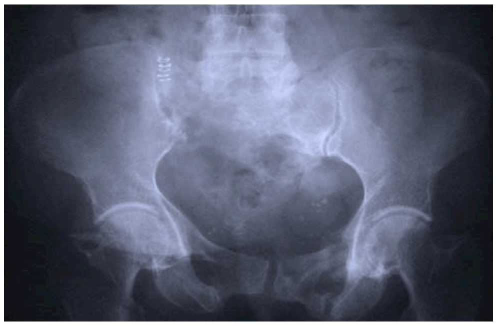
Case Report

70-year-old woman presented with a back pain after a fall. She had a remote
history of adenocarcinoma of the colon with history of external beam radiation included this region 10 years ago.

Your Diagnosis?

X ray:



An anteroposterior radiograph of the pelvis shows a large ill defined radiolucent lesion in the sacrum, mostly on the right side, with widening of the sacroiliac joint.

Further, fractures in various stages of healing are seen in the bilateral pubic rami and the left ischial ramus.

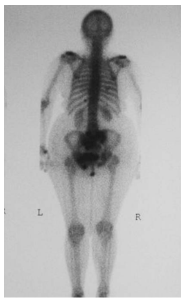
The staples are from the previous biopsy.

CT:

An axial CT scan shows destruction of the right side of the sacrum with attenuation similar to skeletal muscles. No mineralization pattern was seen.

MRI

Diffuse abnormal marrow replacement in the sacrum, more on the right side, with a signal isointense to muscles on T1-weighted.



Bone Scan

A Tc-99m HDP bone scan (posterior view) shows an asymmetrical irregular uptake in the sacrum, more on the right side, as well as the pubic rami.

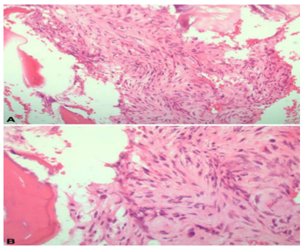
Differential Diagnosis

1. Metastatic colorectal carcinoma
2. Second primary tumors including multiple myeloma, lymphoma, giant cell tumor, chordoma
3. Radiation-induced sarcoma
4. Postradiation osteoporotic insufficiency fracture
5. Hyperparathyroidism
6. Chronic infection (including tuberculosis)

Biopsy

A benign, relatively hypocellular lesion with occasional spindle cells, dense stroma, extensive fibrosis, hemorrhage, and no inflammatory component.

The spindle cells had the histologic appearance of myofibroblastic cells with their plump nuclei and modest amounts of amphophilic cytoplasm. The variable cellularity of the spindle cell component and its cytologic blandness pointed to its reactive nature and was not consistent with neoplasia. No mitotic activity or malignant features were seen. Immunohistochemistry for cytokeratin to rule out metastatic rectal adenocarcinoma was negative.



Diagnosis

Postradiation osteoporotic insufficiency fracture.

The presence of additional fractures in the spine or pelvis (up to 80% and mostly in the pubis), especially with a history of local radiotherapy, helps confirm the pathologic process in the sacrum is indeed a fracture. Most of these fracture occur: most occur within the first 3 years. The incidence was higher for anal carcinoma than rectal or cervical carcinoma, with cumulative 5-year fracture rates .of 14%, 8.7%, and 8.2%. The highest-risk populations for sacral insufficiency fractures are women who are postmenopausal, have osteoporosis, and receive local radiation. Other predisposing factors include corticosteroids, thyroid hormone replacement, connective tissue disorders, obesity, multiparity, diabetes mellitus, metabolic bone disease.

Treatment

Bed rest for 6 weeks with in-bed spinal exercises. This was followed by gradual mobilization with assistive devices and physiotherapy.

Treated for her underlying osteoporosis with bisphosphonates, calcium, and vitamin D supplements throughout. Her pain gradually improved and was considerably better by 3 months.

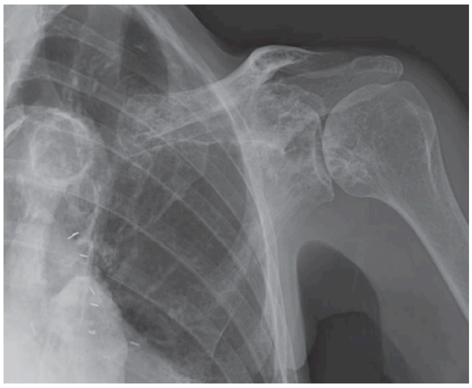
Summary

Although therapeutic radiation is precisely targeted to reach the tumor burden using sophisticated pretherapy planning computer techniques, bone tissue are often exposed. The effects of therapeutic radiation range from asymptomatic molecular changes to significant gross abnormalities.

Radiation-induced bone changes depend on

1. Patient Age
2. Absorbed dose: A threshold dose near 3000 cGy. [Imaging is less than 1000. Recent concern with multiple diagnostic studies]
3. Radiation field, beam energy, and fractionation.

Radiographic



1. **Osteopenia** Approximately 1 year post exposure.
2. **Coarse trabeculation**: Approximately 3 years after exposure, there is recovery of osteoblastic activity resulting in irregular bony repair. Chronic periostitis is seen. This is radiation osteitis. May look like Pagets but bones are not expanded. In contrast to Pagets, there is sharp transition [no flame edge]. **Radiation osteitis**

3. More severe cases with larger zones of bone loss intermixed with bone death are better termed osteonecrosis or **radiation osteonecrosis**.

4. **Physeal plate and irradiation:** One of the earliest radiographic changes is growth plate widening, which is usually seen 2 months after irradiation.

5. **Fragility fracture**

The mechanisms

1. Vascular injury
2. Bacterial infection.
3. Damage to osteoblasts
4. Bone fibrosis

Pathology

1. **Fractures post-radiotherapy** are usually of the insufficiency type.
2. **Radiation induced malignancies** is 0.03% to 0.8%

80% to 90% are in bone

Latent period: 10 years

Types: Commonest Fibrosarcoma

Than MFH and III common is osteosarcoma

D/D: from secondaries

Differentiating a radiationinduced sarcoma from metastasis or osteoradionecrosis can be difficult. Both radiation-induced sarcomas and tumor recurrences occur within the radiation field, whereas metastases can occur elsewhere and are usually multifocal.

Tumor recurrence tends to occur within 5 years of local treatment, whereas radiation-induced sarcomas have a longer average latency.

3. **Growth Retardation**

The physeal plate are the cell population most sensitive to irradiation.

The effects on growing bones are dose dependent, with cell injury and disarray resulting in growth retardation at doses as low as 400 cGy. Permanent changes resulting in limb shortening follow doses _1200 cGy.3,28 The severity of cellular effects are inversely related to age at treatment, with younger children having a worse prognosis. One of the earliest radiographic changes is growth plate widening, which is usually seen 2 months after irradiation. Harris lines may be seen.

Diaphyseal irradiation can lead to overtubulation because of decreased osteoclastic activity and failure of remodeling.

Growth plate disturbances such as slipped capital femoral epiphysis occur 1 to 8 .yrs post-treatment

Prevention of radiation effects

1. Fractionated doses allow healthy tissue recovery that decreases malignant potential.
2. Increasing use of brachytherapy with direct implantation of radioactive seeds into target tissue helps reduce dose to normal tissue.
3. High-energy megavoltage linear accelerators increase penetrability and decrease radiation absorbed by bone.
4. Three-dimensional conformational radiation therapy allows delivery of higher doses of radiation to the target volume of interest while sparing more of the surrounding normal tissues.
5. Current techniques such as reducing dose by a quarter while increasing scanning time provide adequate images with less exposure.

Reference

1. Orthopaedics. **MARCH 2011** | Volume 34 • Number 3
2. Clin Orthop Relat Res (2009) 467:596–602