

Combined Cementoplasty and Percutaneous Image-Guided Screw Fixation for Treatment of Sacral Osteoradionecrosis: A Case Report

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Abstract

Sacral osteoradionecrosis is a pelvic radiation-induced injury. The case illustrates this complication with interventional radiology support. Combination of imaging modalities aided in diagnosis and a biopsy confirmed it. An initial sacral cementoplasty procedure was not sufficient to obtain analgesia, because necrosis continued to evolve. In order to better stabilize the weakened pelvic girdle and reduce pain, percutaneous screw fixation was performed. The patient has a favorable outcome, with reduction of pain and early rehabilitation. No infectious, hemorrhagic complication nor migration of the screws were observed at 6 months' follow-up. Percutaneous image-guided screwing is a minimally invasive technique allowing stabilization of weakened bone and may be proposed in combination with cementoplasty in patients with sacral osteoradionecrosis.

Keywords: Osteoradionecrosis; Percutaneous image-guided screw fixation; Cementoplasty; Radiotherapy; Sacrum

Introduction

Radiotherapy is an essential treatment of gynecologic malignancies. Though major improvements particularly with stereotaxic technique, radiation therapy can include side effects to surrounding tissues, including bone damage [1-3]. Osteonecrosis is one complication that may occur medium to long term after irradiation (range 6-197 months 2). The pathophysiological mechanisms are multiple: on the one hand, the failure of bone healing results from an increased and irreversible process of destruction by osteoclasts, a deficient osteogenesis in favor of scar fibrosis tissue; on the other hand, it results from local microcirculation disorders with thrombosis, cellular hypoxia and chronic ischemia [4]. All these conditions added together lead to bone death. When involving weight bearing locations, especially the sacrum, this complication induces a loss of quality of life and autonomy by causing pain and reducing the walking distance. Conventional management has limitations: bed rest, administration of non-steroid-anti-inflammatory, but also hyperbaric oxygen therapy (which improves oxygenation of damaged tissues) have been reported [5]. Percutaneous cementoplasty aims to inject acrylic cement (polymethylmethacrylate) through a trocar into a weakened bone and is widely used in interventional radiology, mostly in vertebral osteoporotic and metastatic fractures [6]. Sacroplasty (cementoplasty of the sacral bone) has been reported as a minimally invasive and efficient technique to control painful sacral fractures. However, when bone loss is major with poor anchorage of the cement, sacroplasty alone may not provide sufficient stabilization. In recent years, percutaneous image-guided screw fixation has developed in order to stabilize pathologic bone lesions [7-10]. Our case illustrates a sacral osteoradionecrosis, treated by percutaneous image-guided screwing, after failure of conventional cementoplasty of the sacral wing.

Case Report

A 61-year-old woman was treated for an epidermoid carcinoma of cervical uterine cancer, staged IIIB according to the international classification FIGO (International Federation of Gynecology and Obstetrics). A concomitant radio-chemotherapy treatment was administered, consisting of external-beam radiotherapy of 45 Gray (25 fractions) associated with 5 cycles of chemotherapy. Intracavitary brachytherapy of 26 Gray was administered, followed by additional tomotherapy dose of 18 Gray on external iliac lymph nodes. Six months after the end of treatments, she complained of a sacral pain. Biomarker

Squamous Cell Carcinoma (SCC) was negative. The CT (Computerized Tomography)-scan revealed a fracture of the left sacral ala and a fracture of the L5 vertebral body, with hypermetabolic activity on bone scintigraphy (Figure 1A). MRI (Magnetic Resonance Imaging) showed edema in the left sacral wing (Figure 1B). PET-scan (Positron Emission Tomography) with 18-FDG (FluoroDeoxyGlucose) showed no suspect uptake. Bone biopsy was performed, and histopathology found no tumor cell but only fibrinoid necrosis with vascular wall lesions consistent with the diagnosis of radionecrosis. After a multidisciplinary discussion and considering the high risk of fracture of the contralateral sacral wing, L5 vertebroplasty and bilateral sacroplasty was performed, using bone trocars (Osteosite, Cook Medical®, USA) and acrylic cement (Opacity +, Teknimed®, France). There was no complication during this procedure and pain decreased. She unfortunately presented with recurrence of sacral pain one month later, but biomarker remained normal. Another MR imaging showed worsening of bone fractures in both sacral wings (Figures 2A and 2B), around the cemented areas.

Percutaneous trans-sacroiliac screw fixation was also decided in order to stabilize the sacrum. The procedure was performed under general anesthesia in prone position, using cone beam-CT guidance (Allura FD 20, Philips®, The Netherlands). After obtaining a 3-dimensional pelvic acquisition, the trajectory of each screw was planned with a dedicated navigation software (XperGuide®, Philips®), avoiding the sacral foramina and the nerve roots (Figure 3A). After two skin incisions and under fluoroscopic control, a threaded guide wire was inserted through left sacro-iliac joint. Using a mechanical drill, the wire could be advanced through the cement. Then a cannulated screw (Stryker®, Switzerland) was introduced over the guide wire (Figure 3B), and advanced manually with a screwdriver. The guide wire was then

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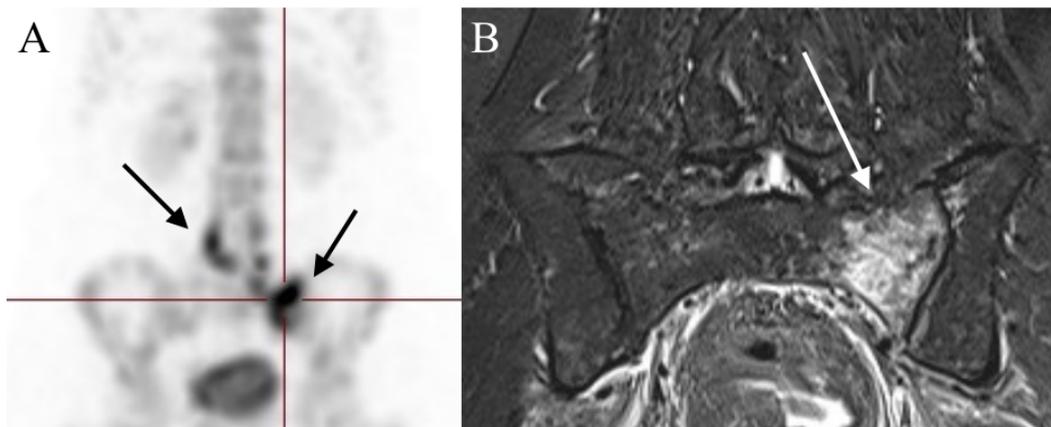


Figure 1: Bone scintigraphy and MRI. A). Hypermetabolic activity in the left sacral ala and the L5 vertebra (black arrows). B). Coronal T2-STIR (Short T1 Inversion Recovery): hyper-intensity in the left sacral ala, sign of edema (white arrow).

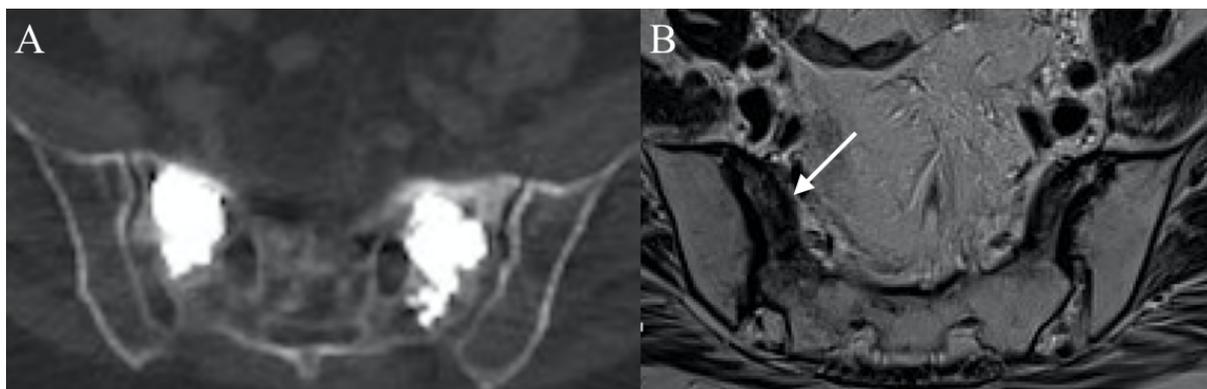


Figure 2: Worsening of bone injuries. A). Axial CT scan shows proper cement distribution in the upper part of the iliac wings, but occurrence of an oblique fracture through the body of S2. B). MRI axial-T2 shows extension of the sacral wings fractures below the cement (white arrow).

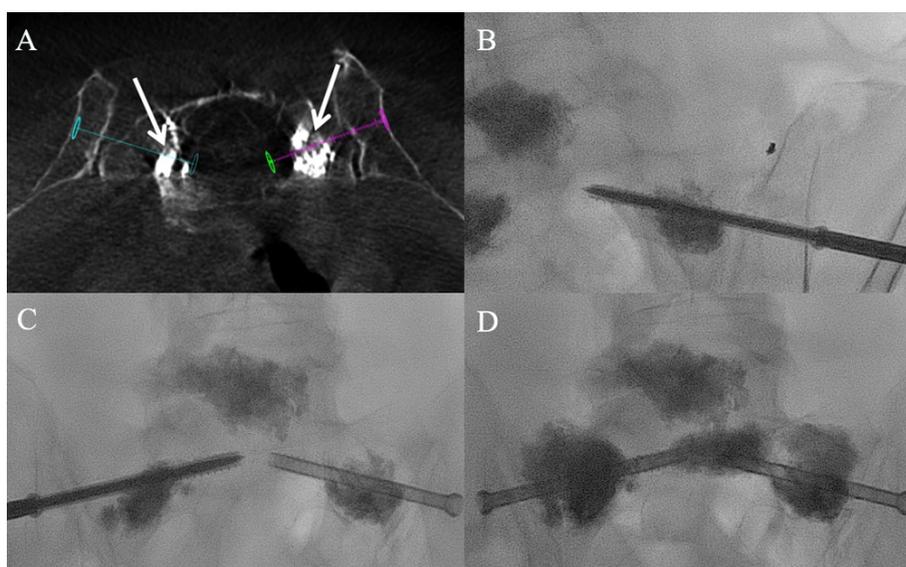


Figure 3: Worsening of bone injuries. A). Axial CT scan shows proper cement distribution in the upper part of the iliac wings, but occurrence of an oblique fracture through the body of S2. B). MRI axial-T2 shows extension of the sacral wings fractures below the cement (white arrow).

removed, and skin entry point was stitched with absorbable thread. Using a similar contralateral approach, a second screw was inserted through the right sacro-iliac joint (Figure 3C). Complementary cementoplasty was performed in order to better fix the screws and to avoid their secondary displacement. Final rotational cone beam CT acquisition with multiplanar reconstructions confirmed proper position of the screws and cement distribution without leakage (Figure 3D). The patient was discharged the day after the procedure with decreasing of pain. At 6 months' follow-up, no bleeding nor infectious complications have been observed and CT scan control showed no migration of the screws nor new fracture. The patient's condition remained stable with proper control of the symptoms.

Discussion

The diagnosis of sacral osteoradionecrosis should be evoked in a context of pain after pelvic irradiation, after eliminating differential diagnoses. Combination of imaging modalities may aid in diagnosis [11]. Bone scintigraphy may be useful as a screening tool, showing an increased uptake in the weakened bone, but it is not specific. CT-scan is very useful showing post-radiation changes as micro-fractures, alternation of osteolysis and condensation areas, bone defects and deformations. MRI is not pathognomonic showing edema and fibrosis. The role of PET-scan is not clearly defined, because 18-FDG accumulates in high glucose metabolizing cells, such as inflammatory cells that are present within osteonecrotic lesion, [12] it also seems to be not specific, but in our case, there was no considerable uptake. The most important point is to eliminate differential diagnoses which have common findings on imaging: bone metastasis, chronic osteitis, radiation-induced osteosarcoma, because the management may change radically. Bone biopsy plays a major role to make a definitive diagnostic, showing osteocytic lacunae, fibrinoid arterial wall necrosis and inflammatory infiltrate [13]. If the doubt persists, follow-up imaging is necessary. Radiation-induced pelvic insufficiency fractures are a frequent complication of radiation therapy for uterine cervical cancer, particularly in the post-menopausal patients [1,3]. Treatment is mainly conservative with bed rest, avoidance of weight bearing and analgesics, but symptoms often last several months with impairment of quality of life. Open surgery is not appropriate due to high risk of morbidity and poor healing in the irradiated zone. The improvements of radiology 3D guiding systems including cone-beam CT, combined CT-fluoroscopy and dedicated software allow interventional radiologists to safely navigate in complex bone lesions. Thus, percutaneous image-guided screw fixation has emerged in the recent past years as a minimally-invasive technique for poor-surgical patients, especially for pelvic bone fixation. Several authors report a high efficacy and safety of this procedure [7-9]. No nerve root lesion, no bleeding or deep hematoma, no skin healing problem, no infectious [7-9]. only four cases of hematoma at the site of puncture in a series of 64 patients [8].

The advantages of image-guided technique are multiple: precise targeting even with damaged bone landmarks, minimal skin incision reducing the risk of infection or skin healing failure, possibility to combine screw fixation and cementoplasty in case of major bone defects. Additional cement injection achieves better anchorage of the screws; thus, it reduces the potential risk of secondary screw displacement when the bone is too weak. This procedure requires short hospitalization stay and early rehabilitation. Moreover, re-introduction of systemic therapy can be rapidly considered if needed [6]. Concerning the treatment of our patient, the initial cementoplasty was not sufficient to reduce pain, and further imaging showed a worsening of bone destruction. Indeed,

osteoradionecrosis is a slow evolving process. Percutaneous image-guided screwing could be performed although prior cementoplasty of the sacral wings.

Conclusion

Radiation-induced sacral fracture is a common complication after pelvic radiation therapy, which can cause pain and impair quality of life. In case of large bone defects or complex fractures, sacroplasty using cement alone may not provide analgesia and sufficient stabilization. In such cases, percutaneous image-guided screw fixation can be proposed as a minimally-invasive, safe and effective alternative or adjunct to conventional sacroplasty.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Ethics

The patient has given an informed consent. The study was approved by the institute's committee.

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