Pelvic Organ Prolapse

New Concepts in Pelvic Floor Anatomy

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KEYWORDS

• Prolapse • Anatomy • Pelvic floor • Compartments • Concepts • Theories

KEY POINTS

- A conceptual understanding of pelvic floor anatomy is essential for surgeons in managing prolapse of the anterior, posterior, and apical compartments of the vagina.
- The emerging concept of cervical elongation is important in the evaluation of apical compartment prolapse.
- The development of anterior and apical compartment prolapse appears intimately associated, as demonstrated by 3-dimensional models.
- Dynamic magnetic resonance defecography may help objectively identify posterior compartment defects not easily seen on physical examination and evaluate symptoms of dysfunctional emptying.

INTRODUCTION

Our knowledge of pelvic floor dysfunction can be greatly enhanced through a better appreciation and knowledge of the anatomic principles that define pelvic floor support in women. As the field of reconstructive pelvic surgery continues to evolve, with the increasing incorporation of mesh for the repair of pelvic organ prolapse, it remains imperative to maintain a functional and fundamental understanding of pelvic floor anatomy. The goal of this review was to provide a focused, conceptual approach to differentiating anatomic defects contributing to prolapse in the various compartments of the vagina. Rather than provide exhaustive anatomic descriptions, basic pelvic floor anatomy is reviewed, new and historical concepts of pelvic floor support are discussed, and relevance to the surgical management of specific anatomic defects is addressed.

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FUNDAMENTALS OF PELVIC ANATOMY

Advanced knowledge and conceptual understanding of pelvic floor anatomy and support are essential in guiding surgeons in the surgical management of prolapse of the anterior, posterior, and apical compartments of the vagina. Pelvic floor support is defined, in large part, by the complex and dynamic interactions of the muscles and connective tissue attachments within the bony pelvis.

In general, the bony pelvis consists of 4 major components: bilateral hip bones (ilium, ischium, and pubis), the sacrum, and the coccyx. The ilium, ischium, and pubis are fused at the cup-shaped acetabulum, articulating with the femoral head. The pelvic halves are joined at the sacroiliac joints (synovial) posteriorly and the symphysis pubis (cartilaginous) anteriorly. The pelvis is artificially divided into a "true" and the "false" pelvis. The *false pelvis* is located superior to the iliopectineal line, coursing along the superior edge of the superior pubic ramus, and circumferentially forms what is termed the pelvic brim. More relevant to pelvic floor support is the *true pelvis*, which is located below the pelvic brim. Within the true pelvis are the sacrotuberous and sacrospinous ligaments, which attach from the ischial tuberosities and ischial spines bilaterally to the sacrum, respectively. Together, these ligaments contribute significantly to the stability of the pelvis.

The firm, soft tissue support of the pelvic floor consists of the muscles of the *pelvic diaphragm*, which is made up of the coccygeus muscles and levator ani muscles (pubococcygeus, puborectalis, and iliococcygeus).[1] The pubococcygeus muscle is further divided into its pubovaginalis, puboperinealis, and puboanalis portions, providing additional support to the urethra and anus, and helping to narrow the urogenital hiatus. The puborectalis muscle is a U-shaped muscular sling encircling the junction between the rectum and anus, which determines the resting anorectal angle and partially contributes to the fecal continence mechanism.[1] The lateral walls of the pelvis are formed by the piriformis muscle and obturator internus muscle. The piriformis muscle originates from the anterior and lateral surfaces of sacrum to fill, in part, the posterolateral pelvic walls. The obturator internus muscle originates on the pelvic surfaces of the ilium and ischium, and fills the remainder of the sidewalls of the pelvis. The *levator plate* is a clinical or conceptual term to describe the connection between the anus and the coccyx, formed by the medial insertions of the iliococcygeus muscle on the coccyx, known as the anococcygeal raphe.[1] As mentioned later, the levator plate is important in the discussion of theories of prolapse development, as it provides a ridge or shelf on which the rectum, upper vagina, and uterus rest.

Crucial to the discussion of pelvic floor support is the classification and distinction of ligamentous support and fascial layers within the pelvis (**Fig. 1**). Classically, fascia is designated as being either parietal or visceral.[1,2] Parietal fascia is thick, tough connective tissue that covers the medial surfaces of most skeletal or striated muscle in the pelvis; for example, the coccygeus and levator ani muscles. Importantly, parietal fascia may be freely dissected off of the underlying muscle. Special condensations of parietal fascia in the pelvis provide muscle attachments to the bony pelvis and anchoring points for visceral fascia.[1,2] Examples include the arcus tendineus levator ani (ATLA), arcus tendineus fascia pelvis (ATFP), and arcus tendineus fascia rectovaginalis (ATFR). In contrast, visceral fascia in the pelvis, also known as *endopelvic fascia*, provides subperitoneal perivascular connective tissue attachments from different pelvic visceral organs to the pelvic walls.[1] Under this classification, we find structures such as the uterosacral ligaments, cardinal ligaments, pubocervical/pubovesical fascia, and rectovaginal fascia. Herein lies controversy over the use of the term "fascia" in describing these visceral attachments, as it relates to the surgical repair of certain