**Objectives:**
- To name the hormone critical to development of the male and female external genitalia
- To describe the formation of the male and female external genitalia
- To list the homologous structures of the male and female external genitalia

**External Genitalia**

**Indifferent Stage**

In the third week of development, mesenchyme cells originating in the region of the primitive streak migrate around the cloacal membrane to form a pair of slightly elevated cloacal folds. Cranial to the cloacal membrane the folds unite to form the **genital tubercle**. Caudally the folds are subdivided into urethral folds anteriorly and anal folds posteriorly.

Another pair of elevations, the **genital swellings**, becomes visible on each side of the urethral folds. These swellings later form the **scrotal swellings** in the male and the **labia majora** in the female. At the end of the 6th week, however, it is impossible to distinguish between the two sexes.

**External Genitalia in the Male**

**(phallus)**

Development of the external genitalia in the male is under the influence of androgens secreted by the fetal testes and is characterized by rapid elongation of the genital tubercle, which is now called the **phallus**. During this elongation, the phallus pulls the urethral folds forward so that they form the lateral walls of the urethral groove. This groove extends along the caudal aspect of the elongated phallus but does not reach the most distal part, the glans. The epithelial lining of the groove, which originates in the endoderm, forms the **urethral plate**.

At the end of the third month, the two urethral folds close over the urethral plate, forming the **penile urethra**. This canal does not extend to the tip of the phallus. The most distal portion of the urethra is formed during the 4th month. Ectodermal cells from the tip of the glans penetrate inward and form a short epithelial cord. This cord later obtains a lumen, thus forming the external urethral meatus. The genital swellings, known in the male as the scrotal swellings, **arise in the inguinal region**. They move caudally, and each swelling then makes up half of the scrotum. The two are separated by the **scrotal septum**.

**Defects in the Male Genitalia**

**(Hypospadias)**

In Hypospadias, fusion of the urethral folds is incomplete, and abnormal openings of the urethra occur along the inferior aspect of the penis, usually near the glans, along the shaft, or near the base of the penis. In rare cases, the urethral meatus extends along the scrotal raphe. The incidence of hypospadias is doubling over the past 15 to 20 years. Reasons for the increase are not known, but one hypothesis suggests it could be a result of a rise in environmental estrogens.

**(Epispadias)**
It is a rare abnormality in which the **urethral meatus is found on the dorsum of the penis**. Although epispadias may occur as an isolated defect, it is most often **associated with extrophy of the bladder**. In extrophy of the bladder, the bladder mucosa is exposed to the outside. Normally, the abdominal wall in front of the bladder is formed by primitive streak mesoderm, which migrates around the cloacal membrane. When this migration does not occur, rupture of the cloacal membrane extends cranially, creating extrophy of the bladder. **Micropenis** occurs when there is insufficient androgen stimulation for growth of the external genitalia. Micropenis is usually caused by primary hypogonadism or hypothalamic or pituitary dysfunction. **Bifid penis (double penis)** may occur if the genital tubercle splits.

### External Genitalia in the Female

Estrogens stimulate development of the external genitalia of the female. The **genital tubercle** elongates only slightly and forms the **clitoris**. **Urethral folds** do not fuse, as in the male, but develop into the **labia minora**. **Genital swellings** enlarge and form the **labia majora**. The urogenital groove is open and forms the **vestibule**. Although the genital tubercle does not elongate extensively in the female, it is larger than in the male during the early stages of development. In fact, using **tubercle length** as a criterion (as monitored by ultrasound) has resulted in mistakes in identification of the sexes during the third and fourth months of gestation.

### Descent of the gonads

Both male and female gonads descend from the 10th thoracic level. Females descend less than males. In Males there are 3 phases of the descent: 1) Caudal displacement due to regression of the mesonephric kidneys, 2) Transabdominal descent to the Inguinal ring caused by regression of the Mullerian ducts, 3) Transinguinal descent into the scrotum guided by the gubernaculum into the scrotal swellings.

### Descent of the Testes

Toward the end of the second month, the **urogenital mesentery** attaches the testis and mesonephros to the posterior abdominal wall. With **degeneration of the mesonephros**, the attachment serves as a mesentery for the gonad. **Caudally, it becomes ligamentous** and is known as the **caudal genital ligament**. Also extending from the **caudal pole of the testis** is a mesenchymal condensation rich in extracellular matrices, the **Gubernaculum**. **Prior to descent of the testis**, the Gubernaculum **terminates in the inguinal region** between the differentiating internal and external abdominal oblique muscles. Later, **as the testis begins to descend** toward the inguinal ring, an extra-abdominal portion of the gubernaculum forms and **grows from the inguinal region toward the scrotal swellings**.
When the testis passes through the inguinal canal, this extra-abdominal portion contacts the scrotal floor (the gubernaculum forms in females also, but in normal cases it remains rudimentary).

— Normally, the testes
* reach the inguinal region by approximately 12 weeks' gestation,
* migrate through the inguinal canal by 28 weeks, and
* reach the scrotum by 33 weeks.
  — The process is influenced by hormones, including androgens.
  — During descent, blood supply to the testis from the aorta is retained, and testicular vessels extend from their original lumbar position to the testis in the scrotum.

— Processus vaginalis
  — Independently from descent of the testis, the peritoneum of the abdominal cavity forms an evagination on each side of the midline into the ventral abdominal wall.
  — This evagination, the Processus vaginalis, follows the course of the gubernaculum testis into the scrotal swellings.
  — Hence the processus vaginalis, accompanied by the muscular and fascial layers of the body wall, evaginates into the scrotal swelling, forming the Inguinal canal.
  — The testis is present in the scrotum at birth.
  — It is then covered by a reflected fold of the processus vaginalis
    1. The peritoneal layer covering the testis is the visceral layer of the tunica vaginalis;
    2. the remainder of the peritoneal sac forms the parietal layer of the tunica vaginalis
  — The narrow canal connecting the lumen of the vaginal process with the peritoneal cavity is obliterated at birth or shortly thereafter.
  — In addition to being covered by peritoneal layers derived from the processus vaginalis, the testis becomes ensheathed in layers derived from the anterior abdominal wall through which it passes.
    — the transversalis fascia forms the internal spermatic fascia
    — the internal abdominal oblique muscle gives rise to the cremasteric fascia and muscle, and
    — the external abdominal oblique muscle forms the external spermatic fascia
  — The transversus abdominis muscle does not contribute a layer, since it arches over this region and does not cover the path of migration.

— Clinical Correlates
— Hernias and Hydrocele
  — The connection between the abdominal cavity and the processus vaginalis in the scrotal sac normally closes in the first year after birth.
  — If this passageway remains open, intestinal loops may descend into the scrotum, causing a congenital inguinal hernia.
  — Sometimes obliteration of this passageway is irregular, leaving small cysts along its course. Later these cysts may secrete fluid, forming a hydrocele of the testis and/or spermatic cord.

— Cryptorchidism
  — In 97% of male newborns, testes are present in the scrotum before birth.
  — In most of the remainder, descent will be completed during the first 3 months postnatally. However, in less than 1% of infants, one or both testes fail to descend. The condition is called Cryptorchidism and may be caused by decreased androgen (testosterone) production.
The undescended testes fail to produce mature spermatozoa and the condition is associated with a 3% to 5% incidence of renal anomalies.

**Descent of the Ovaries**

- Descent of the gonads is considerably less in the female than in the male, and the ovaries finally settle just below the rim of the true pelvis.
- The cranial genital ligament forms the suspensory ligament of the ovary
- The caudal genital ligament forms
  1. the ligament of the ovary proper and
  2. the round ligament of the uterus which extends into the labia majora.

- Thank you
- Next lecture: Eye