Functional Anatomy of the Pelvic Floor

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2.1 Introduction

Pelvic organ prolapse and urinary incontinence are debilitating problems that prevent one in nine women from enjoying a full and active life (Olsen et al. 1997). They arise due to injuries and deterioration of the muscles, nerves and connective tissue that support and control normal pelvic organ function.

Although it is clear that incontinence and prolapse increase with age (Olsen et al. 1997), there is no hour during a woman’s life when these structures are more vulnerable than during the time a woman delivers a child. Vaginal birth confers a 4- to 11-fold increase in risk of developing pelvic organ prolapse (Mant et al. 1997).

This chapter addresses the functional anatomy of the pelvic floor in women. The anal sphincter and intestinal tract are discussed in Section 4 of this book. This chapter focuses specifically on how the pelvic organs are held in their normal positions and how pelvic visceral function affects urinary continence and prolapse of the vagina and uterus. The basic anatomy of the female pelvic floor is covered in Chapter 1, but short reviews of pertinent material are provided here to assist in orientation before describing the functional aspects of those anatomical structures.

2.2 Support of the Pelvic Organs

The pelvic organs, when removed from the body, exist only as a limp and formless mass. Their shape and position in living women is determined by their attachments to the pubic bones through the muscles and connective tissue of the pelvis. The actions of their sphincters and muscles require connection to the peripheral and central nervous systems. The structures of the pelvic organ supports are important to understanding pelvic floor dysfunction. In this chapter the term pelvic floor is used broadly to include all the structures supporting the abdominal and pelvic cavity rather than the restricted use of this term to refer to the levator ani group of muscles.
The pelvic floor consists of several components lying between the pelvic peritoneum and the vulvar skin. These are (from above downward) the peritoneum, pelvic viscera and endopelvic fascia, levator ani muscles, perineal membrane and external genital muscles. The eventual support for all of these structures comes from their connection to the bony pelvis and its attached muscles. The viscera are often thought of as being supported by the pelvic floor, but are actually a part of it. The viscera play an important role in forming the pelvic floor through their connections to the pelvis by such structures such as the cardinal and uterosacral ligaments.

The phenomenon of prolapse can be understood by analogy (Fig. 2.1). Bonney (1934) pointed out that the vagina is in the same relationship to the abdominal cavity as the in-turned finger of a surgical glove is to the rest of the glove. If the pressure in the glove is increased, it forces the finger to protrude downwards in the same way that increases in abdominal pressure force the vagina to prolapse. Figure 2.2 demonstrates this phenomenon and the strategies the body uses to prevent prolapse. Figure 2.2a and Figure 2.2b provide a schematic illustration of this phenomenon of prolapse. In Figure 2.2c, the lower end of the vagina is held closed by the pelvic floor muscles preventing prolapse by constriction. Figure 2.2d shows suspension of the vagina to the pelvic walls. Figure 2.2e demonstrates that spatial relationships are important. This is a flap valve closure where the suspending fibers hold the vagina in a position against the supporting walls of the pelvis so that increases in pressure force the vagina against the wall, thereby pinning it in place. Vaginal support is a combination of constriction, suspension and structural geometry.

Because the supportive tissues attach the pelvic organs to the pelvic walls, the female pelvis can naturally be divided into anterior and posterior compartments (Fig. 2.3). The levator ani muscles form the bottom of the pelvis. The organs are attached to the levator ani muscles when they pass through the urogenital hiatus and are supported by these connections.

### 2.2.1 Endopelvic Fascia

On each side of the pelvis the endopelvic fascia attaches the cervix and vagina to the pelvic wall (Fig. 2.4). This fascia forms a continuous sheet-like mesentery – extending from the uterine artery at its cephalic margin to the point at which the vagina fuses with the levator ani muscles below. The part that attaches to the uterus is called the parametrium and that which attaches to the vagina, the paracolpium (DeLANCEY 1992).

The vagina is attached laterally to the pelvic walls forming a single divider in the middle of the pelvis that determines the nature of prolapse. Cystoceles

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**Fig. 2.1.** Bonney’s analogy of the eversion of an inturned surgical glove finger by increasing pressure in the glove simulating prolapse of the vagina (DeLANCEY 2002, with permission)

**Fig. 2.2a–e.** Diagrammatic display of vaginal support strategies. a Invaginated area in a surrounding compartment; b what happens when the pressure (arrow) is increased; c muscle action where closing the bottom of the vagina prevents its descent; d ligament suspension; e flap valve closure where a tethering suspension holds the vagina in such a position where it is pressed against the wall and pinned in place (DeLANCEY 2002, with permission)