Pelvic insufficiency fractures in patients with pelvic radiation

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Learning objectives

- To show the spectral of radiological findings of pelvic insufficiency fractures in different imaging modalities.
- To illustrate the importance of their correct diagnosis, especially in oncology patients.

Background

Stress fractures occur as a result of repetition forces on healthy bone or on bone weakened. They are divided into fatigue fractures and insufficiency fractures.

**Fatigue fractures** represent the response of a bone with normal elastic resistance to excessive and repeated cyclic loading. They are more common in young people in which young bone well supports the compressive forces and fatigue fractures occur when the bone is subjected to repeated stress forces.

**Insufficiency fractures**, on which we will focus, are the result of the application of physiological stress (normal) on weakened bones, usually osteoporotic bone, in menopausal patients or patients after prolonged corticosteroids treatment.

Less frequently, local radiation in oncology patients (mainly gynecological prostate and rectum tumors) determines a decrease in bone resistance, predisposing the development of insufficiency fractures. At histologic the main change that generates radiation on bone and it predisposes these fractures is damage and occlusion in the microcirculation. The exact prevalence of these fractures is not well known and there is controversy. Pelvic insufficiency fractures in irradiated patients are more common in women than in men, because women often have weakened bones due to osteoporosis. Furthermore, it appears that their frequency is increasing in recent years due to the increasing age of the radiated population.

It is important to know these injuries, especially in the pelvis, because the differential diagnosis includes metastatic disease. Clinically usually present with pain, and often guide the clinician to a recurrence of the primary neoplasm. However, it is not uncommon to find them incidentally in asymptomatic patients in their periodic oncology controls. On the other hand, although rare, can lead to complications such as injury to adjacent organs by displaced fractured fragments.
In the pelvis the most common location of these fractures are sacral wings, close to the sacroiliac joints, which is where the forces are transmitted directly to the full weight of the spine. Fracture lines tend to be vertical (parallel to the sacroiliac joints) or slightly oblique and often are bilaterally. Although rare, sacral insufficiency fractures can have a transverse orientation. Other typical locations of these fractures, and that should support our diagnosis, are the acetabular roof, ischialpubic and iliopunbian branches and femoral neck. There are also rare associated fractures of the lumbar spine. When the radiologist find a insufficiency fracture they should look for more fractures because they are often multiple.

**Imaging findings OR Procedure details**

Initial plain radiography has low sensitivity in detection of pelvis insufficiency fractures and in general does not usually show alterations. Bone scintigraphy is sensitive but not specific. The main imaging methods in their detection are computed tomography (CT) and magnetic resonance imaging (MRI).

In most cases CT usually shows the fracture line in the typical locations of insufficiency fractures and helps differentiate them from fractures secondary to metastatic bone disease, which are usually associated with lytic bone lesions and soft tissue mass.

MRI is the most sensitive and specific technique. Before the establishment of the fracture, in the early phase, bone marrow edema is seen with or without soft tissue edema. In a later stage identifies the fracture line. These findings are also very similar to those of the metastatic disease but the typical location of the lesions, identification of the fracture line (it is often easier to identify on T1 weighted images after gadolinium injection where bone edema enhances and fracture line remains hypointense) and no soft tissue mass support the diagnosis of insufficiency fracture.

Other less common secondary effects of pelvic radiation in oncology patients are osteolysis (in the symphysis pubis and sacroiliac joints) and avascular necrosis of the femoral head.

In the last year, in our institution, there have been five cases of insufficiency fractures in patients with pelvic neoplasms who had received local radiotherapy to standard dose as part of their treatment. They developed lesions in pelvic bones that were diagnosed as insufficiency fractures due to their characteristic findings in different imaging modalities (Fig. 1 on page 4, Fig. 2 on page 4, Fig. 3 on page 5 and Fig. 4 on page 6 ).
One case was initially interpreted as metastatic by the multiplicity and radiological appearance (with signs of aggressiveness) of the lesions (Fig. 5 on page 7). Later in monitoring and reevaluation diagnosis was oriented for multiple insufficiency fractures (Fig. 6 on page 8). As complication the right ischial-pubic branch fractured drilled posterior wall of the vagina. This drilling was complicated by infected collection that spread across the back of the right thigh root surrounding the semitendinosus muscle. The patient was operated (Fig. 7 on page 9).

Images for this section:

CASE 1. 60 years old patient. In December 2008 he was diagnosed with rectal cancer. Surgery is performed followed by concomitant radiotherapy and adjuvant chemotherapy. In February 2011 CT with bone window shows both wings sacral sclerosis of recent onset with a fracture line in left sacral wing parallel to the sacroiliac joint that breaks the upper cortical. Findings consistent with sacral osteonecrosis and insufficiency fracture associated.

Fig. 1
CASE 2. 55 years old patient. In November 2006 she was diagnosed of cervical neoplasm. Surgery was performed followed by radiotherapy. In follow-up studies sclerosis areas exist on both sacral wings in relation to regions of osteonecrosis. In March 2011 the patient refers pelvic pain and in follow-up CT fracture lines are seen in both wings sacral and left acetabular roof, findings consistent with insufficiency fractures.

Fig. 2
CASE 3. 72 years old patient with history of external pelvic radiotherapy 2 years ago by cervix neoplasm. She refers low back pain of recent onset so requested lumbar spine and sacroiliac joints MR. In addition to the patient degenerative changes transverse fracture line in S2 (orange arrows in sagittal), which associates bone edema without soft tissue mass in relation to acute fracture. There is also a vertical fracture line in right wing sacral without edema or soft tissue mass associated (arrow orange in the coronal section). The findings are consistent with sacral insufficiency fractures in different stages. Although rare, sacral insufficiency fractures can have a transverse orientation.

Fig. 3
CASE 4. 80 years old patient with osteoporosis and prior traumatic fracture in right femoral neck treated with prostheses in 2005. He was subsequently diagnosed with cervical carcinoma on December 2010 that was treated with surgery and complementary external radiotherapy. The patient developed multiple insufficiency fractures in the pelvis, affecting both sacral wings, both iliac bones and left ischio-pubic branch. They are all illustrated in this control CT with bone window (orange arrows).

Fig. 4
CASE 5A. 57 years old patient diagnosed with squamous cell carcinoma in 2010 treated with resection followed by endoanal radiotherapy. In August 2011 the patient complained of bone pain of great intensity in the pelvis and pelvic MRI was performed where the appreciated injuries are interpreted as bone metastases.

Pelvic MRI, STIR sequence. Limited signal hyperintensity to both sacral wings, more evident on the right side, in relation to bone edema. It also appreciated areas of bone edema in the right acetabulum and right ischial-pubic branche (orange arrows). Findings that were interpreted as metastatic given the history of the patient.

Fig. 5
CASE 5B. Pelvic CT, bone window. Progression of lesions appreciated on previous MRI. Sacral involvement extends to the other pelvic bones with multiple fractures in various stages (some displacement adn with multiple bone fragments) and medullary sclerosis secondary to osteonecrosis.

Fig. 6
CASE 5C. The patient came to the emergency department with sepsis and signs of inflammation in the perineal area. In a pelvic physical examination a bone fragment in posterior wall of the vagina was appreciated. Pelvis CT with intravenous contrast, soft tissue window. The right ischial-pubic branche fractured and displaced medially had perforated the posterior wall of the vagina. This drilling was complicated by infected collection that spread across the back of the right thigh root surrounding the semitendinosus muscle. The patient was operated.
Conclusion

Is very important to know the radiological findings of pelvic insufficiency fractures in different imaging modalities, with the aim of differentiate metastatic disease, as this implies a completely different prognosis and management.

References


Personal Information