Contents

The medial or fore portion of the superior ramus is broad and flattened anteroposteriorly. Formerly called "the body," it presents an outer and an inner surface, the symphyseal area, and an upper border or "crest."

Approximately 2 cm from the medial edge of the ramus and in line with the upper border is the prominent **pubic tubercle**, an important landmark. Below the crest are the anterior surface and the posterior or deep surface. The medial portion of the superior ramus is continuous below with the inferior ramus, and the lateral part presents a wide, smooth area anterosuperiorly, behind which is an irregular ridge, the pecten ossis pubis. The pecten pubis forms the anterior part of the linea terminalis. In front of and below the pectineal area is the obturator crest, passing from the tubercle to the acetabular notch. On the inferior aspect of the superior ramus is the obturator sulcus. The inferior ramus is continuous with the superior ramus and passes downward and backward to join the inferior ramus of the ischium, forming the "ischiopubic arch." The pubis receives blood from the pubic branches of the obturator artery and from branches of the medial and lateral circumflex arteries.

Pubic Symphysis

The **pubic symphysis** is a synarthrodial joint of the symphyseal surfaces of the pubic bones. The ligaments associated with it are (1) the interpubic fibrocartilage, (2) the superior pubic ligament, (3) the anterior pubic ligament, and (4) the arcuate ligament. The interpubic fibrocartilage is thicker in front than behind and projects beyond the edges of the bones, especially on the posterior aspect, blending intimately with the ligaments at its margins. Sometimes it is woven throughout, but often the interpubic fibrocartilage presents an elongated, narrow fissure with fluid in the interspace, partially dividing the cartilage into 2 plates.

The interpubic cartilage is intimately adherent to the layer of hyaline cartilage that covers the symphyseal surface of each pubic bone. The superior pubic ligament extends laterally along the crest of the pubis on each side to the pubic tubercle, blending in the middle line with the interpubic cartilage. The thick and strong anterior pubic ligament is closely connected with the fascial covering of the muscles arising from the conjoined rami of the pubis. It consists of several strata of thick, decussating fibers of different degrees of obliquity, the superficial being the most oblique and extending lowest over the joint. The arcuate ligament is a thick band of closely connected fibers that fills the angle between the pubic rami to form a smooth, rounded top to the pubic arch. Both on the anterior and posterior aspects of the joint, the ligament gives off decussating fibers that, interlacing with one another, strengthen the joint.

Sacrum

The **sacrum** is formed in the adult by the union of 5 or 6 sacral vertebrae; occasionally, the fifth lumbar vertebra is partly fused with it. The process of union is known as "sacralization" in the vertebral column. The sacrum constitutes the base of the vertebral column. As a single bone, it is considered to have a base, an apex, 2 surfaces (pelvic and dorsal), and 2 lateral portions. The base faces upward and is composed principally of a central part, formed by the upper surface of the body of the first sacral vertebra, and 2 lateral areas of alae. The body articulates by means of a fibrocartilage disk with the body of the fifth lumbar vertebra. The alae represent the heavy transverse processes of the first sacral vertebra that articulate with the 2 iliac bones. The anterior margin of the body is called the promontory and forms the sacrovertebral angle with the fifth lumbar vertebra. The rounded anterior margin of each ala constitutes the posterior part (pars sacralis) of the linea terminalis.

The pelvic surface of the sacrum is rough and convex. In the midline is the median sacral crest (fused spinal processes), and on either side is a flattened area formed by the fused laminae of the sacral vertebrae. The laminae of the fifth vertebra and, in many cases, those of the fourth and occasionally of the third are incomplete (the spines also are absent), thus leaving a wide opening to the dorsal wall of the sacral canal known as the sacral hiatus. Lateral to the laminae are the articular crests (right and left), which are in line with the paired superior articular processes above. The lateral processes articulate with the inferior articular processes of the fifth lumbar vertebra. The inferior extensions of the articular crests form the sacral cornua that bind the sacral hiatus laterally and are attached to the cornua of the coccyx. The cornua can be palpated and are important landmarks indicating the inferior opening of the sacral canal (for sacral-caudal anesthesia).

The lateral portions of the sacrum are formed by the fusion of the transverse processes of the sacral vertebrae. They form dorsally a line of elevations called the lateral sacral crests. The parts corresponding to the first 3 vertebrae are particularly massive and present a large area facing laterally called the articular surface, which articulates with the sacrum. Posterior to the articular area, the rough bone is called the sacral tuberosity. It faces the tuberosity of the ilium. The apex is the small area formed by the lower surface of the body of the fifth part of the sacrum. The coccyx is formed by 4 (occasionally 3 or 5) caudal or coccygeal vertebrae. The second, third, and fourth parts are frequently fused into a single bone that articulates with the first by means of a fibrocartilage. The entire coccyx may become ossified and fused with the sacrum (the sacrococcygeal joint).

The sacrum receives its blood supply from the **middle sacral artery**, which extends from the bifurcation of the aorta to the tip of the coccyx, and from the **lateral sacral arteries** that branch either as a single artery that immediately divides or as 2 distinct vessels from the hypogastric artery. The lowest lumbar branch of the middle sacral artery ramifies over the lateral parts of the sacrum, passing back between the last vertebra and the sacrum to anastomose with the lumbar arteries above and the superior gluteal artery below. The lateral sacral branches (usually 4) anastomose

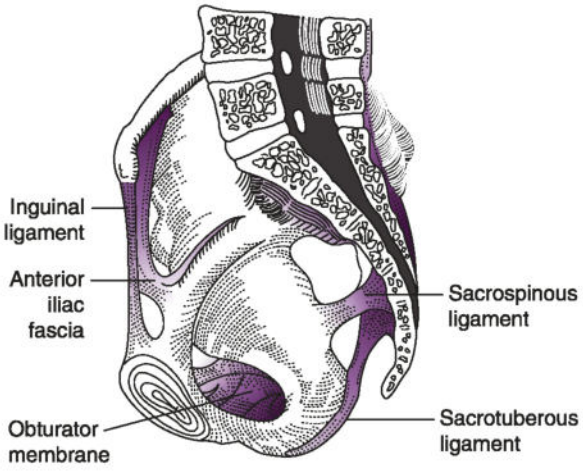
anteriorly to the coccyx with branches of the inferior lateral sacral artery that branch from the hypogastric artery. They give off small spinal branches that pass through the sacral foramens and supply the sacral canal and posterior portion of the sacrum.

Sacroiliac Joint

The **sacroiliac joint** is a diarthrodial joint with irregular surfaces. The articular surfaces are covered with a layer of cartilage, and the cavity of the joint is a narrow cleft. The cartilage on the sacrum is hyaline in its deeper parts but much thicker than that on the ilium. A joint capsule is attached to the margins of the articular surfaces, and the bones are held together by the anterior sacroiliac, long and short posterior sacroiliac, and interosseous ligaments. In addition, there are 3 ligaments (Fig. 1–11), classed as belonging to the pelvic girdle itself, which also serve as accessory ligaments to the sacroiliac joint: the **iliolumbar, sacrotuberous, and sacrospinous ligaments**.

The **anterior sacroiliac ligaments** unite the base and the lateral part of the sacrum to the ilium, blending with the periosteum of the pelvic surface and, on the ilium, reaching the arcuate line to attach in the paraglenoid grooves. The posterior sacroiliac ligament is extremely strong and consists essentially of 2 sets of fibers, deep and superficial, forming the short and long posterior sacroiliac ligaments, respectively. The short posterior sacroiliac ligament passes inferiorly and medially from the tuberosity of the ilium, behind the articular surface and posterior interior iliac spine, to the back of the lateral portion of the sacrum and to the upper sacral articular process, including the area between it and the first sacral foramen.

The **long posterior sacroiliac ligament** passes inferiorly from the posterior superior iliac spine to the second, third, and fourth articular tubercles on the back of the sacrum. It partly covers the short ligament and is continuous below with the sacrotuberous ligament. The interosseous ligaments are the strongest of all and consist of fibers of different lengths passing in various directions between the 2 bones. They extend from the rough surface of the sacral tuberosity to the corresponding surface on the lateral aspect of the sacrum, above and behind the articular surface.



▲ **Figure 1–11.** Ligaments of the pelvis.

Ligaments

The **sacrotuberous ligament**, in common with the long posterior sacroiliac ligament, is attached above to the crest of the ilium and posterior iliac spine and to the posterior aspect of the lower 3 sacral vertebrae. Below, it is attached chiefly to the medial border of the ischial tuberosity. Some of the fibers at the other end extend forward along the inner surface of the ischial ramus, forming the falciform process. Other posterior fibers continue into the tendons of the hamstrings.

The **sacrospinous ligament** is triangular and thin, extending from the lateral border of the sacrum and coccyx to the spine of the ischium. It passes medially (deep) to the sacrotuberous ligament and is partly blended with it along the lateral border of the sacrum.

The **iliolumbar ligament** connects the fourth and fifth lumbar vertebrae with the iliac crest. It originates from the transverse process of the fifth lumbar vertebra, where it is closely woven with the sacrolumbar ligament. Some of its fibers spread downward onto the body of the fifth vertebra, and others ascend to the disk above. It is attached to the inner lip of the crest of the ilium for approximately 5 cm. The sacrolumbar ligament is generally inseparable from the iliolumbar ligament and is regarded as part of it.

Foramens

Several foramens are present in the bony pelvis. The sacrospinous ligament separates the greater from the lesser sciatic foramen. These foramens are subdivisions of a large space intervening between the sacrotuberous ligament and the femur. The piriformis muscle passes out of the pelvis into the thigh by way of the **greater sciatic foramen**, accompanied by the gluteal vessels and nerves. The internal pudendal vessels, the pudendal nerve, and the nerve to the obturator internus muscle also leave the pelvis by this foramen, after which they enter the perineal region through the lesser sciatic foramen. The obturator internus muscle passes out of the pelvis by way of the **lesser sciatic foramen**.

The **obturator foramen** is situated between the ischium and the pubis. The obturator membrane occupies the obturator foramen and is attached continuously to the inner surface of the bony margin except above, where it bridges the obturator sulcus, converting the latter into the obturator canal, which provides passage for the obturator nerve and vessels.

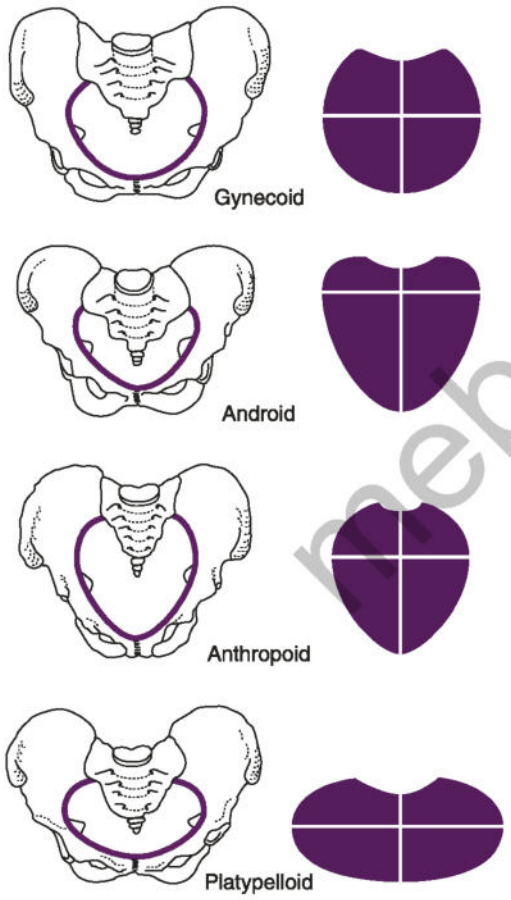
On either side of the central part of the pelvic surface of the sacrum are 4 anterior sacral foramens that transmit the first 4 sacral nerves. Corresponding to these on the dorsal surface are the 4 posterior sacral foramens for transmission of the small posterior rami of the first 4 sacral nerves.

TYPES OF PELVES

Evaluation of the pelvis is best achieved by using the criteria set by Caldwell and Moloy, which are predicated upon 4 basic types of pelves: (1) the gynecoid type (from Greek *gyne* meaning woman); (2) the android type (from Greek *aner* meaning man); (3) the anthropoid type (from Greek *anthropos* meaning human); and (4) the platypelloid type (from Greek *platys* meaning broad and *pella* meaning bowl) (Fig. 1–12).

Gynecoid

In pure form, the **gynecoid pelvis** provides a rounded, slightly ovoid, or elliptical inlet with a well-rounded forepelvis (anterior segment). This type of pelvis has a well-rounded, spacious posterior segment, an adequate sacrosciatic notch, a hollow sacrum with a somewhat backward sacral inclination, and a Norman-type arch of the pubic rami. The gynecoid pelvis has straight side walls and wide interspinous and intertuberous diameters. The bones are primarily of medium weight and structure.



▲ **Figure 1–12. Types of pelves. White lines in the diagrams at right (after Steele) show the greatest diameters of the pelves at left.** (Reproduced with permission from Benson RC. *Handbook of Obstetrics & Gynecology*. 8th ed. Los Altos, CA: Lange Medical; 1983.)

Android

The **android pelvis** has a wedge-shaped inlet, a narrow forepelvis, a flat posterior segment, and a narrow sacrosciatic notch, with the sacrum inclining forward. The side walls converge, and the bones are medium to heavy in structure.

Anthropoid

The **anthropoid pelvis** is characterized by a long, narrow, oval inlet; an extended and narrow anterior and posterior segment; a wide sacrosciatic notch; and a long, narrow sacrum, often with 6 sacral segments. The subpubic arch may be an angled Gothic type or rounded Norman type. Straight side walls are characteristic of the anthropoid pelvis, whose interspinous and intertuberous diameters are less than those of the average gynecoid pelvis. A medium bone structure is usual.

Platypelloid

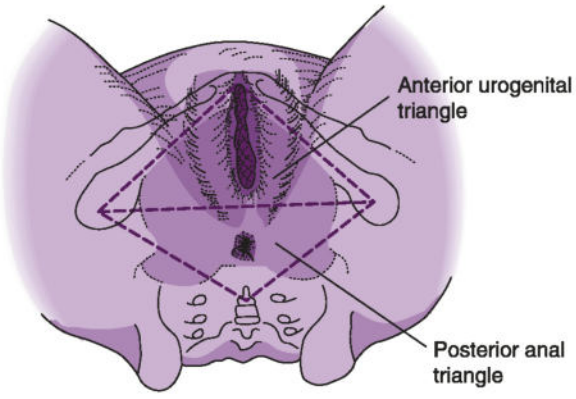
The **platypelloid pelvis** has a distinct oval inlet with a very wide, rounded retropubic angle and a wider, flat posterior segment. The sacrosciatic notch is narrow and has a normal sacral inclination, although it is often short. The subpubic arch is very wide, and the side walls are straight, with wide interspinous and intertuberous diameters.

The pelvis in any individual case may be 1 of the 4 "pure" types or a combination of mixed types. When one discusses the intermediate pelvic forms, the posterior segment with its characteristics generally is described first and the anterior segment with its characteristics next (eg, anthropoid-gynecoid, android-anthropoid, or platypelloid-gynecoid). It is impossible to have a platypelloid-anthropoid pelvis or a platypelloid-android pelvis.

Pelvic Relationships

Several important relationships should be remembered, beginning with those at the inlet of the pelvis. The transverse diameter of the inlet is the widest diameter, where bone is present for a circumference of 360 degrees. This diameter stretches from pectineal line to pectineal line and denotes the separation of the posterior and anterior segments of the pelvis. In classic pelves (gynecoid), a vertical plane dropped from the transverse diameter of the inlet passes through the level of the interspinous diameter at the ischial spine.

These relationships may not hold true, however, in combination or intermediate (mixed type) pelves. The anterior transverse diameter of the inlet reaches from pectineal prominence to pectineal prominence; a vertical plane



▲ **Figure 1–13.** Urogenital and anal triangles.

dropped from the anterior transverse passes through the ischial tuberosities. For good function of the pelvis, the anterior transverse diameter should never be more than 2 cm longer than the transverse diameter (Fig. 1–13).

Obstetric Conjugate

The **obstetric conjugate** differs from both the diagonal conjugate and the true conjugate. It is represented by a line drawn from the posterior superior portion of the pubic symphysis (where bone exists for a circumference of 360 degrees) toward intersection with the sacrum. This point need not be at the promontory of the sacrum. The obstetric conjugate is divided into 2 segments: (1) the anterior sagittal, originating at the intersection of the obstetric conjugate with the transverse diameter of the inlet and terminating at the symphysis pubis; and (2) the posterior sagittal, originating at the transverse diameter of the inlet to the point of intersection with the sacrum.

Interspinous Diameter

A most significant diameter in the midpelvis is the **interspinous diameter**. It is represented by a plane passing from ischial spine to ischial spine. The posterior sagittal diameter of the midpelvis is a bisecting line drawn at a right angle from the middle of the interspinous diameter, in the same plane, to a point of intersection with the sacrum. This is the point of greatest importance in the midpelvis. It is sometimes said that the posterior sagittal diameter should be drawn from the posterior segment of the intersecting line of the interspinous diameter, in a plane from the inferior surface of the symphysis, through the interspinous diameter to the sacrum. However, this configuration often places the posterior sagittal diameter lower in the pelvis than the interspinous diameter. **It is the interspinous diameter, together with the posterior sagittal diameter of the midpelvis, that determines whether or not there is adequate room for descent and extension of the head during labor.**

Intertuberous Diameter

The **intertuberous diameter** of the outlet will reflect the length of the anterior transverse diameter of the inlet (ie, the former cannot be larger than the latter if convergent or straight side walls are present). Therefore, the intertuberous diameter determines the space available in the anterior segment of the pelvis at the inlet, and, similarly, the degree of convergence influences the length of the biparietal diameter at the outlet.

Posterior Sagittal Diameter

The **posterior sagittal diameter** of the outlet is an intersecting line drawn from the middle of the intertuberous diameter to the sacrococcygeal junction and reflects the inclination of the sacrum toward the outlet for accommodation of the head at delivery. It should be noted that intricate measurements of the pelvis are significant only at minimal levels. Evaluation of the pelvis for a given pregnancy, size of the fetus for a given pelvis, and conduct of labor engagement are far more important.

▶ Outlets of the True Pelvis

The true pelvis is said to have an upper "inlet" and a lower "outlet." The **pelvic inlet** to the pelvis minor is bounded, beginning posteriorly, by (1) the promontory of the sacrum; (2) the linea terminalis, composed of the anterior margin of the ala sacralis, the arcuate line of the ilium, and the pecten ossis pubis; and (3) the upper border or crest of the pubis, ending medially at the symphysis. The conjugate or the anteroposterior diameter is drawn from the center of the promontory to the symphysis pubis, with 2 conjugates recognized: (1) the **true conjugate**, measured from the promontory to the top of the symphysis; and (2) the **diagonal conjugate**, measured from the promontory to the bottom of the symphysis.

The transverse diameter is measured through the greatest width of the pelvic inlet. The oblique diameter runs from the sacroiliac joint of one side to the iliopectineal eminence of the other. The **pelvic outlet**, which faces downward and slightly backward, is very irregular. Beginning anteriorly, it is bounded by (1) the arcuate ligament of the pubis (in the midline), (2) the ischiopubic arch, (3) the ischial tuberosity, (4) the sacrotuberous ligament, and (5) the coccyx (in midline). Its anteroposterior diameter is drawn from the lower border of the symphysis pubis to the tip of the coccyx. The transverse diameter passes between the medial surfaces of the ischial tuberosities.

INGUINAL REGION

The **inguinal region** of the abdominal wall is bounded by the rectus abdominis muscle medially, the line connecting the anterior superior iliac spines superiorly, and the inguinal ligament inferiorly. The region contains 8 layers