A system for evaluating the pelvis and hips includes a look at the shape of the pelvis, the density of bone, the sacroiliac joints, the hip joints, and alignments of the natural ovals of the pelvis, as well as the symphysis pubis, sacrum and coccyx.

I-SHAPE
2-DENSITY
3-SI AND HIP JOINTS (includes fat lines about the hips)
4-OVALS
5-SYMPHYSIS PUBIS, SACRUM & COCCYX

The shape of the pelvis is important in order for you to become familiar with normal, which will immediately raise a red flag if you see an FLP, i.e. a funny looking pelvis. You then must play detective, which is the essence and fun of diagnostic radiology, to explain your observation.

One good exercise is to guess the age and sex of the patient before you look at the confirming data. You will soon become pretty good and usually be in the right decade on age, and almost always right on the sex of the patient.

The shape of the pelvis is abnormal in cases of achondroplasia, Mongolism and some other congenital syndromes. It becomes distorted in severe trauma including radical surgery, Paget's disease, primary and metastatic neoplasm, and with certain metabolic, neurogenic or degenerative problems such as acetabulae protrusio (Otto Pelvis), post poliomyelitis cases or severe degenerative arthritis.
Figure # 184 (right). Better positioned AP view of the male pelvis (note soft tissue outline of the penis –red arrow). This image shows the obturator foramen better. In the system list for the pelvis the ovals we refer to include the obturator foramen, the pelvic inlet and gutters (outlined in yellow) and Shenton’s line(s) (outlined in blue). The small white arrow points to the right ischial tuberosity. The ischial tuberosities are the bones on which we sit.

Figure # 185 (left). Take a good look at the shape (outlines) of this pelvis. What do you see? Ignore the high contrast of the spine and hips, which has been manipulated to better demonstrate other pathology.

Figure # 186 (right) is the labeled version of figure 185. Note the loss of normal cortex (density and outline) of the left posterior iliac crest (white arrow). Localized bone mineral loss as demonstrated here is almost always due to malignant neoplasm, in this case a plasmocytoma.
Figure # 188 (left). It’s easy to spot the disruption of the natural ovals of the pelvis in this patient with a fracture of the superior ramus of the left ischium. Note the distortion of Shenton’s line. Refer to figure 184.

Figure # 187 (right) radiographic negative. Here is a funny looking pelvis in a kid. Note the lack of normal flare of the iliac wings which are squared off and vertically oriented. The acetabulae are also flat, lacking the normal angles. The diagnosis would not be a problem if you saw the long bones in this achondroplastic dwarf. Did you know dachshunds are canine achondroplastic dwarfs?

Figure # 189 (right). Ignoring the area of the SI joints, which are under exposed in this reproduction, check for density differences in the remainder of the pelvis and hips. What do you see? Answer on the next page.
Suspicion of avascular necrosis can be confirmed by MRI studies as noted in figure 191 below.

Figure #190 (left). Compare the density of the right femoral head inside the white circle with that of the left inside the red circle. The increased density of the right hip is classic for avascular necrosis and can be considered an "Aunt Minnie" for that diagnosis. An earlier diagnosis can be made with MRI, which is probably the modality of choice in unexplained hip pain, after plain film radiography. MRI exams should be interpreted with plain films of the hips and pelvis because avascular necrosis is not the only cause of altered marrow signal in the hips.

Figure 191 (left). Early Changes of avascular necrosis (AVN) are easily detected as alterations of the marrow signal seen in a normal femoral head. This case is more advanced with deformity of the femoral head already present. Image courtesy of Steven H. Brick, MD of Drs. Groover, Christie & Merritt, PC, via the Internet.
Figure # 191 A (left). When avascular necrosis occurs in an adolescent whose femoral epiphysis have not yet closed it is known as coxa plana or Legge-Perthe’s disease. The radiographic negative to your left shows early flattening of the right epiphysis (red arrow) compared to the normal left side.

Figure # 191 B (right). This is the same patient as in 191A above as seen a few months later. Note the fragmentation of the right femoral epiphysis. The fat lines (red arrows) are easy to see in this radiographic negative. These fat deposits lie next to the joint capsule. Compare their positions and appearance to those of the normal left hip (blue arrows). Do you think there is distention of the capsule on the right? I do!

Figure # 191 C (left). Just to show you that all went well with the patient, this is a radiographic negative of the result of conservative management of this patient with Legge Perthe’s disease!
Increased bone density occurs in Paget's disease, and metastatic ca of the prostate which we discussed earlier. Increased density of the femoral heads either unilateral or bilateral is a clue to loss of normal nutrition of bone such as occurs in avascular necrosis of the hips as shown in the previous figures 189 and 190.

The density of the pelvis varies with age, and although osteopenia or osteoporosis is common in the elderly, spotty or localized areas of bone mineral loss is a clue to something more serious, such as the leukemic infiltrate shown next in figure 192.

**Figure # 192 (right).** Note the density difference between the symphysis (red arrow) and the rest of the pelvis in this patient with leukemia and leukemic invasion of bone. Film courtesy of the dirt museum via the Internet. www.sbu.ac.uk/~dirt/museum/margaret/448-341-3320341.jpg

**Figure # 193 (left).** Ignoring the overexposed areas of the posterior iliac crests in this reproduction, what catches your eye about the outlines of the pelvis in this young sprinter*?

*major clue!
Studying the SI joints is necessary to exclude ankylosing spondylitis, and other diseases as shown in figures 196 and 197. The SI joints can also become disrupted in trauma.

**Figure # 194 (right)** is the labeled version of figure 193. Did you identify the avulsion fracture of the left ischial tuberosity (white arrow)? This is a not uncommon injury in sprinters, particularly as they come out of the starting blocks and stress the hamstring muscles.

**Figure # 195 (left)** radiographic negative. Black pointer indicates intrapelvic protrusion of the acetabulum, a somewhat uncommon affliction of unclear etiology. This one happens to be in a 14-year-old girl. Bilateral acetabulae protrusio is common in Marfan’s syndrome. Other cases are related to rheumatoid or pyogenic arthritis, osteoporosis, degenerative changes etc. Also known as Otto pelvis or (rarely) Arthrokatadysis. Courtesy of Children’s Seashore House, Atlantic City, NJ.

Studying the SI joints is necessary to exclude ankylosing spondylitis, and other diseases as shown in figures 196 and 197. The SI joints can also become disrupted in trauma.

**Figure # 196 (right).** Note the loss of normal definition of the SI joints in this patient with ankylosing spondylitis. Males predominate over females as much as 10/1 in some series, and most patients are serum negative for rheumatoid but HLA-B27 antigen positive (90%). The disease usually affects the joints symmetrically and the radiographic findings may precede symptoms.
The hip joints are also included in any study of the pelvis and it's also wise to include frog-leg lateral projections when feasible. Note the obvious slipped left femoral capital epiphysis in the child of figure 199. Not readily appreciated in the straight ap view, however, is the early slippage of the right side as well. This finding would be more easily detected by a frog-leg view of the pelvis. Figure 200 shows typical advanced degenerative osteoarthritis in a candidate for total hip replacement.

Figure # 197 (left) shows obliteration of the right SI joint and surrounding eburnation (whitening) of a still open left SI joint in this patient with Reiter's syndrome. Compare to the normal SI joints (red arrows) in Figure # 198 (right).

Figure # 199 (above). The advanced slippage of the left femoral capital epiphysis is obvious here (red arrows). What is not so obvious is the early slippage of the right femoral capital epiphysis, which would be easily detected by a frog-leg view (not available). Film courtesy of Loren G. Yamamoto, MD, MPH, and U. of Hawaii via the Internet.
Figure # 200 (left). Radiographic negative of a patient with advanced osteoarthritis of the right hip. Note the large hypertrophic osteophytes on the femoral head (blue arrows) and lateral margin of the acetabulum (red arrow). There is also subcortical cystic change (yellow arrows) in the head of the femur. The joint space is not particularly narrow (white arrow), which is unusual with the other changes and which raises the question of a distended joint space due to fluid or pus. We can’t see the periarticular fat lines in this reproduction which would help evaluate the joint space.

Figures # 201 and # 202 (left and right). Red arrows point to the normal periarticular fat about the hips. With fluid in the joint the fat lines may become bowed. It’s part of your evaluation of the major joints to look for the periarticular fat and determine if it is normal or displaced. This part of major joint evaluation is invaluable for the elbow, knees, ankles etc., as we’ll see later. Go back and review figure 191 b.
Analyzing the circles or more accurately, the ovals of the pelvis as demonstrated in figure 184, is crucial in evaluating trauma patients. I actually follow with my finger around the ovals to find subtle breaks in the cortex. Remember that if you find one break in the circle, there is likely another. In addition, in patients with clinical fractures, the fracture may not be appreciated by plain film radiography and it may be necessary to utilize high resolution or thin cut CT studies to confirm. See if you can spot a fracture in the radiograph below (figure 203).

Figure # 203 (left). This is an AP radiograph of the left hip following reduction of a traumatic dislocation. Can you identify a fracture? Is there any abnormality? Case courtesy of Michael L. Richardson, MD, U. of Washington via the Internet.

Figure # 204 (right). The same radiograph as # 203 above. No fracture is visible (at least to my eye), but there is noticeable widening of the joint space (white arrow). As Dr. Richardson so aptly points out in his on-line teaching file, “Any fracture of the pelvis that may involve the acetabulum should be studied by CT. The same holds for any dislocation of the hip” See CT study next page.
Finally, a look at the symphysis pubis, sacrum and coccyx completes your checklist for looking at the pelvis. Note a classic Aunt Minnie in this patient with osteitis pubis, which is a typical development after childbirth in some women.
The AP view of the sacrum in a pelvic film seldom shows pathology with the exceptions of trauma and some congenital anomalies. Occasionally a normal variant may raise a question if you have not seen it before, such as the prominent foramen show in the next illustration.

![Figure # 207 (left). The sacral foramina shown here (white arrows) are a prominent normal variant. The anterior sacral foramina transmit the first four sacral nerves, arteries and veins.](image)

The coccyx is best evaluated in the lateral view. The anteflexed position of the coccyx is a normal variant as shown here, and is not an indicator of traumatic dislocation or fracture by itself. Clinical correlation is required in cases of trauma. In childbirth an anteflexed coccyx will usually relocate (straighten) with vaginal delivery.

![Figure # 208 (right). The distal two segments of the coccyx shown here by the blue arrows are anteflexed, a normal variant.](image)
Let’s see if you can put your new knowledge to work by evaluating the findings in the next image (Figure # 198 below). This is an AP radiograph of a 61-year-old male with hip pain. Film courtesy of Michael Richardson, U. of Washington via the Internet.

For answers see next page.
Figure #199 (above) is the labeled version of figure 198. The findings include a coarsened trabecular pattern of the right hip, a slightly thickened cortex (red arrows) compared to the opposite hip, and increased density of the hip compared to the left side. Do these findings sound familiar? You are right! Three out of four signs of Paget’s disease are present, which is enough to call the diagnosis!