

# **COMBINED BALLOON AND SPINEJACK® VERTEBRAL AUGMENTATION WITH RADIOFREQUENCY ABLATION FOR SEVERE PATHOLOGICAL VERTEBRAL COMPRESSION FRACTURES: CASE REPORT**

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- Background:** Pathological vertebral compression fractures exert a significant impact on cancer patients' quality of life. Procedures that combine percutaneous vertebral augmentation with radiofrequency ablation (RFA) have expanded the therapeutic options for treating complex fractures accompanied by severe height loss and spinal compromise.
- Case Report:** A woman in her sixties with squamous cell carcinoma of the anal canal developed a T10 metastatic burst fracture with > 80% vertebral height loss and spinal cord compression despite radiation therapy. We performed sequential RFA for local tumor control, followed by balloon kyphoplasty to create cavity space, and SpineJack® (Stryker) deployment for maximum vertebral height restoration. Complete pain relief was achieved, with significant restoration of vertebral anatomy and correction of both antero- and retropulsion. The patient remained asymptomatic at follow-up.
- Conclusion:** The use of second- and third-generation percutaneous vertebral augmentation in combination with RFA represents a promising multimodal approach for managing complex metastatic burst fractures when conventional treatments fail.
- Key words:** Pathological vertebral compression fracture, radiofrequency ablation, balloon kyphoplasty, SpineJack®, case report
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## **BACKGROUND**

Pathological vertebral compression fractures have a major effect on cancer patients' quality of life and morbidity (1). Percutaneous vertebral augmentation procedures (PVAP) have recently achieved remarkable success in treating these injuries, since PVAPs allow efficient management thereof by stabilizing the fractured vertebrae, resulting in rapid pain resolution (2). The minimally invasive nature of these procedures and significant effect on patient morbidity resulted in a shift in the treatment paradigm and potential expansion in the role of augmentation. The addition of radiofrequency

ablation (RFA) now serves as a method to achieve local tumor control, which ensures the long-term effects of the procedure (3). Nevertheless, there are limitations to the use of vertebral augmentation as a management option.

We describe a unique case of pathological burst vertebral body fracture involving more than one vertebral column, in which the use of combined balloon and SpineJack® (Stryker) vertebral augmentation with RFA resulted in significant restoration of vertebral height and total resolution of pain on follow-up.

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Patient consent for publication: Verbal informed consent was obtained directly from patient(s).

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## **CASE**

### **Patient Description**

The patient was a woman in her sixties with a history of basaloid squamous cell carcinoma of the anal canal, initially treated with conventional chemotherapy in the form of 5-fluorouracil and mitomycin-C combined with radiation to the primary site.

### **Case History**

Three years later, the patient presented with a new onset of right-side lower back and intercostal pain. No associated neurological symptoms, such as saddle anesthesia or urinary or bowel incontinence, appeared. Imaging showed osseous metastasis to the T10 vertebra along with a pathological fracture. Initially, the patient was evaluated by radiation oncology and received a total of 400 cGy in 5 fractions, which resulted in considerable pain improvement at the time. Two months later, the patient's pain recurred, requiring control with medications.

### **Physical Examination Results**

The patient presented with localized thoracic back pain and no neurological deficits. No motor weakness or sensory changes were detected on examination.

### **Results of Pathological Tests and Other Investigations**

The initial CT scan showed a T10 vertebral body metastatic lesion with an associated pathological fracture and collapse that resulted in 30% vertebral height loss (Fig. 1). MRI performed 2 months later following radiation treatment showed progressive compression with approximately 50% height loss (Fig. 2).

A follow-up CT scan one month later showed severe compression burst fracture deformity, with >80% height loss. The fracture line is seen extending across the anterior and middle columns of the vertebra, with associated retropulsion of the posterior vertebral body margin slightly indenting the spinal cord, and anteropulsion of the anterior bony fragment through the anterior longitudinal ligament (Fig. 3).

### **Treatment Plan**

Given the severe vertebral height loss and burst fracture pattern, a multimodal approach was planned. The treatment strategy included: 1) RFA for local tumor control, 2) balloon kyphoplasty to partially restore

height and create a safe cavity for cement placement, and 3) SpineJack® (Stryker) deployment to maximize vertebral height restoration while minimizing cement leakage risk.

### **Expected Outcome of Treatment Plan**

We anticipated significant pain relief, improved vertebral stability, restoration of some vertebral height, and reduced risk of further compression. Complete resolution of retropulsion was not expected, given the severity of the initial collapse.

### **Treatment Implementation**

Under general anesthesia and using CT guidance, a pair of 10-gauge guide needles were advanced into the posterior third of the vertebral body via the bilateral transpedicular approach. Measuring bone drills were introduced through the working cannulas, creating a tunnel into the anterior third of the vertebral body, and the appropriate needle length was identified. Two opta-blate 15 mm tip RFA probes (Stryker) were placed through the working cannulas, and ablation was performed according to the prescribed power and duration (80 degrees for 9 minutes) (Fig. 4).

Afterward, balloon kyphoplasty was performed using a pair of 15 mm balloons, which resulted in the partial restoration of the vertebral body height (Fig. 5). At this point, a decision was made to proceed with the SpineJack® (Stryker) placement. Two 5.0 SpineJack® (Stryker) were advanced into the vertebral bodies and fully expanded (Fig. 6). Then, viscous bone cement was injected through the cannulas, and both sides were filled well. There was no extravasation of cement or significant leakage. The needles were then removed without complication. While the cement was stabilizing, the incisions were dressed in the usual fashion.

The final procedure CT scan showed the restoration of vertebral body height and improvement in antero- and retropulsion (Fig. 7).

### **Actual Outcome**

After the procedure, the patient was under observation for 2 hours and then discharged home in stable condition. The patient was ambulating independently after the procedure. At the clinic follow-up one week later, the patient reported complete resolution of back pain and no other symptomatic complaints.

**Consent**

Verbal informed consent was obtained from the patient after the purpose of this case report, the types of information and images to be published, and the potential risks were explained. The patient agreed to the publication of the above. All patient information and images have been fully anonymized to prevent identification.

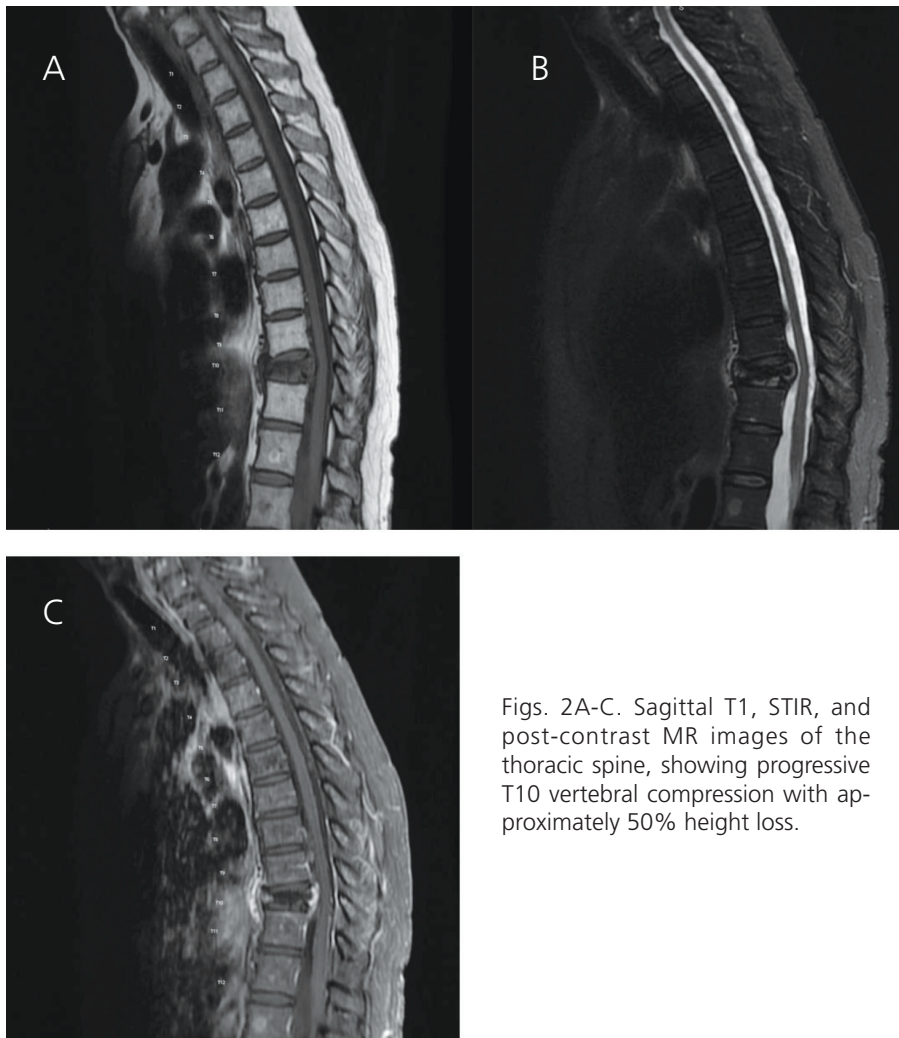
**DISCUSSION**

The third generation of PVAP emerged to solve the issue of restoring and maintaining vertebral height loss associated with compression fractures. SpineJack® (Stryker) is especially known to produce a large force of elevation, which helps in achieving significant vertebral body height restoration (2). However, the use of the device might be limited by anatomical and technical factors such as pedicle size, type of fracture, the degree of vertebral height loss, and the involvement of more than one vertebral column (1,4).

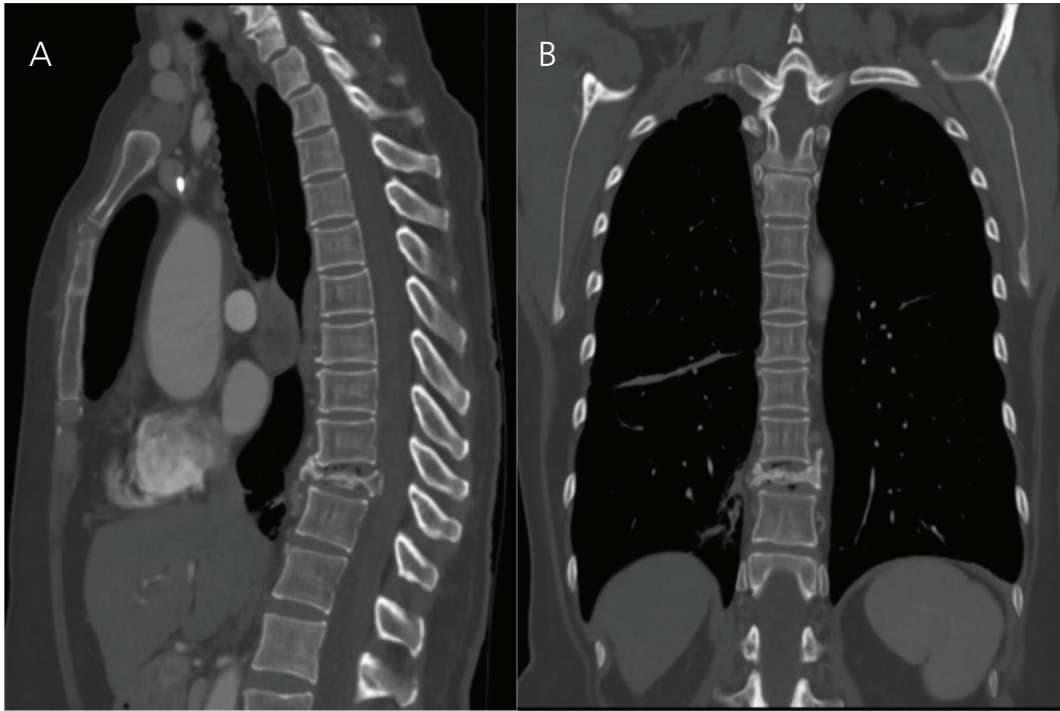
Our case report presents a novel approach in utilizing RFA for vertebral metastasis, combined with balloon kyphoplasty to enable the safe deployment of SpineJack® (Stryker). This technique achieves local tumor control, restores maximum vertebral height, and further enhances fracture stability with potentially lower risk of complications.



Fig. 1. Sagittal CT scan of the chest, showing pathological compression fracture of T10 vertebral body with 30% vertebral height loss.



Figs. 2A-C. Sagittal T1, STIR, and post-contrast MR images of the thoracic spine, showing progressive T10 vertebral compression with approximately 50% height loss.



Figs. 3A-B. Sagittal and coronal CT scan of the chest after one month, showing severe compression burst fracture deformity, with >80% height loss.

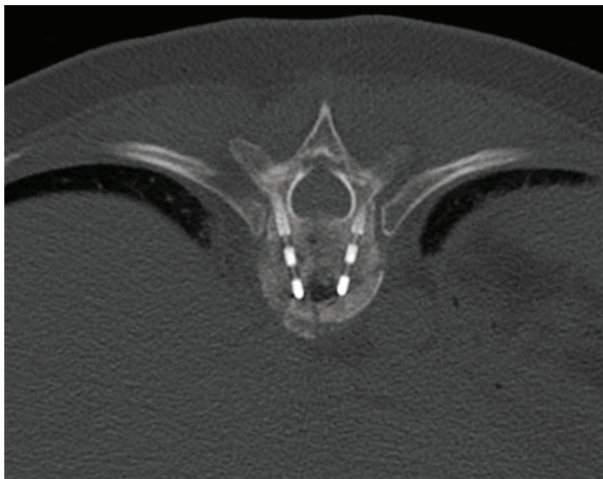


Fig. 4. Intraprocedural axial cut CT image showing a pair of 15-mm-tip OptaBlate® (Stryker) radiofrequency ablation probes centered within the vertebral body.

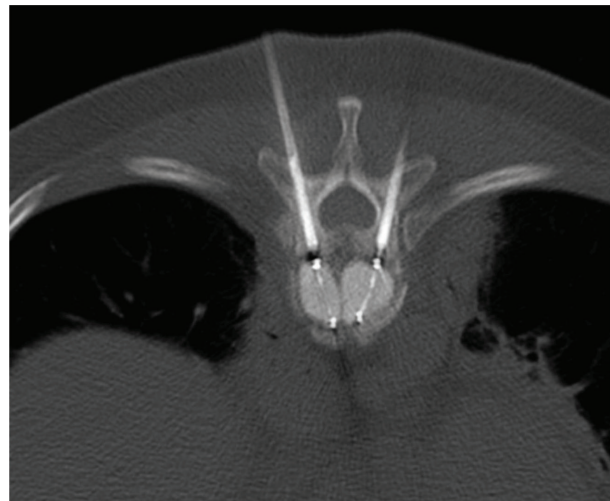


Fig. 5. Intraprocedural axial cut CT image showing a pair of 15-mm balloons insufflated within T10 vertebral body.

Vertebral compression fractures are considered stable fractures when they involve the anterior column of the vertebral body. Fractures that extend beyond the anterior column are termed burst fractures, which

are considered unstable and may require surgical management rather than PVAP (5). Moreover, one of the absolute contraindications of vertebral augmentation is complete vertebral body collapse due to the

substantial risk of cement leakage (6,7). Our patient suffered from a burst fracture involving the anterior and middle columns of the spine with fracture line extending to the posterior wall of the vertebral body, which further increases the risk of cement leakage into the spinal canal.

Second-generation PVAP (balloon kyphoplasty), first conducted in 1998 (8), is currently commonly used in the management of vertebral compression fractures. The use of the balloon creates a cavity inside the vertebral body, allowing for the cement to be injected with less pressure and greater viscosity, thereby reducing the risk of leakage (2). However, SpineJack® (Stryker) is known to allow good reconstruction of the anterior column by exerting the effect of ligamentotaxis on the anterior longitudinal ligament, resulting in restoration of the vertebral height. Additionally, expansion of the device creates a preferential flow direction of high-viscosity cement and further reduces the chances of cement leakage into the intervertebral disc space (2).

The initial severe vertebral body compression present in our patient did not allow for the safe deployment of SpineJack® (Stryker), due to the considerable risk of

endplate cortical break and consequent cement leakage. Starting with balloon kyphoplasty served to achieve partial height restoration, which created a channel to accommodate SpineJack® (Stryker) and helped prove the safety of deploying that device without risking spinal compression.

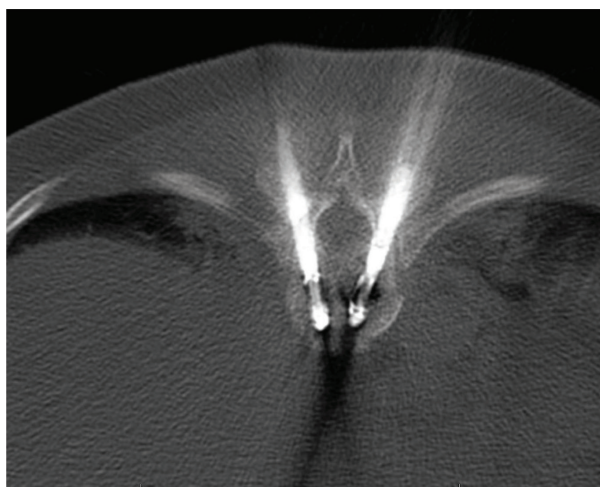
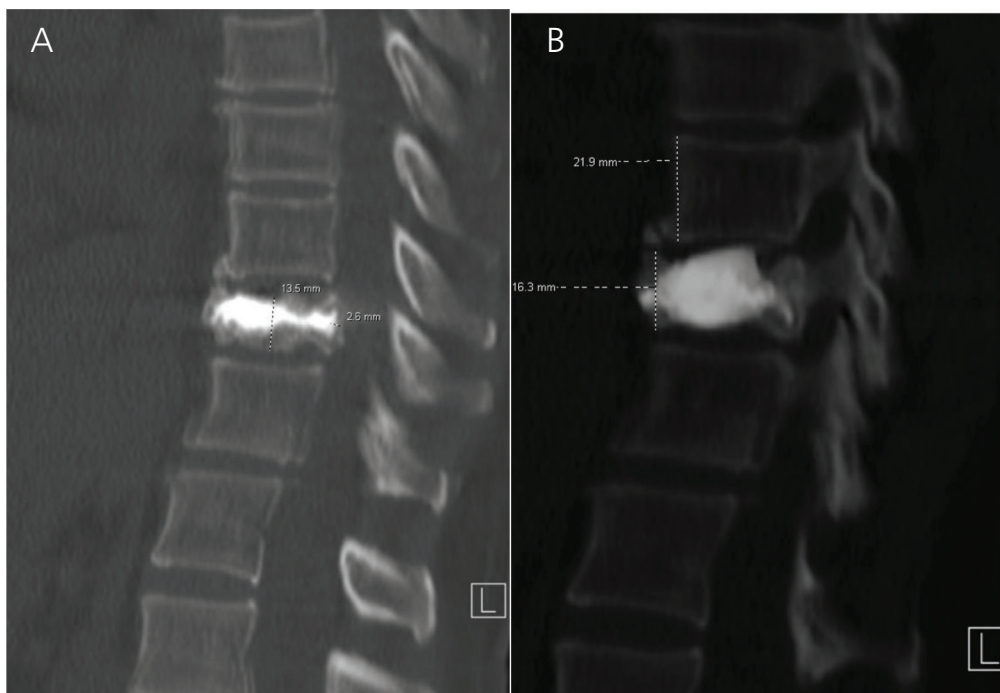


Fig. 6. Intra-procedure axial CT scan showing a pair of 5.0 SpineJacks® (Stryker) advanced into the vertebral body.



Figs. 7A-B. Final-procedure CT scan showing significant restoration of vertebral body height and improvement in antero-and-retropulsion.

## CONCLUSION

This case highlights a novel, multimodal approach that integrates second- and third-generation percutaneous vertebral augmentation techniques with RFA to manage a challenging metastatic burst fracture. The combination achieved stabilization, restoration of vertebral height, correction of retropulsion, and durable pain relief. This strategy may expand the therapeutic potential of minimally invasive spinal interventions in complex oncologic fractures that conventional single-modality procedures have failed to treat.

## Learning Points

1. A combination of second- and third-generation PVAP should be considered in cases of pathological

vertebral burst fractures when severe height loss is identified.

2. The use of balloon kyphoplasty helps in creating space that allows for the safe deployment of devices such as SpineJack® (Stryker), which in turn maximizes height restoration and reduces the chances of cement leakage and adjacent vertebral fractures for the long term.

## Author Contributions

AA conceived the case report, performed the procedure, collected clinical data, and drafted the manuscript. JE assisted with literature review and manuscript preparation. MP supervised the procedure and provided critical revision. All authors approved the final version of this report.

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