

Second Layer (Pelvic Diaphragm)

The levator ani, “the lifter of the anus” is the most important muscle forming the pelvic floor (Figs. 2.2 and 2.3). It is a paired muscle that spans between the sitting bones and between the tail bone (coccyx) and pubic bones. The le-

vator ani muscle not only provides support for all the organs of the pelvis, it also guarantees continence at night and therefore differs from other skeletal muscles in that it has a high resting tone. It is innervated by the pudendal nerve. When coughing and sneezing, quick precontractions are required to maintain continence.

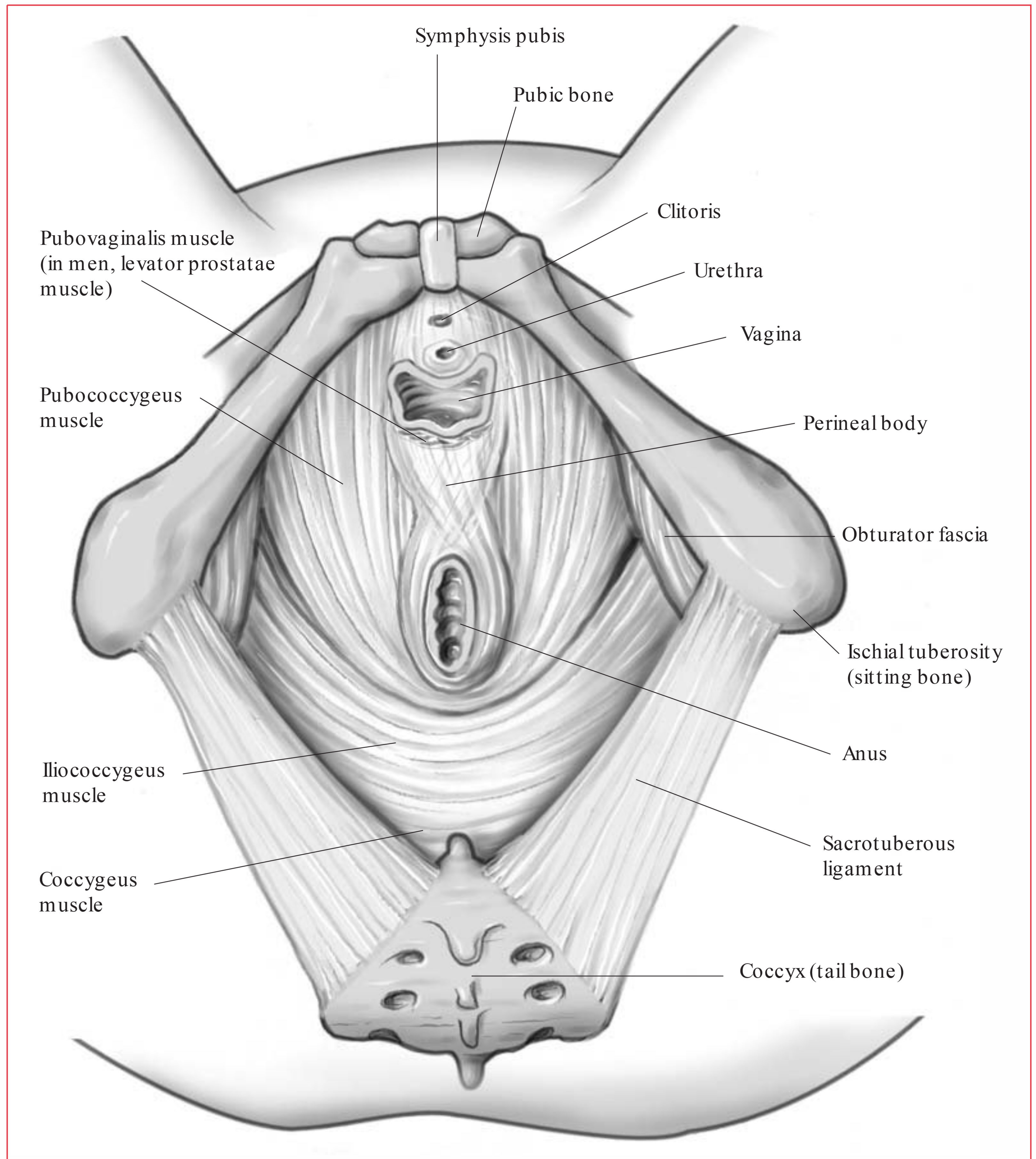


Fig. 2.2 Second layer of the pelvic floor (pelvic diaphragm; levator ani muscle; view from below, the urogenital diaphragm has been removed).

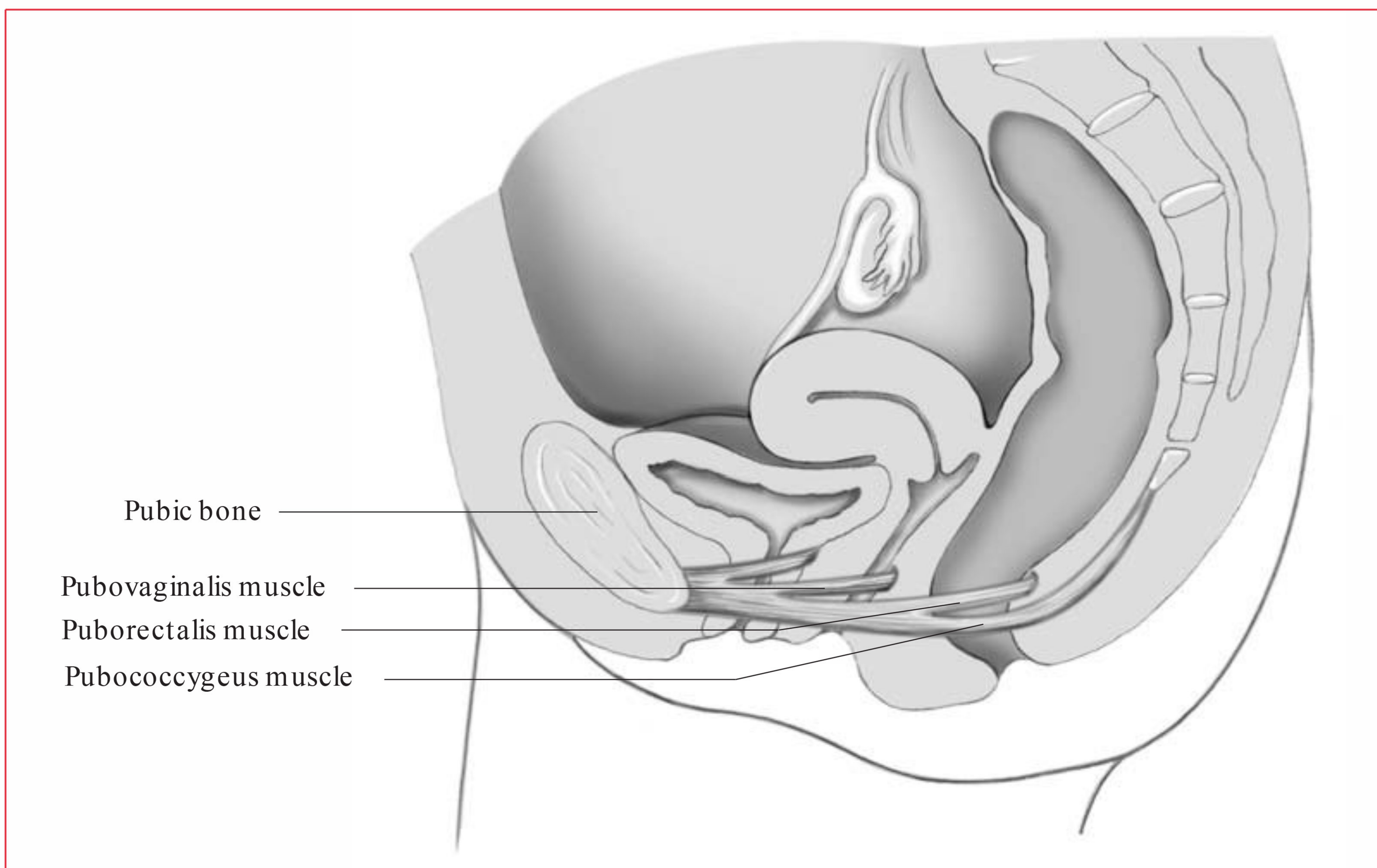


Fig. 2.3 Second layer of the pelvic floor (pelvic diaphragm as part of levator ani muscle; side view).

In order to respond to all the needs, the muscle has approximately 70 % slow muscle fibers and 30 % fast muscle fibers. The muscle has several parts fanning out in different directions:

- *The pubococcygeus muscle.* Its fibers extend from the pubic bones to the tail bone. A contraction sometimes can be felt at the side of the tip of the tail bone.
- *The puborectalis muscle.* Fibers of this very important muscle loop around the rectum, pulling it forward during contraction and assisting with providing continence.
- *The pubovaginalis muscle* (in women only) loops around the vagina. These fibers run in the direction front to back.
- *The levator prostatae muscle* (in men only) supports the prostate gland.
- *The iliococcygeus muscle* extends from the tail bone to each of the sitting bones. Some of these muscle fibers run from one side to the other, some in a more diagonal direction. This muscle does not participate in lifting the anus.
- *The coccygeus muscle* lies adjacent to the iliococcygeus muscle. It can influence stability

of the sacroiliac joint. Abnormal tension of the muscle can keep the sacroiliac joint in a displaced position (Travell and Simons 1992).

- *The internal sphincter muscles* of the bladder and the rectum consist of smooth muscle fibers and cannot be trained with active exercises. Especially during radical surgery of the prostate the internal sphincter of the bladder can be removed or damaged; therefore patients depend on the function of the skeletal muscles of the pelvic floor to stay dry.

Third Layer (Urogenital Diaphragm)

The outer layer of the pelvic floor consists of several muscles (Figs. 2.4 and 2.5). The deep transverse perineal muscle is very important for continence and supports the function of the levator ani. The other muscles of this layer are important for sexual functions. The muscles of the third layer do not support the organs of the pelvis.

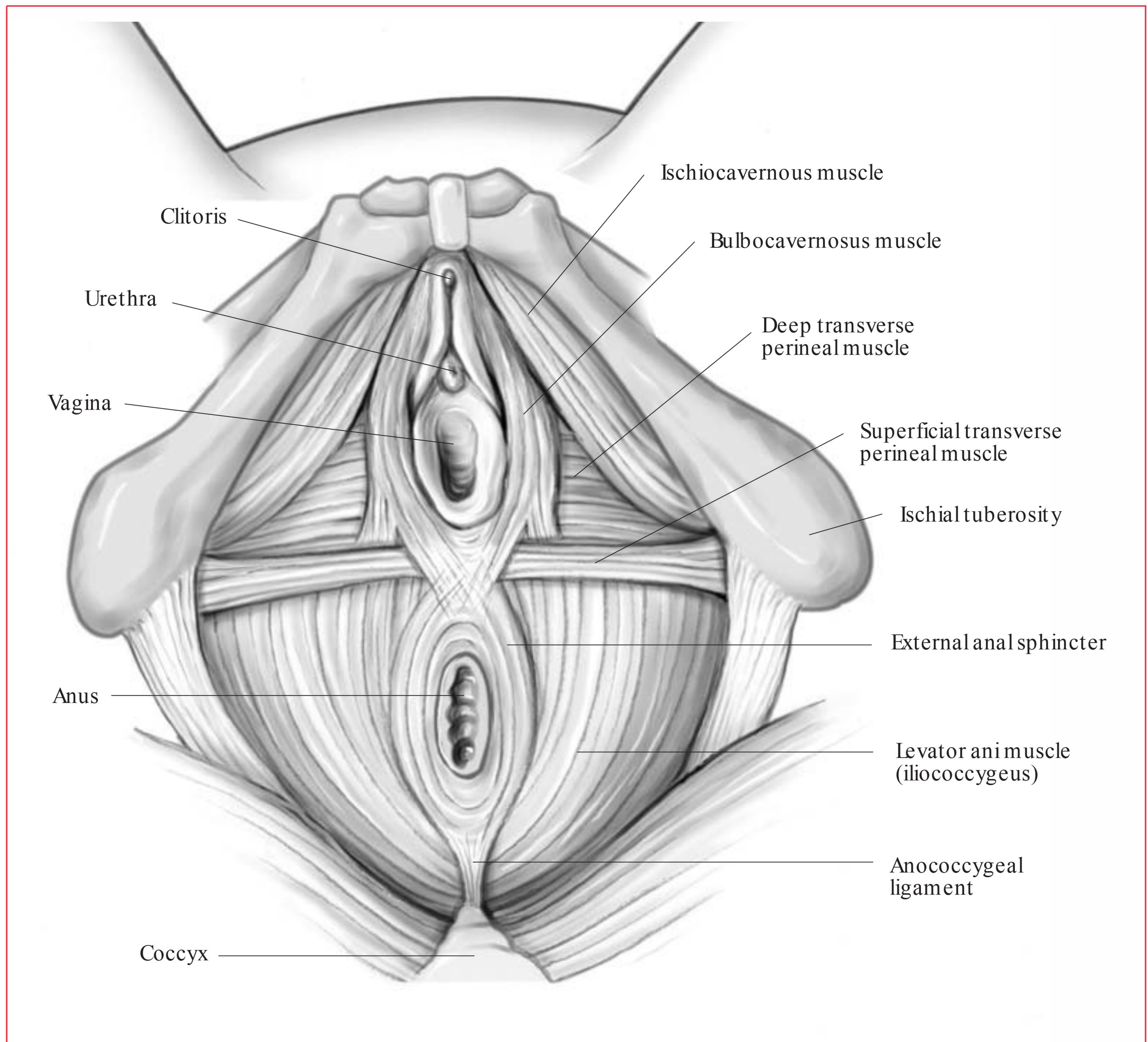


Fig. 2.4 Third layer of the pelvic floor in women (urogenital diaphragm; view from below).

- *The deep transverse perineal muscle* provides additional fibers, such as the sphincter urethra loops around the urethra in men and women, and assists with continence. It is under voluntary control. The muscle fibers run from side to side.
- *The superficial transverse perineal muscle* reinforces the action of the deep transverse perineus. The muscle fibers also run from side to side.
- *The bulbocavernosus muscle (musculus bulbospongiosus)* connects in men the bulb of the penis to the urogenital diaphragm and contracts during ejaculation and at the end of urination. In women it contracts during orgasm, erecting the clitoris. The muscle fibers run in a front to back direction.
- *The ischiocavernosus muscle* has an important function in men since it assists in increasing the erection. The muscle fibers run in a diagonal direction. In women it erects the clitoris.
- *The anal sphincter muscle* loops around the anus like a ring and provides continence of the rectum.



Fig. 10.12 Contracting the pelvic floor muscles while lying on the stomach.



Fig. 10.13 The pelvic floor muscles are activated during exhalation when lying on the back.



Fig. 10.14 On the hands and knees, the pelvis can be tilted in a backward direction during exhalation.

- Exercises begin with the coordination of breathing and gentle puckering of the anal sphincter, especially before coughing and sneezing. It is equally important for men to exercise the muscles in front (bulbocavernosus and ischiocavernosus) by pretending to squirt out the last drop of urine and feel a scrotal lift.
- Once the catheter is removed and the doctor has approved further exercises, a therapist should re-evaluate the patient's condition and review exercises according to the findings.
- Usually pelvic floor contraction can be intensified after the catheter is removed. Pre-contractions are recommended prior to turning



Fig. 10.15 Side-lying exhalation.



Fig. 10.16 Side-lying inhalation.

- in bed, moving from a lying to a sitting position and from a sitting to a standing position.
- Before the patient begins to drive again, these pre-contractions should also be practiced when moving the legs into and out of a car.
 - The exercises described above (Figs. 10.3, 10.4, and 10.13–10.16) can also be done, adjusting the intensity so as not to increase the pain.
 - The progression of exercises depends on the speed and extent of the patient's recovery and on the doctor's findings. The patient can always contact the surgeon with any questions about the progress. The therapist should adapt the exercises to the individual's needs.
 - When sitting on the ball the exercises should primarily be performed in a forward/backward direction to avoid straining the scar until it is well healed. Healing may take about 4–6 weeks.
 - The patient then slowly progresses to doing exercises on the ball in all directions and increases the contraction around the urethra, that is in front of the seat, near the base of the penis.

Note:

- After a prostatectomy bladder dysfunction and inability to tighten the external sphincter of the urethra can cause incontinence. Other individuals may suffer from urine retention, which may cause overflow and dribbling (Van Kampen et al. 1997).
- Incontinence can occur after prostate surgery for benign hyperplasia of the prostate.
- All patients have to develop a keen awareness of when they are leaking urine. The therapist can customize the exercises for individual patients; the activity causing leakage can be practiced by taking the movement sequence as a whole apart and training only individual movement sequences at first.
- Slow fibers of the pelvic floor are trained by holding a contraction for 5–10 seconds or more; fast fibers are trained with repeated quick contractions (quick flicks). Both muscle fiber types of the pelvic floor muscles should be trained.
- Most patients, after a radical prostatectomy, are greatly improved at 4–12 weeks after surgery; a small number may leak urine up to a year and an even smaller percentage can leak beyond this time frame.

- Patients who have problems with erections after surgery need to discuss this with the surgeon. If the nerve could be preserved during radical prostatectomy the patient's erectile function may improve with exercises, erection aids, medication, or a combination of these (Dorey 2001).
- Biofeedback, electrical stimulation, self-relaxation, and other treatments including medication may be required if leakage of urine persists. Close cooperation with the doctor, therapist, and patient are required. ■

Example 1: Months after a radical prostatectomy a patient came to therapy because he was still leaking urine and had to wear several pads a day. When he reported leakage, especially when getting in and out of the car, the exercises described in Chapter 11, Figures 11.5 and 11.6, were prescribed. Lying on his back with the feet on the ball he learned to pre-contract the pelvic floor muscles prior to moving the legs on a stable body. The patient then learned to coordinate the movements in a sitting position when getting out of the car and the leakage decreased. ■

Example 2: At another treatment session the same patient explained that he was leaking, especially after going to the bathroom and when relaxing: “Yesterday I did great, I did not leak at all for most of the day.” When asked what he had done the day before, he answered, “I had to go to a funeral and then go shopping. Then I went to the bathroom and after that I started leaking again.” The patient probably did well because his attention and muscle tone were increased during the activities of the morning. He was instructed to practice puckering at least 10 times immediately after emptying the bladder and eliminating his bowels, holding each contraction for up to 10 seconds. To increase the resting tone of the pelvic floor muscles the patient was also instructed to pretend to hold a lentil with the anal sphincter at all times. These instructions helped the patient to further improve his continence. ■

Pain of the Pelvic Floor Muscles and Leakage of Urine during Intercourse

There are many reasons for pain and discomfort during sexual intercourse (dyspareunia). Studies have shown that 20–40 % of women affected were sexually abused or raped before the age of 18, and 10–25 % of the married women questioned reported sexual violence by their husbands at some time in their marriage (Smith 1997). Instead of talking to a doctor or therapist, these victims often suffer silently and can have many problems including pain, incontinence of stool (fecal incontinence) or urine, constipation, and other gastrointestinal symptoms (stomach and bowel problems).

Leakage of urine during sexual intercourse is a problem affecting the self-esteem of many women. In addition to incontinence, diseases and prolapse (see p. 39) can cause pain and leakage of urine during sexual intercourse. The problem can also stem from a difficult birth or other injuries and scars in the pelvic or pelvic floor area.

Again, many individuals suffer silently because they are not aware that in most cases this is a treatable condition. The first step, therefore, is a thorough evaluation by a doctor who can determine which other treatments may be indicated. Supportive treatment by a psychologist can take place parallel to the physical therapy treatment.

Physical Therapy Treatment Options:

- Review of anatomy and physiology (see Part I).
- Breathing exercises (see Chapter 9).
- Pelvic floor exercises in all planes.
- Combination of breathing with pelvic floor exercises; emphasis on relaxation if the pelvic floor is tight (see Chapter 7) and on strengthening exercises if the pelvic floor muscles are weak.
- Connective-tissue massage.
- Manual therapy.
- Visceral mobilization.
- Colon massage.
- Treatment of scar tissue.
- Biofeedback.
- Electrical stimulation.

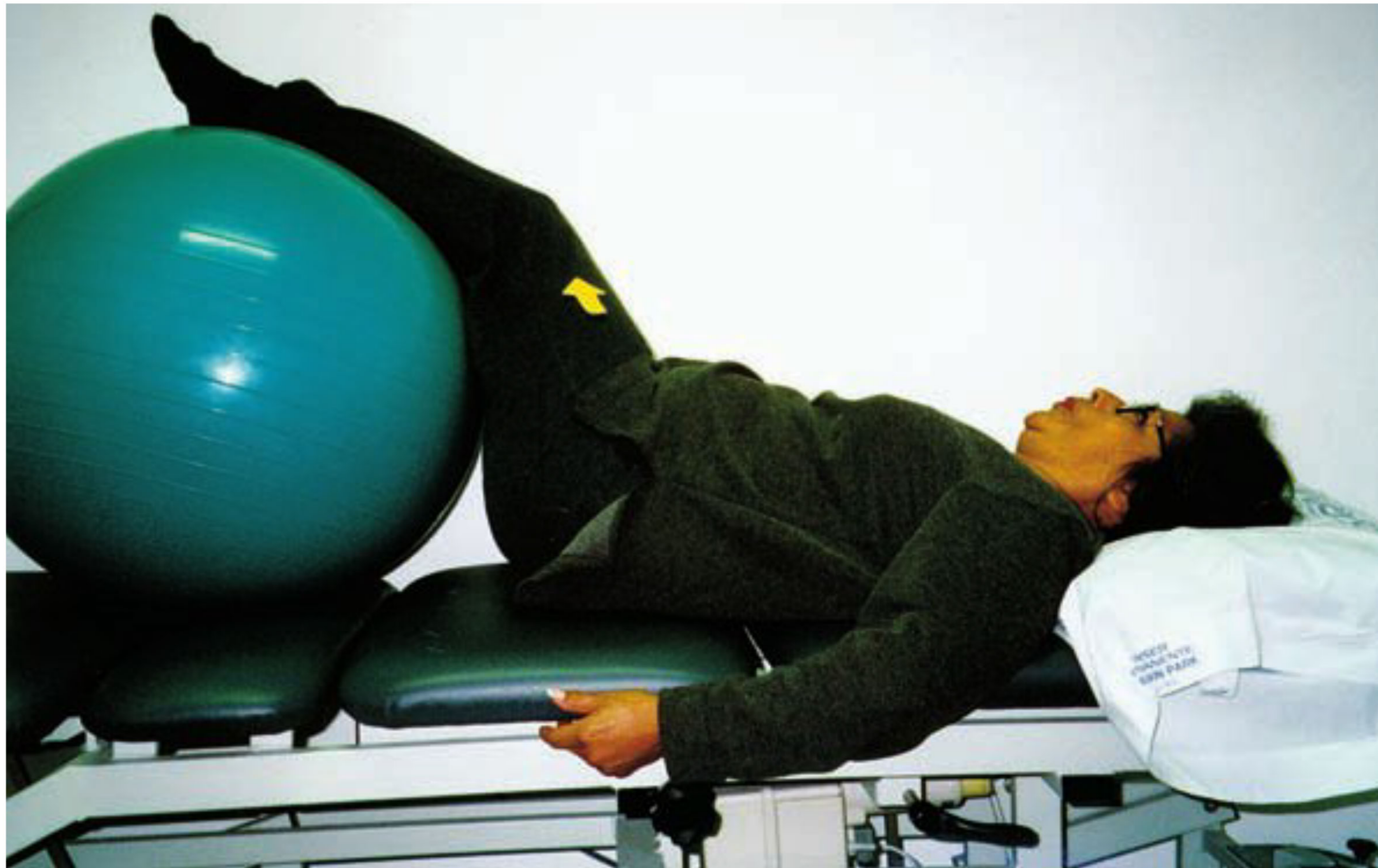


Fig. 11.6 This position is similar to lifting the legs out of a car and can be coordinated with breathing.

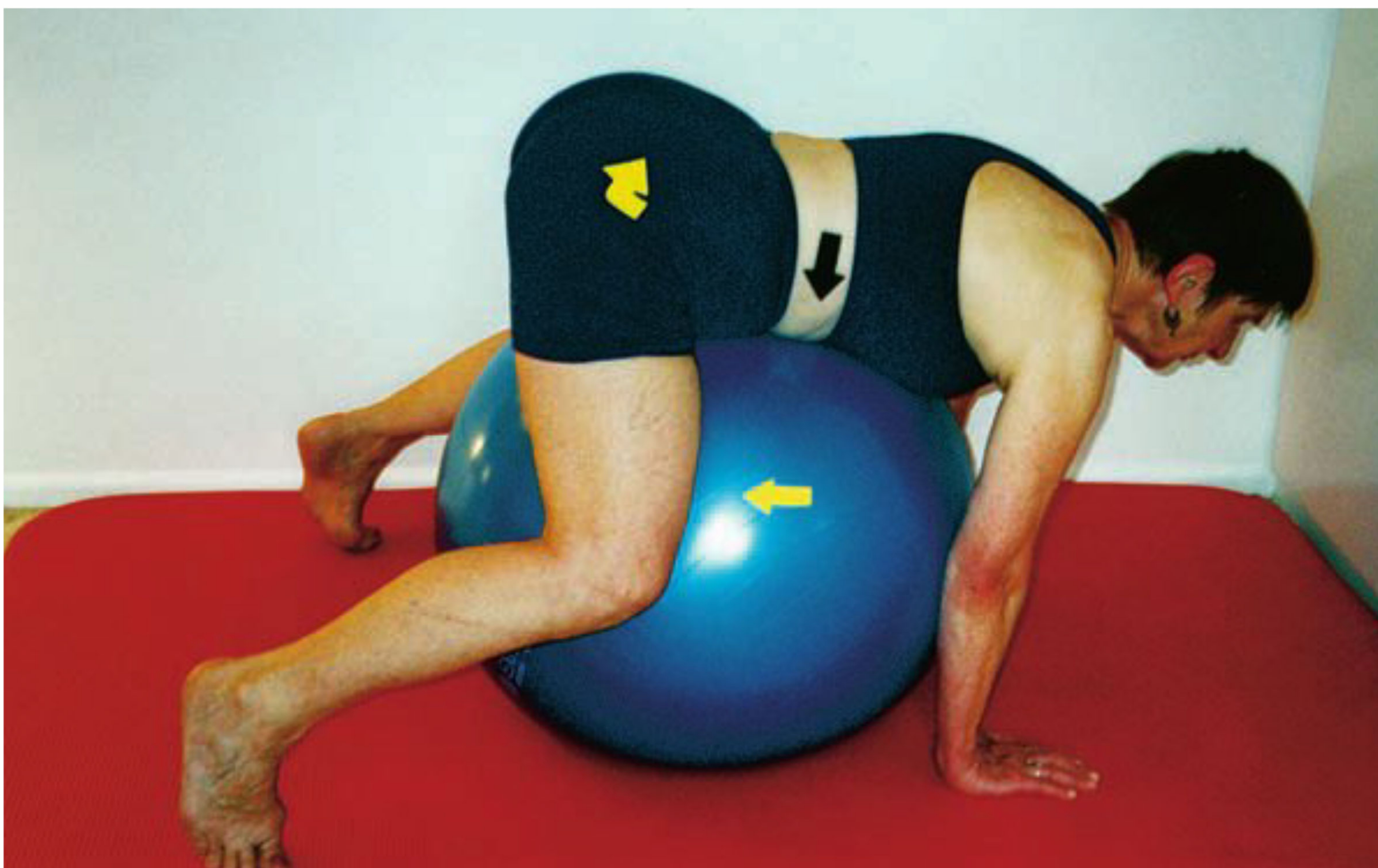


Fig. 11.7 Inhalation against the ball; the pelvis is tilted forward, the back arched.

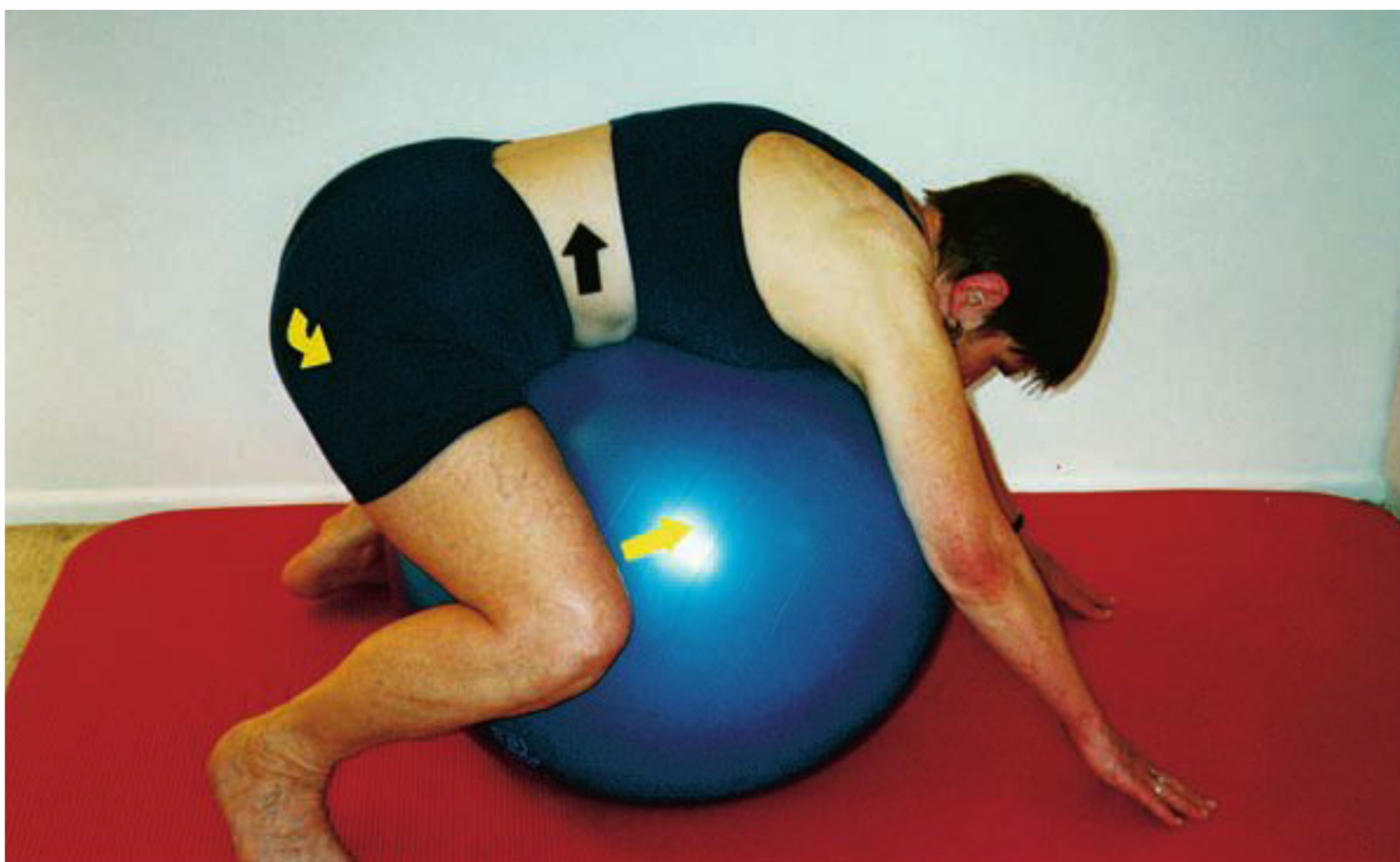


Fig. 11.8 During exhalation, the tail bone is pulled toward the pubic bone. The lumbar spine flattens.



Fig. 11.17 Bouncing on a ball can be done in a corner to ensure that the ball does not roll away. The hands are clenched when the pelvic floor is contracted.

- Start as described above (Figs. 11.9–11.14), but this time move the left sitting bone in the direction of the right knee. As always, the knees and chest do not move. All the movement comes from the pelvis.
- The above exercises can be done with resistance by pushing the ball with the hand in the opposite direction to the movement of the pelvis (Fig. 11.15).
- The exercise can be done on the ball “cushion” if it cannot be done safely on a ball (Fig. 11.16).

Bouncing on the Ball

Bouncing increases the pressure exerted on the pelvic floor, and saying explosive words in addition increases intra-abdominal pressure similar to coughing and sneezing. Bouncing may also simulate jumping and running. The goal is to practice coordination of the pelvic floor activity with the activity of the pulmonary diaphragm and the abdominal and back muscles.



Fig. 11.18 Saying explosive words such as “kick” increases intra-abdominal pressure and therefore the challenge.

- Bounce gently and quickly, contracting the pelvic floor muscles to retrain the fast fibers.
- Breathe in and arch the back. Then exhale, grip the ball, pull it forward and bounce, lifting off the ball while contracting the pelvic muscles.
- Say explosive words, such as “kick” or “cool,” while lifting off the ball.

Note: For safety reasons the exercises should be done with the ball in a base, which is a flat dish in which the ball can roll (see Fig. 10.1), or in a corner to ensure that the ball does not roll away (Fig. 11.17). ■

Two People Sitting Back to Back on the Ball

Sitting back to back on the same ball provides the unique possibility to train the pelvic floor muscles eccentrically. One person pulls the ball



Fig. 12.7 Stretching the right iliopsoas muscle in side-lying position.

- with the thigh of the other leg by pushing the knee downward, extending the leg.
- Lie on the bent knee, face down. It is important that the buttock does not move away from the heel while the other leg lifts off the floor (Fig. 12.9). This stretch is difficult, as it demands a flexible iliopsoas and a strong buttock (gluteal) muscle, strong enough to lift the weight of the leg against the tightness of the iliopsoas.

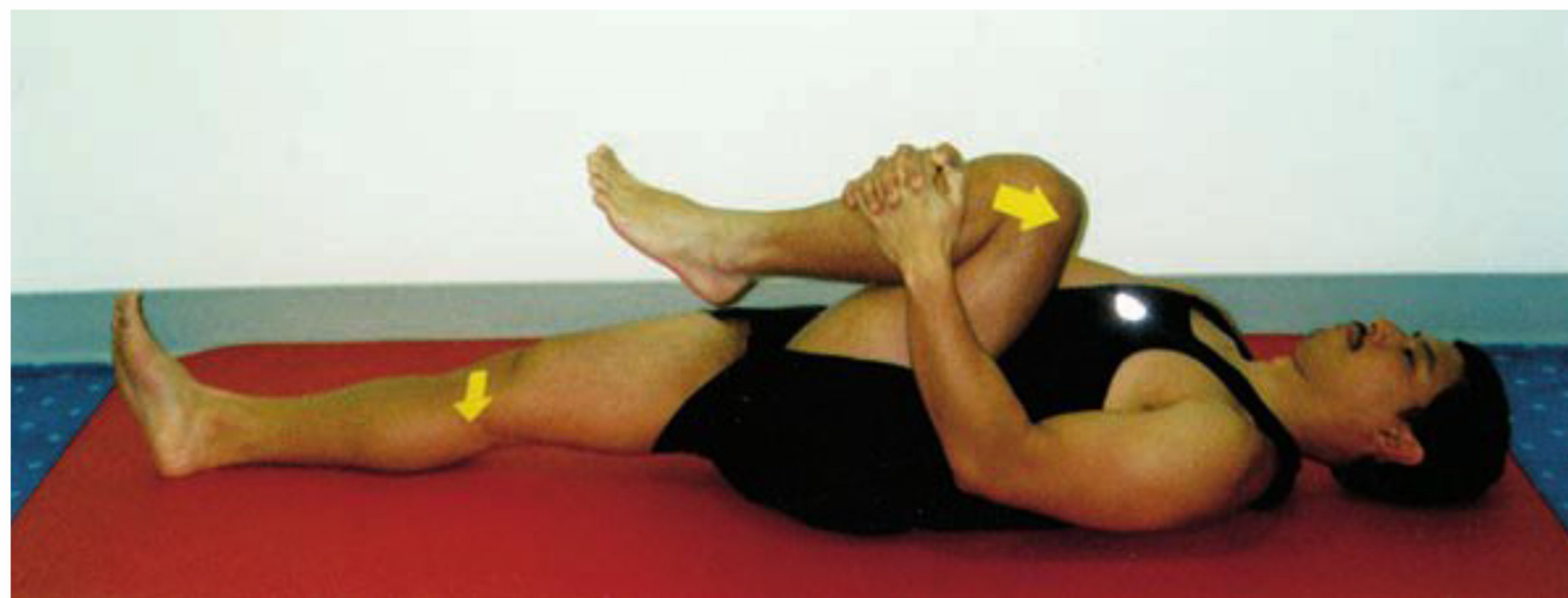


Fig. 12.8 Stretching of the right iliopsoas muscle while lying on the back. Arrows indicate direction of pull.



Fig. 12.9 The right buttock should maintain contact with the right heel when trying to lift the left leg. This stretch is difficult; it requires strong hip extensor muscles.

2 Layers of the Pelvic Floor

The pelvic floor can be viewed in three layers. Sometimes the third layer is described as two different layers because the deep transverse perineal muscle lies deeper than the other muscles of the urogenital diaphragm.

First Layer (Endopelvic Fascia)

The first layer is called the endopelvic fascia (Fig. 2.1). It is a lining made of a mesh of smooth muscle fibers, ligaments, nerves, blood vessels, and connective tissue; it supports and covers the bladder, the inner organs such as the intes-

tine, and the uterus in women. Some of the ligaments of the endopelvic fascia connect to the lumbar spine and the symphysis pubis. Even though this layer cannot be exercised, training the pelvic floor muscles of the second layer (pelvic diaphragm) can improve back pain by increasing support of the bladder and uterus from below and decreasing the strain on the ligaments on which the support otherwise depends. Strong pelvic floor muscles can help support the bladder, uterus, and rectum if a person has sustained tears of the endopelvic fascia through a difficult birth or other injury.

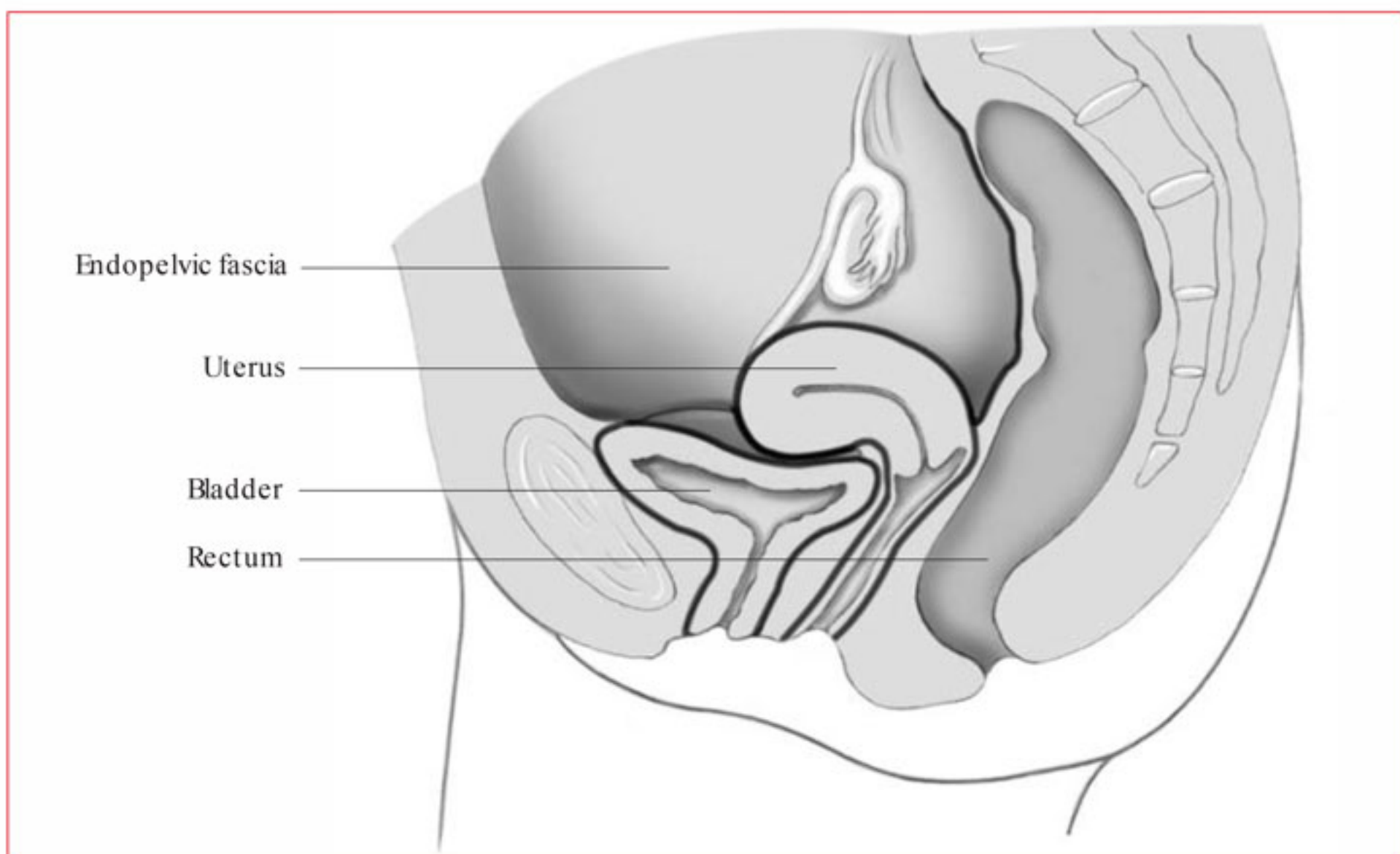


Fig. 2.1 First layer of the pelvic floor (endopelvic fascia; side view).