

# I ANATOMY PELVIC FLOOR & COLORECTAL

## OVERVIEW

### **Definition of pelvic floor**

From genitalia to organs, superior endopelvic supportive tissues  
3 layers of muscle, different muscles within each layer  
Intervening layers of fascia surrounding each muscle  
Fascial thickening = ligaments  
Endopelvic connective tissue surrounding all viscera

### **Functions of pelvic floor**

Support of the organs  
Sphincteric of the outlets (urethra, vagina, rectum) and openings (meatus, introitus, anus)  
Sexual – providing tone for the vaginal and rectal canals  
Stabilization  
“Sump Pump” Lymphatic

### **Terminology**

Confusing as to what specific anatomical reference  
Different disciplines emphasize different structures  
Changing – pubococcygeus is now the pubovesical

### **Mobility versus stability concept**

Organs and outlets need to expand and be mobile  
Too much mobility is prolapse or incontinence  
Too much fixation/stability is painful

The concept of organ mobility and stability is key to understanding dysfunctions of the pelvic floor. The organs are sacs that are meant to move, expand and empty. This is true for the bladder, uterus, vagina, rectum and colon. Should they not be able to expand fully because of fibrotic attachments, endometrial adhesions, tissue changes or scarring from surgery, the patient may present with symptoms of pressure, pain, constipation, urinary frequency, dyspareunia, urethral syndrome, to name but a few. Should the organs not be stabilized in their proper positions because of weakened or torn muscles and ligaments, problems such as prolapse, perineal pressure, pelvic heaviness, constipation and urinary retention may present. Thus, it is a fine balance of mobility and stability of the structures that maintains pelvic health.

## ANATOMY

### Origin and Insertions Pelvic Floor Muscle Divisions

Seen from below, the perineum is a diamond-shaped area, which can be subdivided into an anterior part, called the urogenital triangle, and a posterior part, called the anal triangle

**Urogenital Triangle- UGT** – Contains the superficial muscles of the perineal region known as FIRST LAYER

#### **Superficial Transverse Perineal Muscle**

- O: Ischial tuberosity and ramus
- I: Central perineal tendon = perineal body
- A: Stabilizes perineal body
- N: Pudendal nerve

#### **(Bulbospongiosus) Muscles Female**

- O: Central perineal tendon, travels under the labia
- I: Bulb of vestibule, perineal membrane, body of clitoris, and fascia of the corpus cavernosum of the clitoris
- A: Functions as a vaginal sphincter and assists in erection of the clitoris
- N: Pudendal nerve

#### **Bulbocavernosus (Bulbospongiosus) Muscles Male**

- O: Central perineal tendon, midline raphe
- I: Fascia of the bulb of the penis, corpus cavernosum and spongiosum
- A: Functions as compressor of the urethra, assists in penile erection and ejaculation
- N: Pudendal nerve

#### **Ischiocavernosus Muscle Female**

- O: Ischial tuberosity and ramus
- I: Crus of the clitoris
- A: Clitoral erection
- N: Pudendal nerve

#### **Ischiocavernosus Muscle Male**

- O: Ischial tuberosity and ramus
- I: Crus of the penis
- A: Maintains and assists with penis erection
- N: Pudendal nerve

### **Anal Triangle**

**External Anal Sphincter** (has subcutaneous, superficial and deep parts)

- O: Deep: Surrounds superior aspect of anal canal/Superficial: Surrounds lower part of anal canal/Subcutaneous: Surrounds anal aperture
- I: Perineal body and anococcygeal body
- A: Part of voluntary sphincter of anal cana, closes anal canal
- N: Pudendal nerve S2 and S3, direct branches directly from S4

**SECOND LAYER** -- Deeper portion of UGT -- enveloped by the superior and inferior fascia

**The Urogenital diaphragm (UGD)** consists of 3 layers:

1. an inferior layer of fascia, known as the perineal membrane;
2. a muscle layer, containing the sphincter urethrae (which acts as a voluntary sphincter for the urethra)
3. deep transverse perineal muscles; and a superior layer of fascia.

**The Perineal Membrane** – inferior fascia of the UGD

**Sphincter Urethra** -- Circular fibers of the trigonal ring when present make up the somatic fibers of the “internal sphincter” of the urethra

- O: Inferior pubic arch
- I: Blends with the anterolateral walls of the vagina and into the trigonal ring surrounding the urethra
- A: Constricts the urethra
- N: Perineal branches of pudendal nerve

**Components of the Sphincter Urethra – External Sphincters**

**Urethrovaginal Sphincter** – Surrounds the urethra and vagina as a unit

- O Perineal body
- I: Ventral surface of the urethra.
- A: Compresses the ventral wall and assists in the continence mechanism
- N: Perineal branches of the pudendal

**Compressor Urethrae (in women only)**

- O: Ischiopubic ramus on each side
- I: Blends with partner muscle (on other side) anterior to urethra
- A: Compresses the ventral wall and assists in the continence mechanism
- N: Perineal branches of pudendal nerve

**Deep Transverse Perineal**

- O Medial surface of the rami of the ischium
- I: Perineal body, runs across to attach to opposite side
- A: Aids in stabilizing the perineal body
- N: Perineal branches of pudendal nerve

UGT and UGD **innervated by the pudendal nerve** 3 branches in the superficial and deep layers

1. Dorsal nerve of the clitoris or penis
2. The perineal branch
3. The inferior hemorrhoid nerve or inferior rectal

## THIRD LAYER

**Levator ani** group muscle group consists of the following muscles

Innervation: direct branches of the sacral plexus S2, S3, **S4** (pudendal nerve, levator ani nerve)

### **Pubococcygeus (Pubovisceral, Pubovaginalis)**

- O: Dorsal surface of the pubic bone and fascia of the obturator internus.
- I: Anococcygeal body, between the tip of the coccyx and the anal canal.
- A: Supports the pelvic viscera

### **Puborectalis**

- O: Dorsal surface of the pubic bone and fascia of the obturator internus.
- I: Anococcygeal body, sling around junction of rectum and anal canal
- A: Voluntary sphincter of the anal canal.

### **Iliococcygeus – Posterior and lateral fibers of levator ani**

- O Arcus tendinous levator ani (a fibrous band suspended between the pubic bone and ischial spine).
- I: Anococcygeal body and the coccyx.
- A: Support of viscera and lateral coccyx

**Pelvic Diaphragm** = two PF muscles , two LE muscles

### **Coccygeus (Ischiococcygeus) –not in levator ani group**

- O: Ischial spine and the pelvic (anterior) surface of sacrospinous ligament
- I: On the lateral margin of coccyx and lower sacrum
- A: Flexes the coccyx, supports pelvic viscera, and stabilizes the sacroiliac joint.
- N: Branches from anterior rami of S3 and S4

### **Levator ani listed above**

### **Piriformis – muscle separates the superior and inferior gluteal vessels and nerves**

- O: Pelvic (anterior) surface of the sacrum, passes through the greater sciatic foramen.
- I: Medial side of the superior border of the greater trochanter of the femur.
- A: Lateral hip rotator – assist with abduction if the hip is flexed
- N: Branches of L5, **S1**, S2

### **Obturator Internus – join with gemelli as muscles inferior to sciatic nerve**

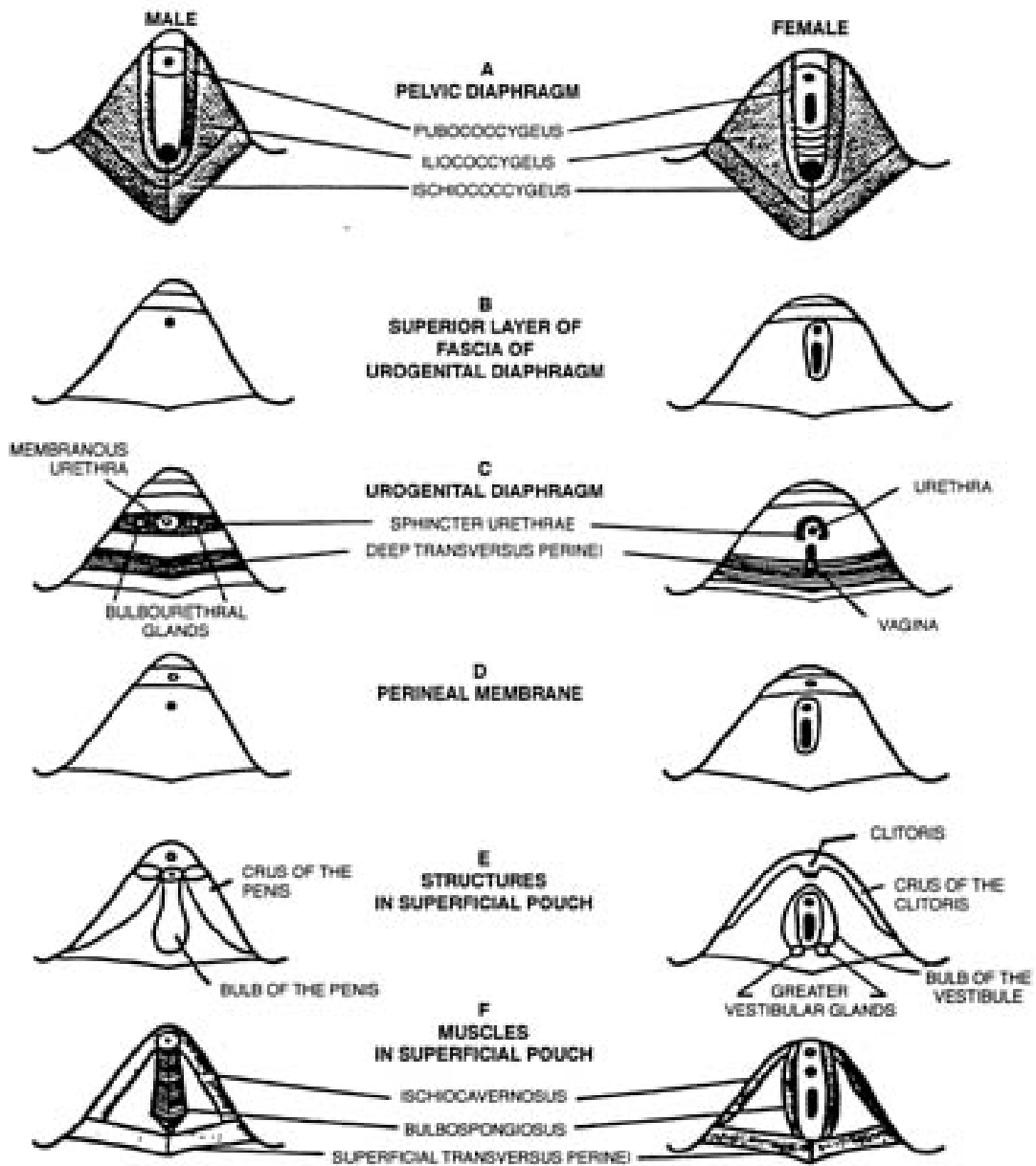
- O: Internal or pelvic surface of the obturator foramen,
- I: Medial surface of the greater trochanter of the femur proximal to the trochanteric fossa.
- A: Lateral hip rotator – assist with abduction if the hip is flexed
- N: Nerve to obturator internus L5,**S1**

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Schematic diagrams summarizing the contents of the urogenital triangle in male and female. Displayed A is the deepest to F most superficial . (From: Moore, Clinically Oriented Anatomy, Fig. 3-16, p. 309.)



## ANAL AND RECTAL ANATOMY

### Anal Triangle

- A. The anal region contains the anal orifice (anus), the anal canal, the internal and external anal sphincters, the ischioanal fossa and the pudendal canal.
- The boundaries of the anal triangle are:
    - posteriorly – coccyx, the sacrotuberous ligament and gluteus maximus
    - anteriorly – a line joining the ischial tuberosities and superficial transverse perineal muscle
  - The perineal skin contains:
    - large sebaceous glands
    - large sweat glands
    - pigmentation
    - skin folds produced by the pull of the underlying fibroelastic septa
  - The anal canal is:
    - three cm long
    - extends posteroinferiorly from the distal end of the rectum
    - contains anal columns with mucosal folds, anal valves, anal sinuses with branches of the superior rectal vein sites for internal hemorrhoids, whereas external hemorrhoids are varicosities of the inferior rectal veins
    - the nerve supply of the anal canal superior to the pectinate line is the same as the rectum, the sympathetic nerves pass along the inferior mesenteric and superior rectal arteries, the parasympathetics are from S2-S4 and run in the pelvic splanchnic nerves to join the inferior hypogastric plexus, it is sensitive only to stretching, inferior to the pectinate line are the inferior rectal branches of the pudendal nerve, it is sensitive to pain, touch and temperature
  - The internal anal sphincter is
    - formed from the inner circular muscular layer of the inferior anal canal
    - an involuntary sphincter
    - the internal anal sphincter relaxes when it is stimulated by the parasympathetic nerves supplying it
  - The external anal sphincter is
    - under voluntary control
    - surrounds the inferior end of the canal
    - forms a band 2-3 cm wide on each side of the canal
    - attaches to the perineal body and to the anococcygeal ligament
    - consists of three parts:
      - subcutaneous – surrounds the anus anteriorly and posteriorly with no bony attachments
      - superficial – fibers extend from the tip of the coccyx and anococcygeal ligament to the perineal body mooring the anus to the median plane

- (3) deep – surrounds the canal with fibers joining the opposite superficial transverse perineal muscle, and fibers from the perineal body fusing with puborectalis muscle (Table 2)
    - innervated by the perineal branch of the 4<sup>th</sup> sacral and inferior rectal nerves
    - closes the anus
    - draws the canal anteriorly increasing the anorectal angle to maintain fecal continence
6. The boundaries of the ischioanal fossa are:
    - laterally by the ischium and inferior part of the obturator internus muscle
    - medially by the rectum and anal canal, levator ani and external anal sphincter
    - posteriorly by the sacrotuberous ligament and gluteus maximus muscle
    - anteriorly by the urogenital diaphragm
  7. The ischioanal fossa contains:
    - soft fat to support the anal canal
    - internal pudendal vessels and nerves
    - branches of the second and third sacral nerves
    - perineal branch of the fourth sacral nerve
  8. The pudenda canal is a fibrous tunnel on the lateral wall of the ischioanal fossa containing:
    - inferior pudendal artery
    - inferior pudendal vein
    - pudendal nerve which innervates most of the perineum with branches of the
      - (1) perineal nerve which innervates the urogenital diaphragm and labia
      - (2) dorsal nerve of the clitoris or penis which is a sensory nerve to those structures

## B. Rectum

1. Continuous with the sigmoid colon it begins at the level of S3 and extends for twelve cm following the curve of the sacrum and coccyx to end as the anal canal
2. The puborectalis muscle forms a sling at the junction of the rectum and anal canal
3. Posteriorly it rests on the inferior three sacral vertebra, the coccyx, the anococcygeal ligament, inferior ends of the sympathetic trunks and superior rectal artery
4. Anteriorly in the female the rectum is separated from the vagina by the rectouterine pouch (Douglas) and the rectovaginal septum
5. Blood is supplied by five rectal arteries: one superior, two middle and two inferior
6. The nerve supply is derived from the sympathetic and parasympathetic systems
  - numerous branches from the inferior hypogastric plexus



- parasympathetics from the second, third and fourth sacral nerves which in the pelvic splanchnic nerves to join the inferior hypogastric
- sensory nerves follow the parasympathetics, with stimulation by distention of the wall of the rectum

C. Anorectal angle

1. Angle formed between the axis of the rectum and the anal canal
2. Normally it is 80-100 degrees
3. Varies depending on the strength of the puborectalis relaxation of the muscle or position of the pelvis
  - squatting increases the anorectal angle
  - hip flexion past 90 degrees increases the angle
  - voluntary muscle relaxation increases the angle >100
  - weakness of the muscle can increase the angle >100
4. Angle is maintained by the puborectalis sling
5. A strong muscle usually means a normal angle
6. A weak muscle can mean a larger angle and descended perineum
7. Patients with fecal incontinence often have a large angle

### ANAL TRIANGLE

Muscle	Origin	Insertion	Action
External anal sphincter 1. subcutaneous 2. superficial 3. deep	puborectalis muscle, perineal body	anococcygeal ligament	compresses anal canal
Internal anal sphincter	perineal body, inner circular muscular layer of the anal canal	coccyx	compresses anal canal; relaxes and opens the anal canal

## O1 Colorectal Anatomy

### Contents – Anal Triangle

- . Anal orifice
- . Anal canal
- . Internal sphincter
- . External sphincter
- . Ischiorectal fossa
- . Pudendal canal

### Anal Triangle

#### Anal triangle

#### Superficial

- . EAS
- . Ischiorectal / ischioanal fossa
- . Deep
  - Sacrotuberous ligament
  - Levator ani muscles

#### Ischiorectal Fossa

- . Fat for cushioning
- . Continence
- . Excursion of the pelvic floor muscles –
- . Lateral walls-
  - Alcock's canal
  - Pudendal nerve and vessels

### Boundaries

- . The boundaries of the anal triangle are
- . posteriorly - coccyx, the sacrotuberous ligament and gluteus maximus
- . anteriorly -a line joining the ischial tuberosities and superficial transverse perineal muscle

### Skin

- . The perianal skin contains
- . large sebaceous glands
- . large sweat glands
- . pigmentation
- . skin folds produced by the pull of the underlying fibroelastic septa

### Anal Canal

- . three (3) cm long
- . extends posteroinferiorly from the distal end of the rectum
- . contains anal columns with mucosal folds, anal valves, anal sinuses with branches of the superior rectal vein sites for internal hemorrhoids, whereas
- . external hemorrhoids are varicosities of the inferior rectal veins

### Nerves

- . the nerve supply of the anal canal superior to the pectinate line is the same as the rectum
- . the sympathetic nerves pass along the inferior mesenteric and superior rectal arteries

- . the parasympathetics are from S2-S4 and run in the pelvic splanchnic nerves to join the inferior hypogastric plexus

### **Innervation**

- . Superior to the pectinate line the anal canal is sensitive only to stretching
- . inferior to the pectinate line are the inferior rectal branches of the pudendal nerve
- . it is sensitive to pain, touch and temperature

### **Sphincters – Internal**

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- . formed from the inner circular muscular layer of the inferior anal canal
- . an involuntary sphincter
- . the internal anal sphincter relaxes when it is stimulated by the parasympathetic nerves supplying it

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- . surrounds the inferior end of the canal
- . forms a band 2-3 cm wide on each side of the canal
- . attaches to the perineal body and to the anococcygeal ligament
- . consists of three parts

### **Sphincters – External**

- . subcutaneous – surrounds the anus
- . anteriorly and posteriorly with no bony attachments
- . superficial – fibers extend from the tip of the coccyx and anococcygeal ligament to the perineal body mooring the anus to the median plane
- . deep – surrounds the canal with fibers joining the opposite superficial
- . transverse perineal muscle, and fibers from the perineal body fuse with puborectalis muscle

### **Sphincters**

- . innervated by the perineal branch of the 4th sacral and inferior rectal nerves
- . closes the anus
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### **Ischiorectal Fossa**

- . The boundaries of the ischiorectal fossa are
- . laterally by the ischium and inferior part of the obturator internus muscle
- . medially by the rectum and anal canal, levator ani and external anal sphincter
- . posteriorly by the sacrotuberous ligament and gluteus maximus muscle
- . anteriorly by the urogenital diaphragm

### **Ischiorectal Fossa**

- . The ischiorectal fossa contains
- . soft fat to support the anal canal and close it
- . internal pudendal vessels and nerves
- . branches of the 2nd & 3rd sacral nerves
- . perineal branch of the 4th sacral nerve

## **Rectum**

- Continuous with the sigmoid colon it begins at the level of S3 and extends for twelve (12) cm following the curve of the sacrum and coccyx to end as the anal canal

## **Puborectalis**

- The puborectalis muscle forms a sling at the junction of the rectum and anal canal

## **Innervations of the Levator ani muscles**

- Sacral nerve roots (S3-S5) on the superior surface of the pelvic floor Levator ani nerve Barber
- NOT innervated by the Pudendal nerve

## **Rectum**

- Posteriorly it rests on the inferior three sacral vertebra, the coccyx, the anococcygeal ligament, inferior ends of the sympathetic trunks and superior rectal artery

## **Rectum**

- Anteriorly the rectum is separated from the vagina by the rectouterine pouch (Douglas) and the rectovaginal septum

## **Rectum**

- Blood is supplied by five (5) rectal arteries: superior, two (2) middle and two (2) inferior

## **Innervation**

- The nerve supply is derived from the sympathetic and parasympathetic systems
- numerous branches from the inferior hypogastric plexus
- parasympathetics from the 2nd, 3rd and 4th sacral nerves which in the pelvic splanchnic nerves to join the inferior hypogastric
- sensory nerves follow the parasympathetics, with stimulation by distention of the wall of the rectum

## **Anorectal Angle**

- Anorectal angle
- Angle formed between the axis of the rectum and the anal canal
- Normally it is 80-100 degrees

## **Anorectal Angle**

- Varies depending on the strength of the puborectalis
- relaxation of the muscle or position of the pelvis
- squatting makes the anorectal angle bigger
- hip flexion past 90 degrees increases the angle
- voluntary muscle relaxation increases the angle
- weakness of the muscle can increase the angle

## **Ano-rectal Angle – normal vs abnormal**

## **Flap Valve Mechanism**

- The flap valve mechanism explains the functional significance of the anorectal angle

**Flap Valve Mechanism**

- When the angle is normal, increases in intraabdominal pressure are transferred to the anterior aspect of the rectum, closing the canal and maintaining continence
- When the anorectal angle is larger, increases in the intra-abdominal pressure open the valve and push the contents of the rectum into the anal canal

**Rectocele**

- Feces pushed out by the puborectalis at a point in the canal, can not do the work if weakness present and also a rectocele present
- Hemorrhoids from straining a result
- [www.womenshealthmatters.ca/.../Rectocele1.gif](http://www.womenshealthmatters.ca/.../Rectocele1.gif)