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Oxford Textbook of Orthopedics & Trauma, 1st Edition

Anatomy

Part of "3.49 - Pelvic ring fractures: assessment, associated injuries, and acute management"

Bony pelvis and ligaments

The pelvis is a ring structure composed of the sacrum and the two innominate bones. Each innominate bone is formed by the fusion of three separate centers of ossification: the ilium, the ischium, and the pubis. These three components meet at the triradiate cartilage of the acetabulum which fuses by age 16.

The innominate bones and the sacrum are connected by ligamentous supports at the sacroiliac joints and the symphysis pubis. The pelvic girdle transmits weight from the spinal axis across the sacroiliac joints and the femoral necks to the lower extremities—the so-called femoral–iliac–sacral arch (Fig. 1). The symphysis pubis is a complex structure of hyaline cartilage, fibrocartilage, and ligamentous fibers, but is of minor relevance regarding the weight-bearing function.

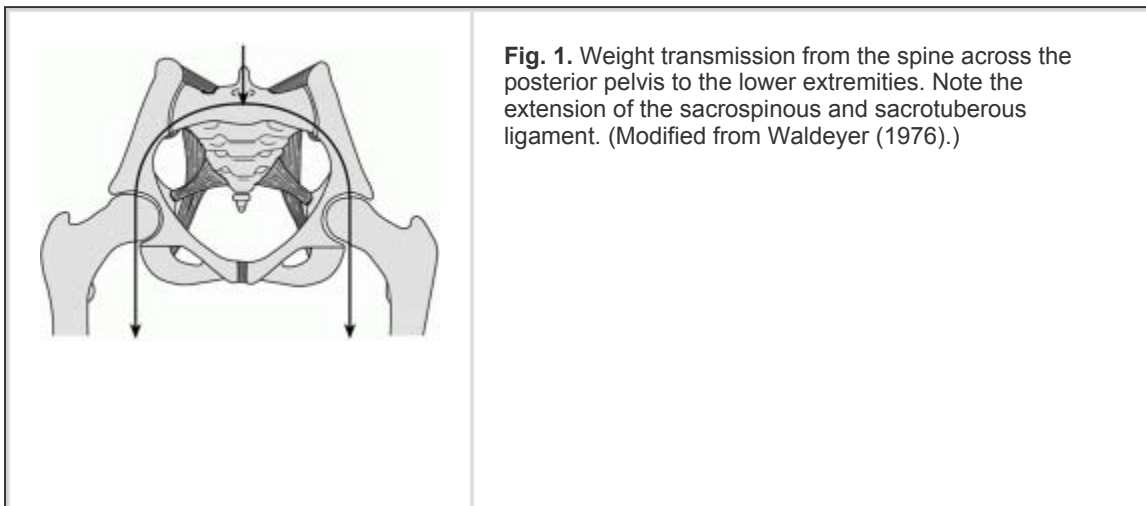
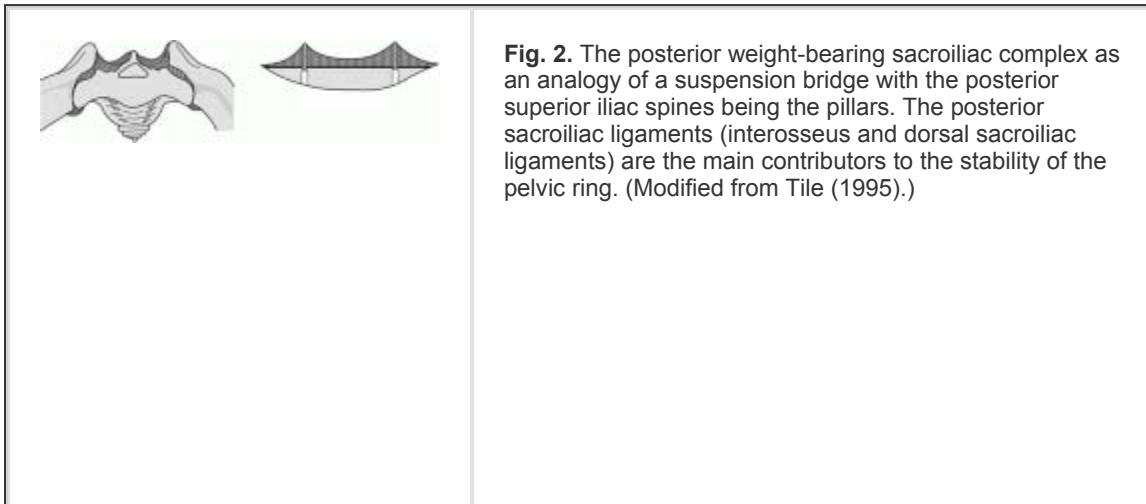


Fig. 1. Weight transmission from the spine across the posterior pelvis to the lower extremities. Note the extension of the sacrospinous and sacrotuberous ligament. (Modified from Waldeyer (1976).)

Box 1 Pelvic ring fractures

- 1–3 per cent of all fractures
- Bimodal frequency
- Massive fractures usually due to road accidents
- Look for associated injuries (chest, limbs, etc.)

The major stabilizing structures are posterior. Pelvic stability depends upon the integrity of the sacroiliac complex. The sacroiliac joint is an amphiarthrosis. The anterior sacroiliac ligaments and especially the extremely strong posterior sacroiliac ligaments maintain the normal position of the sacrum in the pelvic ring, and the entire complex has the appearance of a suspension bridge (Fig. 2).



Additional stability is provided by the sacrospinous and sacrotuberous ligaments (Fig. 1). The sacrospinous ligaments link the lateral margin of the sacrum to the ischial spine and resist external rotation of the hemipelvis. Lying posterior to the sacrospinous ligaments, the sacrotuberous ligaments extend from the sacrum to the ischial tuberosity and resist rotational (and shearing) forces in the sagittal (vertical) plane.

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The pelvic ring is connected to the lumbar spine at the strong lumbosacral articulation with the intervertebral disk. Two ligaments are of particular importance: the iliolumbar ligament originates from the costal (transverse) process of the fifth (and fourth) lumbar vertebra and is anchored at the iliac crest; the lateral lumbosacral ligament attaches the fifth lumbar transverse process to the ala of the sacrum (Waldeyer 1976; Tile 1988, 1995; Agur 1991; Tile *et al.* 1991; Gerlach and Lierse 1992; Rieger 1996).

Viscera, blood vessels, and nerves

The interior of the bony pelvis is at risk as pelvic ring disruption is usually combined with substantial soft-tissue damage. The lumbosacral nerve plexus (Fig. 3) can be injured, especially in transforaminal fractures and crush lesions of the sacrum. Arterial and venous vessels form an extensive network that firmly adheres to the bony pelvis and the viscera and is often lacerated. Pelvic (retroperitoneal) hemorrhage can be life threatening and is one of the major causes of death. The arteries of the pelvis are the median sacral artery, the superior rectal artery, and—most surgically important—the internal iliac artery and its divisions (Fig. 4). Pelvic veins usually contribute to pelvic bleeding, with the sacral venous plexus being of major significance (Fig. 5). Tears of the (predominantly male) urethra and the bladder are not uncommon. Open pelvic fractures with perineal laceration are often

combined with lesions of the rectum and the vagina (Waldeyer 1976; Agur 1991; Hanson *et al.* 1991; Tile 1995; Rieger 1996).

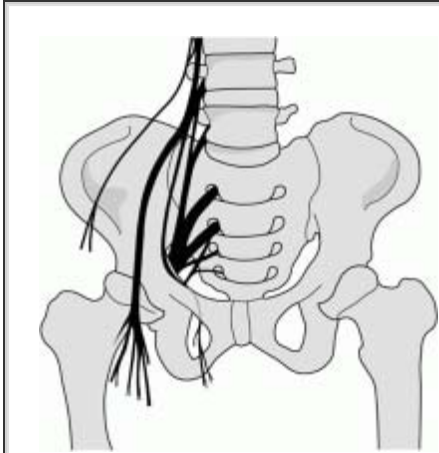


Fig. 3. The lumbosacral plexus. (Reproduced from Rieger (1996).)

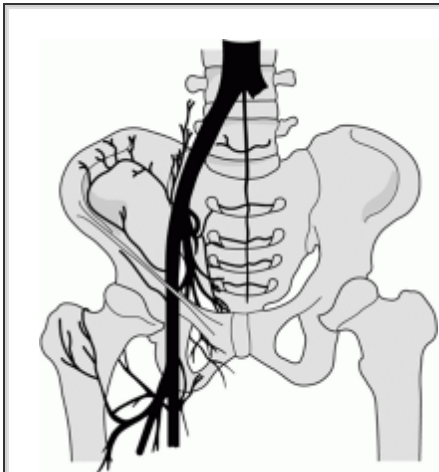


Fig. 4. The arterial system of the pelvis. (Reproduced from Rieger (1996).)

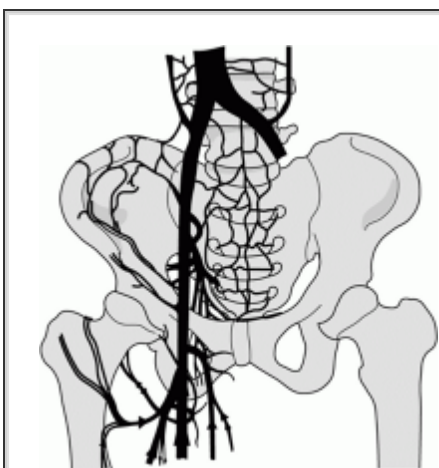


Fig. 5. The pelvic venous system. (Reproduced from Rieger 1996.)