Sacral Destruction: Foraminal Lines Revisited

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Although imaging techniques have improved greatly in recent years, plain radiography remains the initial imaging method for evaluation of patients with low back pain. The sacrum, in particular, is a difficult structure to evaluate. In reviewing 12 cases, the authors found an unacceptably high rate of missed sacral metastases (83%). Using a photograph and a radiograph of two bony pelvic specimens to represent normal anatomy and the normal appearance of the sacral foraminal lines, sacral destruction is illustrated in six cases. All lesions were neoplastic and most were metastatic. In each case there was destruction of one or more sacral lines. The importance of careful observation for symmetric appearance of these lines is emphasized.

The sacrum is a common site for involvement of metastatic disease [1, 2]. Symptoms are varied, including low back, hip, and buttock pain, and may be associated with sensory and motor deficits. Plain-film evaluation of this region is often a preliminary step in determining the etiology of symptoms. The anatomic configuration of the sacrum and the superposition of soft-tissue structures make it a difficult area to evaluate. Computed tomography (CT) provides precise delineation of sacral lesions [3]; but since most of these patients initially undergo conventional radiography, it is important to study the plain radiographs carefully. We reviewed 12 proven cases of sacral pathology and were dismayed to note that the correct initial diagnosis was made in only two patients. On retrospective evaluation of the same films, sacral pathology could be diagnosed in all instances. The radiographic feature or sign common to all patients was the absence of one or more sacral arcuate lines. The significance of this anatomic feature has been emphasized in detection of vertical sacral fractures [4]. The same anatomic landmarks should be used in detection of destructive lesions of the sacrum.

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Materials and Methods

A patient came to our attention who had experienced significant delay in the diagnosis and treatment of sacral pathology (see Representative Case Report). This case prompted us to review the records of 12 other patients with proven sacral pathology. In each case, we studied the initial radiographic report, the patient's charts, and all radiographs, with particular attention to the sacral arcuate lines. CT scans and bone scans, when available, were also reviewed.

We made photographs and radiographs of two detached pelvic specimens in order to illustrate the bony prominences that cause the curvilinear densities seen on plain radiographs.

Representative Case Report

A 32-year-old man initially presented to the emergency room with low back pain. He was discharged on muscle relaxants after a lumbosacral series was interpreted as normal. He was seen 10 days later at a different institution because of exacerbation of his symptoms. Repeat radiographs of the lumbosacral region were obtained and again were interpreted as

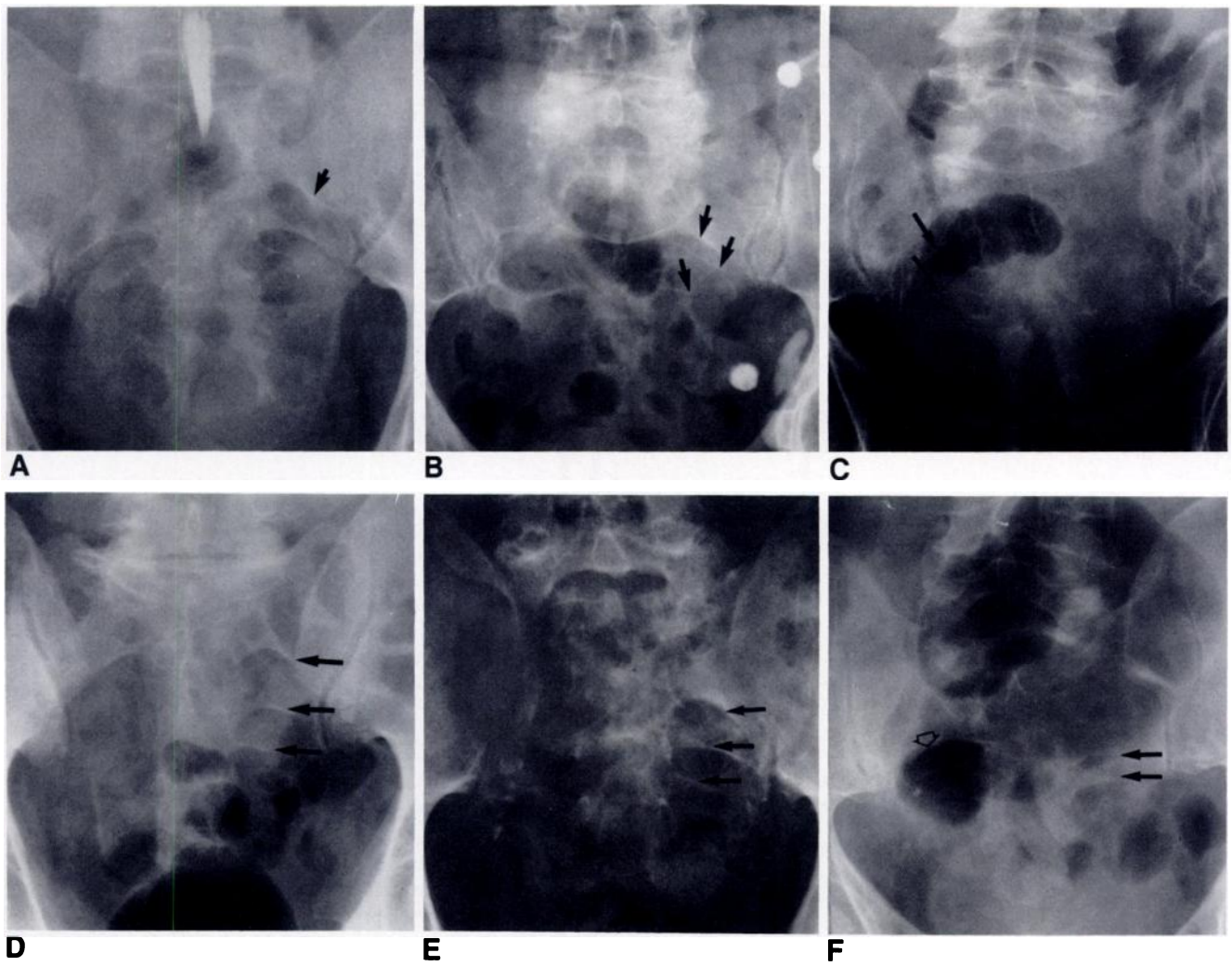

Fig. 1.—Plain radiographs (anteroposterior views) illustrating sacral destruction in six cases. In **A**, *arrow* indicates first left sacral line; first right sacral line is destroyed, as is most of body of sacrum on right. Residual Pantopaque in subarachnoid space. Diagnosis was metastatic epidermoid carcinoma from lung. In **B**, *arrows* indicate normal left sacral lines; first and second right sacral lines are missing. Residual barium in diverticula from previous barium enema. Diagnosis was plasmacytoma. In **C**, *arrows* indicate normal right sacral lines; left sacral lines are missing. Diagnosis was metastatic squamous cell carcinoma from lung. In **D**, *arrows* indicate normal left sacral lines; second and third right sacral lines are missing. Diagnosis was metastatic squamous cell carcinoma from lung. In **E**, *arrows* indicate normal left sacral lines; there is massive destruction of right sacrum, including ala. Diagnosis was metastatic breast cancer. In **F**, *open arrow* indicates normal first right sacral line; first left sacral line is missing. *Solid arrows* indicate second and third left sacral lines. Diagnosis was metastatic squamous cell carcinoma from lung.

normal. He was treated with bed rest, analgesics, and muscle relaxants and was discharged several days later.

Seven weeks after his initial visit, the patient was admitted to the orthopedic service of our institution with severe pain in the right lower extremity, weakness, nausea, and vomiting. Lumbosacral myelography revealed no defects into the subarachnoid space up to T12. During review of the myelogram, along with the preliminary plain films, the right sacral lines were noted to be absent (figure 1A). Review of the three recent lumbosacral series showed the same abnormality. Skeletal survey revealed asymptomatic lytic lesions of several ribs and some long bones. Biopsy of a radial lesion revealed metastatic epidermoid carcinoma. A small left-lower-lobe pulmonary mass was believed to be the primary site.

Results

In 10 (83%) of the 12 patients whose records were reviewed, the initial radiologic interpretation was incorrect. In only one patient was the sacral pathology detected on the plain radiograph. In another patient, sacral destruction was detected incidentally on an abdominal CT scan obtained in a search for intraabdominal and intrapelvic metastases. Subsequent skeletal survey on this patient revealed a sacral metastatic lesion.

In the other ten patients, sacral pathology was not reported initially. Eventual correct diagnosis was made by CT in four patients. In the remaining six, persistent strong clinical suspicion prompted review of the initial radiographs by several observers; in all six patients, this review led to the correct diagnosis of sacral destruction (figs. 1B–1F). In four of these patients, new films were also requested by the referring physicians.

Seven of the 12 patients had direct biopsy of the sacral

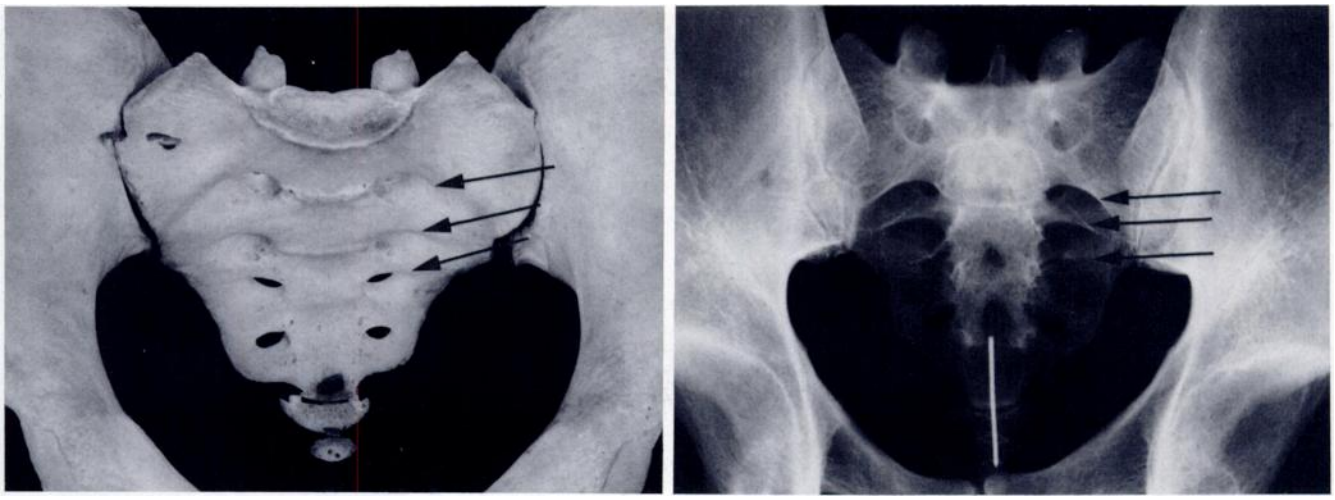

Fig. 2.—Photograph (**A**) and anteroposterior radiograph (**B**) of detached bony pelvis. Normal sacral arcuate lines exhibit left-right symmetry (*arrows* indicate three lines on left).

lesion. Eleven patients had metastatic carcinoma: seven from primary lung cancer; one each from primary rectal, breast, and esophageal cancer; and one from an unknown primary. One patient had a plasmacytoma. The interval between the initial incorrect radiographic interpretation to the correct diagnosis in the 10 patients ranged from several days to several months. On review of all 12 patients' initial radiographs, sacral line abnormality was present.

Discussion

The sacrum is a difficult site to evaluate because it is a flat, curvilinear bone with an irregular surface and because it is often obscured by overlying soft-tissue structures and bowel contents. The sacrum has four or five pairs of neural foramina. The upper margins of three of these are seen consistently on radiographs as three distinct paired lines arising from near the midline [5] (fig. 2). These lines exhibit right-left symmetry unless congenital anomaly, surgery, fracture, or metastatic disease involves the sacrum.

Even with significant bowel contents, the symmetric sacral lines can be seen on routine projections. A specific search for these sacral lines should be made, since even large areas of sacral destruction may be very difficult to detect. The best projection for depicting the sacral lines is the tilted view of the sacrum. Tube angulation is 15° craniad with thighs flexed so that the sacrum is flat against the table. Thus, the lower sacral segments are not obscured by the pubic symphysis [6].

Recent articles have dealt with CT of the normal sacrum and sacral pathology. CT most accurately defines bony structures, abnormalities, and associated soft-tissue masses [7, 8]. However, plain films remain the easiest and least costly method of detecting sacral pathology. Once pathology is detected, CT may be then required for further definition of pathology, for biopsy, or for therapy planning.

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