

# COMBINED RADIOFREQUENCY ABLATION AND BALLOON KYPHOPLASTY FOLLOWING RADIATION THERAPY FOR SPINAL METASTASES AND ASSOCIATED PAIN. A CASE REPORT

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**Background:** The spine is a common area of metastasis to the bone. Radiation therapy has been the standard treatment for focal metastatic spine tumors, and although it has shown an ability to reduce pain, it is not curative for all patients and can negatively impact a patient's quality of life. Treating spinal metastatic pain with the use of radiofrequency ablation (RFA) in combination with kyphoplasty has been shown to be safe and effective in the treatment of spinal metastatic pain. We present a case of using balloon kyphoplasty with OsteoCool™ RFA for treating both spinal metastasis and pain.

**Case Report:** A 65-year-old man with a history of prostate cancer presented with metastasis to the L1 vertebral body and chronic low back pain refractory to multimodal pharmacologic treatment. He previously had radiation therapy for this bone metastasis and was maintained on enzalutamide for prostate cancer with decreasing prostate-specific antigens followed by hematology/oncology. Balloon kyphoplasty with OsteoCool RFA was performed with resolution of the patient's pain as well as the tumor metastasis.

**Conclusion:** To our knowledge, there is no available literature discussing the administration of all the above (i.e., RFA, kyphoplasty/vertebroplasty, radiation) together, the sequence in which they are performed, the benefits and consequences of the treatment sequence, the time to and level of pain relief, and differences in radiation exposure. The results of this case provide a clinical rationale for performing RFA and kyphoplasty prior to radiation treatment, while further studies should be conducted to further elucidate the best administration of this treatment.

**Key words:** Back pain, bone, cancer, kyphoplasty, metastasis, radiation, radiofrequency ablation, vertebroplasty

## BACKGROUND

The spine is the most common area for metastasis to the bone, affecting up to 40% of all cancer patients (1). Approximately 70% of spinal metastases occur in the thoracic spine, with 20% and 10% affecting the lumbar and cervical spine, respectively (2,3). Furthermore, up to 70% of patients with multiple myeloma or metastatic disease will undergo vertebral body collapse and subsequent pain (4). To date, the standard of care has included the use of analgesics, bisphosphonates, radia-

tion, and surgery to treat pain associated with these tumors, but that has left much to be desired in terms of pain control (1). External beam radiation therapy has been the standard palliative treatment for focal metastatic spine tumors, and it has been shown to reduce pain by 50% to 90% (5). However, the time to peak pain reduction in focal radiation treatment has been found to be between 12 and 20 weeks (6). Furthermore, Gilbert et al (5) found that only 55% to 65% of patients had sustained pain relief up to one year later or at the time

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of death. Only 63% of patients surviving more than 3 months were satisfied with quality of life (5).

Radiation therapy (RT) in combination with radiofrequency ablation (RFA) has been shown to be better for controlling local pain generated by metastatic disease in the spine when compared to RFA alone (7). Research over the last 2 decades has demonstrated percutaneous vertebroplasty and kyphoplasty (PVP, PKP) to be effective in the treatment of osteoporotic compression fractures, osteolytic metastases, hemangiomas, and multiple myeloma (8,9). More recently, PVP/PKP combined with RFA has emerged as a new and possibly superior treatment for pain associated with spinal metastases in terms of efficacy and time to peak pain reduction (10). Katonis et al (10) found RFA combined with balloon kyphoplasty to be safe and effective in treating a patient's low back pain caused by a metastatic vertebral tumor. Similarly, Greenwood et al (11) achieved palliation of their patient's pain with the use of RFA in conjunction with RT in a radiation-resistant tumor of the spine. Zheng et al (12) demonstrated that image-guided RFA with PKP was a safe and effective treatment for thoracolumbar vertebral metastasis (TVM) in a retrospective trial of 26 patients. Furthermore, a 2019 systematic review found percutaneous thermal ablation combined with cementoplasty to be a safe and effective palliative intervention for cancer patients with bone metastases with an analgesic effect that could last 24 or more weeks after intervention (13).

However, there is limited data on the ideal timing of these treatments. Further, there is currently insufficient evidence to determine appropriate methods of adjunctive procedures or their sequencing with vertebral augmentation interventions for optimal fracture management and local tumor control (14). As pain is the most common presenting symptom in patients with spinal metastasis, it is important to administer treatments to improve quality of life and reduce morbidity in a timely manner to provide such relief. This is particularly relevant as detection and treatments for cancer continue to extend the affected patient population's lifespan. The present report reviews a case of metastatic lumbar lesion treated with balloon kyphoplasty combined with OsteoCool RFA after the patient had already received 2 months of palliative radiation to his spine in 2018 with persistent debilitating posttreatment pain.

## **CASE**

The patient was a 65-year-old man with a past medical

history of prostate cancer who presented to our pain management practice as a referral from hematology/oncology for his severe low back pain. The pain coincided with his diagnosis of prostate cancer with bone metastasis to his lumbar spine in 2018. His pain improved after RT in 2018 for 2 months, then worsened thereafter. He was currently maintained on enzalutamide with decreasing prostate-specific antigens and followed by hematology/oncology. The pain was located at the mid to low back area and radiated up his back and to the sides of his lateral abdomen. The pain was described as a tight band and sharp. His pain was worse with sitting and bending forward. The pain was improved with heat as well as medications of methocarbamol 500 mg orally 3 times a day and hydrocodone bitartrate and acetaminophen 5 mg orally twice a day as needed. The pain was rated as 4 of 10 at the time, 2 of 10 on his best day, and 9 of 10 on his worst day. His symptoms interfered with his work and daily activities. His Pain Disability Index Review was 28. On examination, he had tenderness to palpation over his bilateral lumbar paraspinal muscles associated with painful range of motion with lumbar flexion and right rotation. He had negative facet loading, sacroiliac joint provocative maneuvers, and straight leg raise. His neurological exam was unremarkable, including normal strength, sensation, and reflexes. His recent lumbar magnetic resonance imaging (MRI) with and without contrast medium demonstrated an enhancing lesion within the L1 vertebral body extending to the right pedicle and posterior elements (Figs. 1-3). His pain was consistent with cancer pain at the L1 level and subsequently he was scheduled for L1 balloon kyphoplasty with OsteoCool RFA.

## **Procedure Technique**

For the procedure, a transpedicular approach to the vertebral body was deemed appropriate. An 11-gauge needle was advanced through the L1 pedicle to the junction of the pedicle and vertebral body on the left side while confirmed with both anteroposterior (AP) and lateral images. A guide pin was inserted through the needle to a point 3 mm from the anterior cortex. The needle was then removed leaving the guide pin in place. The osteointroducer was placed over the guide pin and advanced through the pedicle. Once we were at the junction of the pedicle and the vertebral body, a lateral image was taken to ensure that the cannula was positioned approximately 1 to 2 cm past the vertebral body wall. Through the cannula, a drill was advanced



Fig. 1. Sagittal short-T1 inversion recovery, arrow indicates the L1 vertebral body.

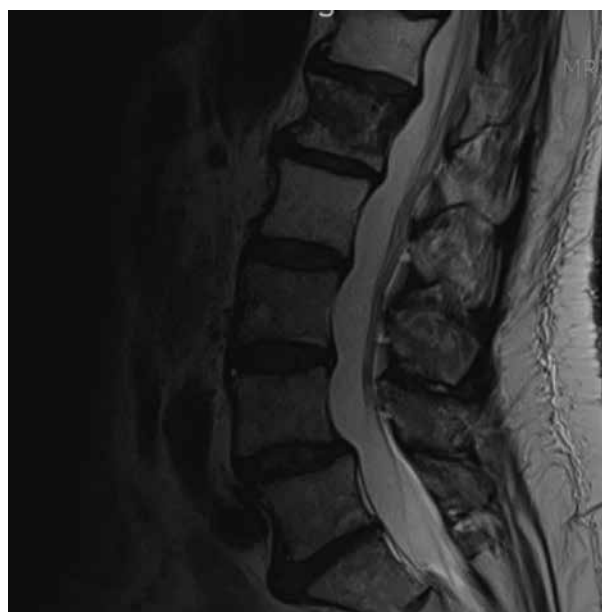


Fig. 2. Sagittal T2.

into the vertebral body under fluoroscopic guidance toward the anterior cortex, creating a channel. The same procedure was performed on the right side. After completing the entry into the vertebral body, OsteoCool RFA was performed for 7 minutes with a 10-mm probe. The 2 15-mm inflatable bone tamps were inserted through the cannula and advanced under fluoroscopic guidance into the vertebral body near the anterior cortex. The radiopaque marker bands on the bone tamp were identified using AP and lateral images (Fig. 4). The balloon was inflated to 0.5 mL and 50 psi. Expansion of the bone tamp was done with careful attention being paid to the inflation pressures and balloon position. The inflation was monitored with AP and lateral imaging. The final balloon volume was 2 mL passing midline. There was no breach of the lateral wall or anterior cortex of the vertebral body. The balloon was deflated and removed under live fluoroscopy, after which the needle was inserted under live fluoroscopy, and internal fixation was achieved through a low-pressure injection of bone cement. The cavity was filled with a total volume of 2 mL covering the whole vertebral body. Once the bone cement had hardened, the needle and cannula was then removed under live fluoroscopy. There were no complications and the L1 vertebral body bone biopsy was sent to pathology.

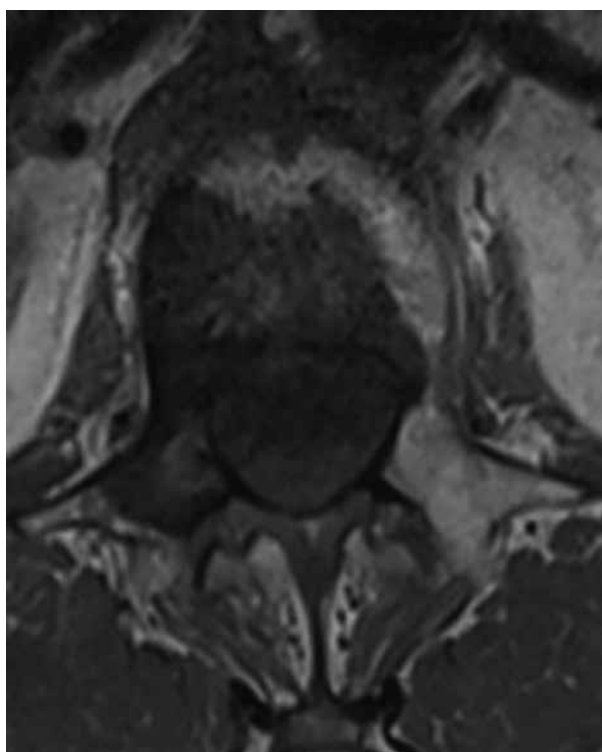


Fig. 3. Axial T1 stack.



Fig. 4. Fluoroscopic image of bilateral transpedicular cannulae with OsteoCool Radiofrequency Ablation in place.

### Progress and Outcome

The patient returned to clinic for follow-up one week later status post L1 kyphoplasty with RFA and reported complete resolution of pain and discomfort. His reported Pain Disability Index Review was 5 at his follow-up visit, down from 28 on his initial evaluation. The pain relief was so dramatic that the patient was able to return to work right after the procedure. He was encouraged to start physical therapy and follow-up as needed.

**Pathology:** Vertebral bone L1 biopsy: “atypical gland, consistent with metastatic prostatic adenocarcinoma. Multiple levels examined.”

### DISCUSSION

Unresectable spinal tumors can cause significant pain and affect quality of life of patients afflicted with this disease (4-6). External beam RT has been the standard palliative treatment for focal metastatic spine tumors, but there is a delay in the time to peak pain reduction (5,6). The treatment of spinal metastatic pain with the use of RFA in combination with kyphoplasty has been shown to be safe and effective in the treatment of spinal metastatic pain (10). To date, there is no data analyzing the most effective timeframe to initiate cementoplasty and RFA in the treatment paradigm compared to standard care with palliative radiation and pharmacologic therapies.

Intraoperatively, we found the bone at the interface of the pedicle and vertebral body to be significantly harder than what is typically experienced when per-

forming this procedure. We believe this was primarily due to severe sclerosis of the bone secondary to prior RT. This feature of the vertebral body wall required extensive drilling and hammering to overcome, prolonging the radiation and anesthesia exposure and increasing procedure time. Despite a thorough literature review, we found no studies addressing this specific issue. If a patient is identified who has pain that can be traced to a specific metastatic bony lesion in the spine, we believe it is worth considering performing RFA of the tumor followed by kyphoplasty for vertebral body stability prior to initiating RT to the spine.

Reversing the treatment algorithm in this way serves 3 purposes. As discussed, performing RFA followed by balloon kyphoplasty prior to RT may help avoid having to overcome hardened, sclerotic bone at the pedicle/vertebral body junction. This would make the procedure easier from a technical standpoint and require less radiation to the patient and staff, as well as less time under anesthesia. Additionally, RFA alone may eliminate most or all of the tumor, which could lead to less or possibly no radiation for the patient, depending on the remaining tumor burden. The patient would also not have to wait for a tumor-induced compression fracture to occur before receiving this procedure. Finally, it may also prevent a future compression fracture from occurring in the first place, protecting them from experiencing unnecessary pain.

In summary, RT has long been used in the palliative management of painful malignant spinal metastases (6). In recent years, RFA, kyphoplasty (or vertebroplasty), and a combination of the 2 have also been used for pain management (1,4,8,10,13). To our knowledge, there was no available literature discussing the administration of all the above (i.e., RFA, kyphoplasty/vertebroplasty, radiation) together, the sequence in which they are performed, the benefits and consequences of the treatment sequence, the time to and level of pain relief, and differences in radiation exposure. The results of this case provide a clinical rationale for performing RFA and kyphoplasty prior to RT. Additional case series and randomized trials should be conducted to further elucidate the best administration of this treatment (e.g., timing, sequencing). If future studies are congruent with the present case, it might be suggested that the treatment tree should consist of first performing kyphoplasty with RFA prior to initiating RT. The rationale for this suggestion is that performing kyphoplasty after RT could lead to a higher probability of adverse events

(e.g., greater time under anesthesia, increased radiation exposure, and greater technical difficulty). Should further research agree with our recommendations, clinicians (particularly oncologists) planning RT for a patient with a vertebral body metastasis may consult

an interventional pain medicine physician to evaluate the patient for kyphoplasty and RFA treatment to not only reduce or resolve their pain more quickly, but also to reduce or eliminate their cancer burden and lessen future radiation doses.

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