy in 1 to 5 fractions, with a dose per fraction of 7 to 20 Gy. Radiosurgery-related neurotoxicity was observed in 3 patients, without significant recovery. Two noted to have had antiangiogenic or epidermal growth factor receptor inhibitor therapy within 2 months of developing clinical myelopathy.

Ryu et al. retrospectively reviewed the toxicity and cumulated dose-volume histogram data for patients treated with single-fraction radiosurgery, with the dose range from 8 to 18 Gy (mean, 14.3 Gy). None of the patients had received prior spinal radiotherapy. The authors concluded that the partial-volume tolerance of the spinal cord is at least 10 Gy to 10% of the spinal cord volume 6 mm above and below the target. This dose constraint has gained wide acceptance and is applied in the current ongoing RTOG spinal radiosurgery trial.

Sahgal et al. studied dosimetric data from 5 cases of radiation-induced myelopathy after SBRT. Mathematical modeling of the dose to the thecal sac suggested a stricter dose constraint to prevent myelopathy after SBRT. The study recommended a 10-Gy maximum point dose to the thecal sac when planning for single-fraction SBRT. For multifraction SBRT, the group suggested the mean normalized 2-Gy–equivalent biologically effective dose (nBED 2/2) of 30 to 35 Gy to the thecal sac.

A recent publication from the quantitative analysis of normal tissue effects in the clinic (QUANTEC) comprehensively reviewed literature on radiation dose tolerances of a variety of normal tissues. For the spinal cord, the available literature suggested the risk of radiation-induced myelopathy is less than 1% when the maximum dose to the partial spinal cord is limited to 13 Gy for single-fraction treatment and 20 Gy for 3-fraction–hypofraction treatment. Further investigation is needed to delineate dose constraints for spinal SBRT.

Reirradiation and overall tolerance of the spinal cord after conventional radiotherapy are under active investigation. In a separate report examining tolerance of the spinal cord to reirradiation using SBRT 5 months or more after conventional palliative radiotherapy, Sahgal et al. concluded that nBED 2/2 of the maximal dose to the thecal sac should be kept at 20 to 25 Gy while the total maximal point dose nBED 2/2 does not exceed 70 Gy. The SBRT dose to the thecal sac should be limited to less than 50% of the total nBED. The analysis emphasized that the dose from the initial course of radiotherapy should be taken into account. Although the data are preliminary and retrospective, these proposed guidelines permit safe SBRT planning and allow future research to refine more precise constraints for the spinal cord.

As previously mentioned, a higher rate of fracture associated with SBRT was reported by Rose et al. from the Memorial Sloan-Kettering Cancer Center. The dose used was significantly higher than the experiences from other institutions (mean, 24 Gy; range, 18 to 25 Gy). Several other institutions treated patients with a mean dose of 16 Gy, with no increased risk of fracture. At this time, whether there is a dose-response relationship that influences the fracture risk is not well understood. The current RTOG study evaluating radiosurgery for spinal oligometastasis with a single fraction of 16 Gy may provide prospective evaluation of the fracture risk.

Another rare toxicity after cervical or upper thoracic spinal SBRT is brachial plexopathy. Reports of this toxicity in the literature are limited. A relatively recent publication, which focused on patients with lung cancer treated with SBRT, highlighted the risk of this delayed radiation toxicity. The risk of grades 2–4 plexopathy increased significantly when the maximal dose to the brachial plexus exceeded 26 Gy in 3 or 4 fractions.

Conclusions

Palliative radiotherapy plays a major role in skeletal metastasis and is effective in controlling pain, preventing fracture, maintaining patient quality of life and independence, and preventing or stabilizing tumor progression. Delivery of an ablative radiotherapeutic dose with emerging technology such as image-guided SBRT may allow a higher biologically effective dose to be delivered for better pain relief and potential local tumor control. Integration of stereotactic ablative radiation therapy into the care of patients with bony oligometastatic disease may yield future benefits, with improved disease-free and overall survival. Reirradiation may be safe and potentially more effective with spinal SBRT. Radiosurgical decompression of spinal cord compression using SBRT should be further investigated: if proven to be safe and effective, it will offer inoperable patients an option to prevent or stabilize progressive neurologic complications secondary to tumor compression of the spinal cord.
References


