14. MALE GENITAL ANATOMY: Scrotum, penis, prepuce, coronal sulcus, frenulum, glans penis, navicular raphe, external urethral meatus, Hart's line

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The male genitalia are the penis, the scrotum (fused scrotal sacs) which contains the testes and the genital raphe.

Development of the male genitalia:

Scrotum:

The walls of the scrotal sacs are derived from the scrotal folds (ectoderm and underlying mesoderm). The median septum of the scrotum is the elongated septum between the bulbar raphe and the tendinous raphe of the bulbospongiosus muscle and median sulcus of the corpus spongiosum.

Penis:

The penis is pendulous organ derived from the genital swelling which consists of the genital fold and genital tubercle. The *genital fold* (ectoderm and underlying mesoderm) gives rise to the skin and coverings of the penis, and epithelium and lamina propria) of the glans penis.
The *genital tubercle* (mesoderm) forms the pendulous *body of the penis* which contains the phallic parts of the bicavernosal body (fused corpora cavernosa), corpus spongiosum of the penile urethra), dorsal plate of the fossa navicularis, fossa navicularis (endoderm), and spongy tissue of the glans penis.

Genital raphe:

The *genital raphe* (ectoderm supported by a layer of mesoderm), develops by postero-anterior ventral midline *fusion of the urogenital/vestibular/urethral folds* (except the distal ends of the folds), to form the scrotal raphe, penile raphe, the frenulum, and navicular raphe.

The *distal ends* of the urogenital/ vestibular/urethral folds, remain *unfused*, and develop the labia and *dorsal commissure* of the labia, of the glans penis (external urethral meatus).

Reflections of scrotal fold and fused urogenital folds:

In the ventral midline, the *scrotal walls*, (scrotal folds), reflect on the *scrotal raphe* (fused urogenital/vestibular/urethral folds).

Reflections of genital fold, and <u>fused</u> urogenital/vestibular/urethral fold:

In the ventral midline, *the genital fold reflects on the fused urogenital fold as follows:*

- penile skin reflects on the lateral borders of the penile raphe and preputial raphe.
- coronal sulcus skin reflects on the outer layers of the frenulum.
- glans penis skin, reflects on the lateral borders of the navicular raphe.

Reflections of the genital fold and <u>unfused</u> urogenital/vestibular/urethral folds (external urethral meatus):

- *epithelium of the anterior/distal borders of wings of glans penis* (genital fold), reflects on *outer layers of the labial folds* (urogenital fold) of the glans penis.
- *epithelium at the ventral point of the crescentic cap of the glans penis* (genital fold), reflects on the outer layer of the dorsal commissure of the labial folds (urogenital fold).

Anatomy of the male genitalia:

Scrotum:

Origin: the scrotum develops from scrotal folds, that form lateral and ventral, to the genital swelling. The median septum that divides the scrotum into separate scrotal sacs, is derived from midline fusion of mesoderm in the urogenital fold. The scrotal folds reflect on the lateral borders of the *scrotal raphe* (bulbar raphe), derived from the fused vestibular/urethral fold.

The scrotum is a prominent pouch in the perineum on either side of, and posterior to, the penis. Anatomically, the scrotum is divided into the scrotal wall, scrotal septum, and scrotal raphe.

The *walls of the scrotum* consist of epithelium, dermis, and subdermal condensation of tissue rich in smooth muscle fibers, called *dartos fascia* which confers rugosity to the scrotal skin. In the penis, dartos fascia is represented by a thin layer of subcutaneous tissue.
Deep to dartos fascia is a layer or *areolar tissue*, continuous with the fatty Camper's fascia (superficial layer of superficial fascia) of the abdomen, superficial fascia of the perineum, and areolar layer of the penis (containing the superficial veins of the penis).
The areolar layer lies on *Colles' fascia*, which is fibrous tissue layer, continuous with Scarpa's fascia (deep layer of superficial fascia) of the abdomen, Colles' fascia in the perineum, and Buck's fascia (deep fascia) of the penis.
A layer of loose areolar tissue separates the scrotal wall from the c*overings of the spermatic cord and testes*, formed by external spermatic fascia (from aponeurosis external oblique muscle), cremaster muscle (from internal oblique muscle), and internal spermatic fascia (from transversalis fascia).

The scrotal septum is a median condensation of areolar tissue that divides the scrotum into dual sacs, each containing the ipsilateral testis. The scrotal septum joins the *scrotal raphe* to the *tendinous raphe of the bulbocavernosus muscle* and *median sulcus* between the hemispheres of the *bulbar urethral segment of the corpus spongiosum.*

Reflections of the scrotum:
The upper borders of the scrotal sacs blend with the lower borders of the *mons pubis*.
The penis emerges from the upper ends of the medial borders of the scrotal sacs.
The upper parts of the lateral borders reflect on the groin and lower abdomen.
The lower parts of the lateral borders reflect on the sulcus of the thigh.
The posterior borders of the scrotal sacs reflect on the perineum, which is divided into right and left sides, by the perineal (anogenital) raphe.
The flaccid penis, rests on the anterior surface of the scrotum.
In the midline, the medial borders of the scrotal sacs reflect on the scrotal raphe.
The medial borders of the scrotal sacs reflect on the *scrotal raphe*.

The *scrotal raphe*, derived by fusion of the vestibular/urethral folds, is separated from the *corpus spongiosum of the bulbar urethra*, by the median septum of the scrotum.

Penis:
The penis is the male genital organ involved in urination and reproduction. Penis consists of the root of the penis, and the phallus or pendulous part of the penis. The *phallus* emerges from the perineum, below the *mons pubis,* and between the *upper ends of the scrotal sacs*.
Penile length and circumference are variable. Flaccid length 5-15cm, (average 8cm); erect length 5-25cm, (average 14cm). Average flaccid circumference 8cm, erect 12cm.

Development of phallus:
Genital swelling forms the phallus. The genital swelling consists of the genital fold (ectoderm) and genital tubercle (mesoderm) and phallic segments of the urogenital folds.
Genital fold forms the *epithelium* of penile shaft, prepuce, and coronal sulcus. Mesoderm under the genital fold forms, the *cover*ings of the body of the penis.
Genital tubercle contains, the bicavernosal body, corpus spongiosum and penile urethra, fossa navicularis, dorsal plate of fossa navicularis a derivative of corpus spongiosum which generates glans penis.
Urogenital/vestibular/labial folds.
Proximal *fused urogenital/vestibular/urethral folds*, form the penile and preputial raphe, and frenulum.
Distal *unfused urogenital/vestibular/urethral folds*, form labia of glans penis (external urethral meatus).

Anatomy of the perineal and pendulous parts of the penis

- perineal part or root of the penis.
- phallus or pendulous part of the penis.

Perineal part of the penis: *Root of penis.*
- *crura of corpora cavernosa, attached to medial aspects of ischiopubic rami*
- *bulbar segment of corpus spongiosum, adherent to undersurface of perineal membrane, encloses bulbar urethra.*

Pendulous part of penis: *Phallus or shaft of penis.*
*B*ody of penis, glans penis, labia of glans penis (external urethral meatus)
*Coverings of the penile shaft: c*overings of the body, glans, and labia of the glans penis.
Phallic segments of urogenital raphe: penile raphe, preputial raphe, frenulum, navicular raphe.

Body of penis:
- *bicavernosal body of the penis enclosed in tunica albuginea.*
- *corpus spongiosum (and penile urethra), enclosed in tunica albuginea.*

Glans penis:
- dorsal plate (from corpus spongiosum) adherent to roof of tubular fossa navicularis.
- crescentic cap, over conical end of bicavernosal body.
- roof, on top and lateral aspects of bicavernosal body.
- wings, wrap around the sides, and floor (except in the midline) of fossa navicularis.
- navicular raphe, ventral to fossa navicularis.

Labia of glans penis, (external urethral meatus):
- epithelium of inner and outer layers of labia and dorsal commissure of glans penis.
- minute filling of mesenchyme in labia and dorsal commissure of the glans.

C*overings of the body of the penis:*
- *skin* of the penile shaft, prepuce, and coronal sulcus.
- subdermal layer *(dartos fascia)*.
- *loose areolar tissue* continuous with, Camper's fascia of abdomen, loose areolar tissue of scrotum, and superficial fascia of perineum.
- deep fascia (Buck's fascia).

Covering of glans penis:
-epithelium of glans penis

Coverings of labia of glans penis (external urethral meatus):
-epithelium of inner and outer layers of labia of glans penis.

Phallic segments of urogenital raphe:
Scrotal raphe joins penile raphe.
- penile raphe, ventral to penile urethra proximal to coronal sulcus.
- preputial raphe, is part of the penile raphe.
- frenulum, ventral to penile urethra in coronal sulcus.
- navicular raphe, ventral to fossa navicularis.

Epithelial reflections of phallus:
Ventral aspect of the phallus, epithelium of the penile shaft reflects on lateral borders of *penile raphe* and preputial raphe, and lateral surfaces of the *frenulum.*
Ventral aspect of the glans penis, epithelium of the *ventral borders of the wings* of the glans, reflects on the lateral borders of the *navicular raphe*.
Labia of gland penis: Epithelium of the distal/anterior borders of the wings of the glans penis, reflects on the proximal/posterior borders of the *outer layers of the labia* of the glans penis. Epithelium of the *inner layers of the labia* of the glans penis, meets mucosa of the fossa *navicularis*, at *Hart's line*.

Prepuce:
Origin: Genital fold, and urogenital folds, proximal to *coronal sulcus.*

The prepuce is a *double layered cone-shaped fold* of penile skin and the penile raphe. The base of the prepuce and preputial raphe begins circumferentially at the proximal border of the coronal sulcus, and extends distally, to cover the coronal sulcus and most or all the glans penis. The prepuce may extend a variable distance beyond the glans penis and ends in a narrowing. The opening at the end of the cone-shaped prepuce is the *preputial orifice*. At the preputial orifice the outer layer of the prepuce tuns inwards to become the inner layer of the prepuce and the preputial raphe on the outer layer continues as the preputial raphe of the inner layer.

The *inner layer of the prepuce* is in contact with the *glans penis and the coronal sulcus.*
The *cone shaped potential space* between the inner layer of the prepuce, and the coronal sulcus and glans penis, is called the *preputial sac. In the recess of the preputial sac, the prepuce reflects on the coronal sulcus, and the preputial raphe, joins the frenulum of the penis.*

When the prepuce is normally extended, the glans penis and a narrowing behind the glans is discernible. The apparent narrowing of the shaft of the penis, called the *neck of the penis*, is the the coronal sulcus, *behind the corona of the glans penis*.

The preputial raphe:
The preputial raphe, a continuation of the penile raphe, runs distally on the outer layer of the prepuce, makes a U-turn at the preputial orifice, and runs proximally on the inner layer of the prepuce. In the preputial recess, the preputial raphe joins the frenulum. The short anterior free border of the frenulum joins the preputial raphe on the inner layer of the prepuce, to the navicular raphe on the ventral aspect of the glans penis.

Reflection of the inner layer of the prepuce on the coronal sulcus:
On either side of the frenulum, epithelium of the *inner layer of the prepuce*, reflects circumferentially on epithelium of the *coronal sulcus.*

Frenulum:
Origin: The frenulum is a quadrilaminar membrane, formed by postero-anterior midline fusion of the vestibular/urethral folds, ventral to corpus spongiosum and penile urethra, in the coronal sulcus.

The *frenulum,* tethers the inner layer of the prepuce to the coronal sulcus, including its V-shaped extensions along the forwardly curved posterior borders of the corona of the glans penis. In the coronal sulcus, the frenulum is barely separated from the corpus spongiosum enclosing the penile urethra, by a minute amount of areolar connective tissue.

The frenulum is roughly *triangular.* It has two attached borders which meet at an acute angle in the recess of the preputial sac, and a short anterior free border.

Anatomy of the frenulum with the prepuce normally <u>extended over the glans penis</u>:
In the *r*ecess of the preputial sac, one *fixed border* of the frenulum is attached to the *inner layer of the prepuce*, and the other *fixed border* is attached to the coronal sulcus, ventral to the corpus spongiosum and penile urethra.
The *short vertical free border* of the frenulum joins the *coronal sulcus end of the preputial raphe* on the inner surface of the prepuce, to the *posterior end of the navicular raphe,* at the *apices of the V-shaped spaces of the coronal sulcus,* between the forwardly curved posterior borders of the glans penis.

Anatomy of the frenulum with the <u>prepuce</u> <u>retracted</u>, behind the coronal sulcus:
The frenulum occupies the *obtuse angle* between the inner layer of the prepuce and coronal sulcus. The *stretched, free border* of the triangle, oriented *horizontally*, joins the *coronal sulcus end of the preputial raphe* (on the inner layer of the prepuce), to the *posterior end of the navicular raphe.*

Coronal sulcus:
Origin: Epithelium (ectoderm) of the genital fold, between the origin of the preputial fold, and posterior border of the roof and wings (corona) of the glans penis, on either side of the frenulum (fused urogenital/vestibular/urethral folds.

The *coronal sulcus* is also called the *neck of the penis, because of the* apparent narrowing of the phallus *behind the prominent corona* of the glans penis.
The circumferential coronal sulcus is interrupted in the *ventral midline* by the frenulum.
On each side of the frenulum, the coronal sulcus has a V-shaped extension between the frenulum and the forwardly curved posterior borders of the wings of the glans penis. Between the apices of the V-shaped spaces of the coronal sulcus, the distal end of the free border of the frenulum, joins the proximal end of the *navicular raphe*.

Reflections of the coronal sulcus on either side of the frenulum:
Proximally, the coronal sulcus reflects (on either side of the frenulum, reflects on the inner layer of the *prepuce (on either side of the preputial raphe).*
Distally, the coronal sulcus and its ventral V-shaped extensions (on either side of the frenulum), reflects on the posterior border the *corona of the glans penis (on either side of the navicular raphe.*
The short anterior free border of the frenulum joins the (coronal sulcus end of the) preputial raphe on the inner layer of the prepuce, to the posterior end of the navicular raphe.

Glans penis:

GLANS PENIS: Nomenclature

a) Epithelium of the glans penis, divided into the epithelium of the cap, roof, and wings of the glans penis.
Origin: genital fold (ectoderm), supported by a lamina propria (mesoderm).

b) Body of the glans penis is divided into the *cap, roof*, and *wings* of the glans penis.
Origin: spongy erectile tissue (like corpus spongiosum), is generated by the distal end and lateral borders of the dorsal plate of fossa navicularis.

c) Navicular raphe.
Origin: <u>Fused</u> urogenital/vestibular/urethral folds, ventral to fossa navicularis.

d) Labia and dorsal commissure of the glans penis (external urethral meatus).
Origin: <u>Unfuse</u>d urogenital/vestibular/urethral folds distal to the navicular raphe (ectoderm).
The epidermal folds of the labia of the glans penis (ectoderm) contain a small amount of areolar tissue (mesoderm).

Anatomy of the glans penis:
The glans penis is a smooth cone-shaped swelling at the end of the penis, that is usually concealed by the prepuce. When the prepuce is retracted or circumcised, the glans penis, coronal sulcus, and frenulum of the coronal sulcus, remain exposed.

For descriptive purposes, the glans penis can be divided into the *body of the glans penis*, the *navicular raphe*, and the labia of the glans penis (*external urethral meatus*

Body of the glans penis:
Origin: Spongy tissue (mesoderm) generated by the *distal end and lateral borders* of the dorsal plate of the fossa navicularis, insinuates under the genital fold (ectoderm).

The body of the glans consists of a layer of *spongy tissue* (mesoderm) derived from the dorsal plate of the fossa navicularis), covered by a thin layer skin, with smooth non-keratinized squamous *epithelium* (ectoderm from the genital fold), supported by a *lamina propria* (mesoderm).

The body of the glans penis may be divided into a *cap, a roo*f, and *wings of the glans penis.* The prominent *proximal borders of the roof and wings* of the glans, form the *corona of the glans penis.*

a) The cap of the glans is a crescent-shaped hemisphere, molded over the (tunica albuginea of the) cone-shaped *end of the bicavernosal body* of the corpora cavernosa.
Origin: Epithelium (ectoderm), of the cap, is derived from the genital fold.
Spongy tissue (mesoderm) of the cap is generated by the distal end of the dorsal plate of fossa navicularis and insinuates between the genital fold and the conical end of the bicavernosal body of the penis.

The *tip of the glans penis* is the *conical end of the cap* of the glans penis, which covers the cone-shaped tip of the bicavernosal body of the penis.
The *ventral end of the crescentic cap of the glans, tapers to a point, which is just ventral to the tip* of the glans cap.

Origin of the ventral point of the crescentic cap of the glans penis:
The *dorsal plate of fossa navicularis*, has a layer or tunica albuginea on its dorsal surface, and is adherent to the *ventral groove of the tunica albuginea* of the bicavernosal body of the penis.
The ventral point of the cap of the glans penis, is *spongy tissue that extends ~2-3mm beyond to the distal end of the dorsal plate* of fossa navicularis. It is *covered by epithelium* of the cap of the glans, which is just *ventral to the tip of the glans penis*.

Epithelium (ectoderm) of the ventral point of the cap (ectoderm), reflects on the outer layer (ectoderm), of the *dorsal commissure of the labia of the glans* penis (external urethral meatus). Epithelium at the *proximal border* of the cap of the glans penis, is seamlessly continuous with epithelium of the roof of the glans penis.

Spongy tissue (mesoderm) at the *ventral point of the crescentic cap* of the glans penis, contacts the small amount of connective tissue *(mesoderm) in the dorsal commissure* of the labia of the glans penis. Spongy tissue at the proximal border of the cap of the glans penis is continuous with spongy tissue of the roof of the glans penis.

b) The roof of the glans penis is continuous with the proximal end of the cap of the glans. It drapes over the upper and lateral surfaces of the (underlying segment of the) bicavernosal body of the penis. The *prominent posterior border* of the roof forms the *roof section of the corona of the glans penis.*

Origin:
Epithelium (ectoderm) of the roof of the glans, is derived from the genital fold.
Spongy tissue (mesoderm) of the roof generated by the lateral borders of the dorsal plate of fossa navicularis, insinuates between the epithelium of the genital fold and the bicavernosal body of the penis.

Epithelium at the distal end of the roof, is seamlessly continuous with epithelium of the cap.
Epithelium of the (roof section of the) corona of the glans penis, reflects on epithelium of the coronal sulcus.
Epithelium of the ventral borders of the roof, is seamlessly continuous with epithelium of the wings of the glans penis, at the level of the *ventral surface of the dorsal plate* of fossa navicularis.
Spongy tissue at the distal end of the roof, is continuous with spongy tissue of the cap.
Spongy tissue at the ventral borders of the roof, blends with spongy tissue of the of the lateral borders of the dorsal plate of fossa navicularis.
Spongy tissue of the roof joins spongy tissue of the wings, of the glans penis, at the level of the *ventral surface of the dorsal plate* of fossa navicularis.

c) The *wings of the glans penis*, drape around the lateral surfaces of fossa navicularis, and the *floor of fossa navicularis except in the ventral midline.* The prominent *posterior/proximal borders* of the wings, form the *wing sections of the corona* of the glans penis.

Origin:
Epithelium (ectoderm) of the wings of the glans, is derived from the genital fold.
Spongy tissue generated by the inferior surface of the dorsal plate of fossa navicularis, insinuates between the *genital fold*, and the lateral surfaces and floor (except in the ventral midline) of *fossa navicularis.*

Epithelial connections of the wings of the glans penis:
Dorsally, epithelium of the wings blends seamlessly with epithelium of the roof, at the level of the ventral surface of the dorsal plate of fossa navicularis.
Proximally, epithelium of the (wing sections of the) corona of the glans penis, reflects on epithelium of the coronal sulcus, including the V-shaped distal extensions of the coronal sulcus, on both sides of the frenulum).
Ventrally, epithelium of the *wings* of the glans, reflects on the lateral borders of the (midline) *navicular raphe.*
Distally, epithelium of the *anterior/distal borders* of the wings of the glans penis, *reflects on the outer layers of the labia of the glans penis*.

Spongy tissue connections of the wings of the glans penis:
Dorsally, spongy tissue of the *wings of the glans,* is in contact with the *ventral surfaces of the lateral borders of the dorsal plate* of fossa navicularis.
Proximally, spongy tissue of the *wing sections of the corona* of the glans, borders the lateral *limbs of the V-shaped extensions of the coronal sulcus*.
Ventrally, spongy tissue of the wings is in contact with the small amount of areolar tissue, that separates the floor of fossa navicularis, from the navicular raphe.

Distally, spongy tissue of the wings is in contact with the small amount of tissue, between the outer and inner layers of the folds of the labia of the glans penis (external urethral meatus).

Navicular raphe:

Origin: Ventral midline *postero-anterior fusion of the urogenital/vestibular/urethral folds* (ectoderm), *ventral to the fossa navicularis*, forms the *quadrilinear navicular rap*he.
On *each side,* the *upper border of the outer layer* of the vestibular/urethral fold fuses with the *upper border of the inner layer* of the vestibular/urethral fold. The pair of folds fuse in the midline, to form the quadrilinear navicular raphe.

The *quadrilaminar frenulum,* joins the posterior end of the *quadrilinear navicular raphe*.
The anterior/distal end of the quadrilinear navicular raphe, joins the ventral ends of the labia of the glans penis which are formed by the unfused distal end of the vestibular/urethral fold.

The navicular raphe, about 3-4mm in length, occupies the midline gap between the ventral borders of the wings of the glans penis. It is barely separated from the mucosa (endoderm) of the floor of the *fossa navicularis* by a minute amount of connective tissue.

Epithelial reflections of the navicular raphe:
Epithelium of the lateral borders of the navicular raphe (ectoderm of fused vestibular/urethral folds), reflects on epithelium of the ventral borders of the wings of the glans penis, (ectoderm of the genital fold).

Mesodermal connections of the navicular raphe:
A tiny amount of areolar tissue separates the navicular raphe from the floor of fossa navicularis. The thin midline strip of areolar tissue, contacts (spongy tissue of) the ventral borders of the wings of the glans penis.

Navicular raphe joins labia of glans penis:
The quadrilinear navicular raphe (fused vestibular*/urethral folds), joins* the tapered *ventral ends of the labia* of the glans penis (unfused vestibular/urethral folds), at the ventral angle of the external urethral meatus.
The *ventral ends of the inner borders of the labia* of the glans penis, are fused in the midline.

External urethral meatus:
The *external urethral meatus* consists of the *labia of the glans penis*, and *dorsal commissure of the labia of the glans penis.*

Origin: Distal unfused segment of the elliptical vestibular/urethral fold.

Note: The anterior commissure of the vestibular/urethral fold is attached to the distal end of the dorsal plate of distal end of the vestibule/urethra (future fossa navicularis), and ventral end of the crescentic cap of the glans penis. Epithelium of the outer layer of the anterior commissure of the vestibular/urethral fold reflects on epithelium at the ventral end of the crescentic cap of the glans penis. Mesoderm in the fold of the anterior commissure of the vestibular/urethral fold is common with mesoderm at the distal end of the dorsal plate of fossa navicularis. Epithelium of the inner layer of the anterior commissure of the vestibular/urethral fold, meets mucosa of the roof of the distal end of the vestibule/urethra.

The distal and ventral borders of the *developing wings of the glans penis*, *push the proximal ends of the unfused distal section of the vestibular/urethral fold, forwards/distally.*
The result is that the unfused distal section of the vestibular/urethral fold, is *tilted into a vertical orientation*, and *lines up with the elliptical opening of the fossa navicularis*.
The vertically oriented limbs of the vestibular/urethral fold, and its anterior commissure are now termed the *labia of the glans penis, and dorsal commissure* of the labia of the glans penis.

In the *ventral angle of the external urethral meatus, the ventral ends of the inner borders of the labia of the glans penis, fuse in the midline.*

The labia, and dorsal commissure of the labia of the glans penis, form the *external urethral meatus*.

The elliptical *external urethral meatus* is ~4-5mm in vertical length.

Epithelial connections of the external urethral meatus:

a) Dosal commissure of the labia of the glans penis:
Epithelium (ectoderm) of the *dorsal border of the outer layer* of the *dorsal commissure*, reflects on the *epithelium* at the *ventral end of the crescentic cap of the glans penis.*
Epithelium (ectoderm) of the *ventral border of the inner layer of the dorsal commissure, joins* mucosa (endoderm), *of the roof of fossa navicularis,* at *Hart's line.*

The small amount of *areolar tissue* (mesoderm) in the dorsal commissure, is in contact with *spongy tissue* (mesoderm), in the ventral end of the crescentic cap of the glans penis.
The spongy tissue, in the ventral end of the cap of the glans penis, is generated by the distal end of the dorsal plate of fossa navicularis.

b) Labia of the glans penis:
Epithelium (ectoderm) of the *outer layers of the labia*, reflects on the epithelium of the anterior/distal borders of the wings of the glans penis.

Epithelium (ectoderm) of the *inner layer*s of the labia, joins the *mucosa* (endoderm) of fossa navicularis, at *Hart's line.*

The small amount of *areolar tissue in the folds of the labia of the glans penis*, is in contact with *spongy tissue* of the anterior/distal borders of the *wings of the glans penis.*

V*entral angle of the external urethral meatus*:
The tapered *ventral ends of the labia of the glans penis (unfused vestibular/urethral folds),* join the distal ends of the *quadrilinear* navicular raphe *(fused vestibular/ urethral folds).*
Epithelium of the *proximal borders of the outer layers of the labia,* joins epithelium of the *lateral lines of the navicular raphe.*

Epithelium of the *proximal borders of the inner layers of the labia, joins the middle two lines of the navicular raphe.*

The ventral ends of the proximal borders of the inner layer of the labia of the glans penis are fused in the midline.
The small amount of areolar tissue in the ventral ends of the labia of the glans penis, is continuous with the small amount of areolar tissue between the navicular raphe and the floor of the fossa navicularis.

Outlet of the vestibule/urethra:

The outlet of the vestibule/urethra is lined by *epithelium of the* inner layers, of the labia of the glans penis, and inner layer of the dorsal commissure of the labia of the glans penis.

The outlet of the vestibule/urethra is ~4-5mm, in vertical height, and ~1-2mm in depth. The outlet of the vestibule/urethra can be examined, by eversion of the labia of the glans penis.

Hart's line in the male:

Hart's line is the *line of junction* of the mucosa (endoderm), of the *vestibule/urethra* and epithelium (ectoderm) lining the *outlet of the vestibule/urethra.*

Origin: Disintegration of the urogenital membrane allows mucosa (endoderm) of the vestibule/ urethra, to meet epithelium (ectoderm) of the inner layer of the *elliptical vestibular/urethral fold*.

Postero-anterior ventral midline fusion of the vestibule/urethra moves the opening of the vestibule/urethra, to the end of the fossa navicularis.

Postero-anterior fusion of the longer proximal/posterior segment of the vestibular/urethral fold, creates the urogenital raphe. The *distal/anterior unfused segment of the vestibular/ urethral fold* forms the *labia and dorsal commissure* of the labia of the glans penis, which are aligned with the opening of fossa navicularis.

In the *ventral angle of the external urethral meatus*, the *ventral ends of the proximal borders*, of the *inner surfaces of the labia* of the glans penis, are *fused in the midline*.

Hart's line is an *elliptical line* that marks the line of junction of the opening of fossa navicularis, and the outlet of the vestibule/urethra. At Hart's line, *mucosa (endoderm),* at the end of the *elliptical fossa navicularis*, meets *epithelium (ectoderm),* lining the inner layers of the labia, and dorsal commissure of the *labia of the glans penis* (unfused distal segment of the vestibular/urethral fold).

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From https://anatomydevelopment.com/#undefined

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