TS17 10.5dpc (range 10-11.25 dpc)
TS18 11dpc (range 10.5-11.25 dpc)
TS19 11.5 dpc (range 11-12.25 dpc)
TS20 12 dpc (range 11.5 – 13 dpc)
TS21 13 dpc (range 12.5 – 14 dpc)
TS22 14 dpc (range 13.5 – 15 dpc)
TS23 15 dpc
TS24 16 dpc
TS25 17 dpc
TS26 18 dpc
TS27 newborn (range P0 - P3)
TS28 P4 – Adult

Ontology trees – red text = new terms or modified terms

A number of terms have been merged, with the Alt ID providing a reference to the secondary ID.

Urethra

Urethra must be divided into pelvic urethra and phallic urethra from TS21. The phallic urethra begins as the urethral plate epithelium, and then becomes the phallic urethra of male/female, both are part of the genital tubercle (because they are located within the genital tubercle), in addition to being part of the urethra of male/female. Genital tubercle is covered in a separate document. However, urethra and pelvic urethra do not become sex-specific until TS23.

In addition to urethra of female/male and phallic urethra of female/male, we also have urethra, divided into pelvic urethra and phallic urethra at TS21 and TS22.

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EMAPA:17366   TS19-TS28 | | ├ urinary system
EMAPA:30901   TS21-TS22 | | | ├ urethra (Alt ID: EMAPA:30891)
EMAPA:30903   TS21-TS22 | | | | ├ pelvic urethra (Alt ID: EMAPA: 30893)
EMAPA:30911   TS21-TS22 | | | | ├ phallic urethra (syn: caudal urethra) (Alt ID: EMAPA: 30895)
EMAPA:28555   TS20-TS21 | | | | ├ urethral plate (Alt ID: EMAPA: 30897)
EMAPA:30899   TS20-TS22 | | | | └ urethral fold (Alt ID: EMAPA: 30915)
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The pelvic urethra

Pelvic urethra terms for TS21-TS22 have been merged.

EMAPA:17366 TS19-TS28 | | ├ urinary system
EMAPA:30901 TS21-TS22 | | | ├ urethra (Alt ID: EMAPA:30891)
EMAPA:30903 TS21-TS22 | | | | ├ pelvic urethra (Alt ID: EMAPA: 30893)
EMAPA:30905 TS21-TS22 | | | | | ├ epithelium of pelvic urethra
EMAPA:36099 TS21-TS22 | | | | | | ├ urogenital sinus ridge
EMAPA:36104 TS21-TS22 | | | | | | └ rest of epithelium of pelvic urethra
EMAPA:30907 TS21-TS22 | | | | | ├ mesenchymal layer of pelvic urethra (syn:mesenchyme of pelvic urethra) (Alt ID: EMAPA:31573)
EMAPA:31575 TS21-TS22 | | | | | | ├ mesenchymal layer of dorsal pelvic urethra (syn:dorsal mesenchyme of pelvic urethra) (Alt ID: EMAPA:31572)
EMAPA:31574 TS21-TS22 | | | | | | └ mesenchymal layer of ventral pelvic urethra (syn:ventral mesenchyme of pelvic urethra) (Alt ID: EMAPA:31561)
EMAPA:30909 TS22-TS22 | | | | | ├ muscle layer of pelvic urethra
EMAPA:31577 TS22-TS22 | | | | | | ├ muscle layer of dorsal pelvic urethra
EMAPA:31576 TS22-TS22 | | | | | | └ muscle layer of ventral pelvic urethra
EMAPA:31523 TS21-TS22 | | | | | ├ nerve of pelvic urethra (Alt ID: EMAPA:31558)
EMAPA:36102 TS21-TS22 | | | | | ├ developing vasculature of pelvic urethra
EMAPA:36103 TS21-TS22 | | | | | └ adventitia of pelvic urethra

Urethra: (TS21 and TS22): The urethra links the primitive bladder/bladder to the outside of the embryo. At TS21 it is part of the urinary system. It is subdivided into pelvic urethra (located within the body of the embryo) and phallic urethra of male/female (located within the genital tubercle). Pelvic urethra is derived from the caudal urogenital sinus and phallic urethra is derived from urethral plate epithelium.

Pelvic urethra (TS21 and TS22) comprised of epithelium of pelvic urethra (eplur, subdivided into urogenital sinus ridge (sr) and rest of epithelium of pelvic urethra), mesenchymal layer of pelvic urethra (mplur; divided into dorsal and ventral), nerve, developing vasculature, adventitia and from TS22 muscle layer (muplur; divided into dorsal and ventral). Pelvic urethra is a part of the urinary system and is part of the urethra. The epithelium of pelvic urethra is contiguous with the epithelium of phallic urethra (caudally) and bladder urothelium (cranially). Derived from the caudal urogenital sinus (TS20). Becomes the pelvic urethra of male/female from TS23.

urogenital sinus ridge (synonym: sinus ridge) part of the urogenital sinus (TS19-21), and part of the caudal urogenital sinus (TS19-20), then part of pelvic urethra (TS21-22) and then part of the pelvic urethra of male/female (TS23). The thickened and raised, dorsal portion of the epithelium located at the site where the common nephric duct/nephric duct/reproductive ducts join the urogenital sinus/pelvic urethra. From TS19-22 the urogenital sinus ridge surrounds the common nephric duct. Marked by Cdh1 and derived from cloacal endoderm. It is a signalling centre, important for regulating common nephric duct remodelling and apoptosis during ureter maturation and repositioning.

From TS23-28, urethra and pelvic urethra become sex-specific.

Major change to urethra ontology is the addition of mesenchymal and epithelial layers without dorsal/ventral subdivisions.

EMAPA:28747 TS23-TS28 | | | ├ urethra of female
EMAPA:28753 TS23-TS28 | | | | ├ pelvic urethra of female (syn: cranial urethra, internal urethra)
EMAPA:28759 TS23-TS28 | | | | | ├ epithelium of pelvic urethra of female
EMAPA:36105 TS23-TS28 | | | | | | ├ superficial cell layer of pelvic urethra of female
EMAPA:36106 TS23-TS28 | | | | | | ├ intermediate cell layer of pelvic urethra of female
EMAPA:36107 TS23-TS28 | | | | | | └ basal cell layer of pelvic urethra of female
EMAPA:32264 TS23-TS28 | | | | | | ├ epithelium of dorsal pelvic urethra of female
EMAPA:36108 TS23-TS23 | | | | | | | ├ urogenital sinus ridge of female
EMAPA:36109 TS23-TS23 | | | | | | | ├ rest of epithelium of dorsal pelvic urethra of female
EMAPA:32266 TS23-TS28 | | | | | | | ├ superficial cell layer of dorsal pelvic urethra of female
EMAPA:32306 TS23-TS28 | | | | | | | ├ intermediate cell layer of dorsal pelvic urethra of female
EMAPA:32267 TS23-TS28 | | | | | | | └ basal cell layer of dorsal pelvic urethra of female
EMAPA:32282 TS23-TS28 | | | | | | └ epithelium of ventral pelvic urethra of female
EMAPA:32291 TS23-TS28 | | | | | | ├ superficial cell layer of ventral pelvic urethra of female
EMAPA:32305 TS23-TS28 | | | | | | ├ intermediate cell layer of ventral pelvic urethra of female
EMAPA:32292 TS23-TS28 | | | | | | └ basal cell layer of ventral pelvic urethra of female
EMAPA:28765 TS23-TS28 | | | | | ├ mesenchymal layer of pelvic urethra of female
EMAPA:36110 TS25-TS28 | | | | | | ├ lamina propria of pelvic urethra of female (syn: peri-epithelial mesenchymal layer of pelvic urethra of female; sub-epithelial mesenchymal layer of pelvic urethra of female)
EMAPA:36111 TS25-TS28 | | | | | | ├ muscularis mucosa of pelvic urethra of female
EMAPA:36112 TS25-TS28 | | | | | | ├ submucosa of pelvic urethra of female
EMAPA:31554 TS23-TS28 | | | | | | ├ mesenchymal layer of dorsal pelvic urethra of female
EMAPA:32296 TS25-TS28 | | | | | | | ├ lamina propria of dorsal pelvic urethra of female (syn: peri-epithelial mesenchymal layer of dorsal pelvic urethra of female; sub-epithelial mesenchymal layer of dorsal pelvic urethra of female)
EMAPA:32295 TS25-TS28 | | | | | | | ├ muscularis mucosa of dorsal pelvic urethra of female
EMAPA:32313 TS25-TS28 | | | | | | | └ submucosa of dorsal pelvic urethra of female
EMAPA:31553 TS23-TS28 | | | | | | ├ mesenchymal layer of ventral pelvic urethra of female
EMAPA:32310 TS25-TS28 | | | | | | | ├ lamina propria of ventral pelvic urethra of female (syn: peri-epithelial mesenchymal layer of ventral pelvic urethra of female; sub-epithelial mesenchymal layer of ventral pelvic urethra of female)
EMAPA:32309 TS25-TS28 | | | | | | | ├ muscularis mucosa of ventral pelvic urethra of female
EMAPA:32308 TS25-TS28 | | | | | | | └ submucosa of ventral pelvic urethra of female
EMAPA:32287 **TS24**-TS27 | | | | | | └ mesenchymal pad of pelvic urethra of female
EMAPA:36113 TS24-TS27 | | | | | | └ anterior mesenchymal pad of female
EMAPA:36114 TS24-TS27 | | | | | | └ dorsal mesenchymal pad of female
EMAPA:36115 TS24-TS27 | | | | | | └ ventral mesenchymal pad of female
EMAPA:28771 TS23-TS28 | | | | | ├ muscle layer of pelvic urethra of female
EMAPA:31560 TS23-TS25 | | | | | | ├ muscle layer of dorsal pelvic urethra of female
EMAPA:31559 TS23-TS25 | | | | | | └ muscle layer of ventral pelvic urethra of female
EMAPA:36116 TS28-TS28 | | | | | | ├ smooth muscle layer of pelvic urethra of female
EMAPA:36117 TS28-TS28 | | | | | | └ rhabdosphincter of female (syn: striated muscle layer of pelvic urethra of female)
EMAPA:36118 TS23-TS28 | | | | | ├ adventitia of pelvic urethra of female
EMAPA:32283 **TS23**-TS28 | | | | | ├ vasculature of pelvic urethra of female
EMAPA:31567 TS23-TS28 | | | | | ├ nerve of pelvic urethra of female
EMAPA:32288 TS25-TS27 | | | | | └ neural crest derivative of pelvic urethra of female
EMAPA:36132 TS24-TS26 | | | | | ├ ventral epithelial bud of female
EMAPA:36133 TS27-TS28 | | | | | ├ urethral gland of pelvic urethra of female
EMAPA:18999 TS24-**TS27** | | | | | ├ sinovaginal bulb (syn: lower vagina, sinus vagina, vaginal bulb)
EMAPA:29058 TS24-**TS27** | | | | | | ├ epithelium of sinovaginal bulb (syn:epithelial layer of lower vagina)
~~EMAPA:29935 **TS24-TS27** | | | | | | | ├ gland of lower vaginal epithelium~~
~~EMAPA:29937 **TS24-TS27** | | | | | | | └ rest of epithelium of lower vagina~~
EMAPA:32259 **TS24-TS27** | | | | | ├ lamina propria of sinovaginal bulb

~~EMAPA:29061 TS24-TS27 | | | | | | ├ muscular layer of sinovaginal bulb lower part of vagina~~
EMAPA:29939 **TS24-TS27** | | | | | | ├ adventitia of sinovaginal bulb
EMAPA:31224 **TS24-TS27** | | | | | | └ vasculature of sinovaginal bulb
EMAPA:29653 **TS27**-TS28 | | | | └ female urethral gland (syn: Skene's gland)
EMAPA:36133 TS27-TS28 | | | | | ├ urethral gland of female pelvic urethra (syn: Skene's gland of pelvic urethra)
EMAPA:36134 TS27-TS28 | | | | | ├ urethral gland of clitoral urethra (syn: Skene's gland of clitoral urethra)

EMAPA:18692 TS23-TS28 | | | ├ urethra of male
EMAPA:18995 TS23-TS28 | | | | ├ pelvic urethra of male
EMAPA:28697 TS23-TS28 | | | | | ├ epithelium of pelvic urethra of male
EMAPA:36120 TS23-TS28 | | | | | | ├ superficial cell layer of pelvic urethra of male
EMAPA:36121 TS23-TS28 | | | | | | ├ intermediate cell layer of pelvic urethra of male
EMAPA:36122 TS23-TS28 | | | | | | ├ basal cell layer of pelvic urethra of male
EMAPA:32300 TS23-TS28 | | | | | | ├ epithelium of dorsal pelvic urethra of male
EMAPA:36123 TS23-TS23 | | | | | | | ├ urogenital sinus ridge of male
EMAPA:36124 TS23-TS27 | | | | | | | ├ rest of epithelium of dorsal pelvic urethra of male
EMAPA:32263 TS23-TS28 | | | | | | | ├ superficial cell layer of dorsal pelvic urethra of male
EMAPA:32307 TS23-TS28 | | | | | | | ├ intermediate cell layer of dorsal pelvic urethra of male
EMAPA:32260 TS23-TS28 | | | | | | | └ basal cell layer of dorsal pelvic urethra of male
EMAPA:32258 TS23-TS28 | | | | | | └ epithelium of ventral pelvic urethra of male
EMAPA:32284 TS23-TS28 | | | | | | ├ superficial cell layer of ventral pelvic urethra of male
EMAPA:32314 TS23-TS28 | | | | | | ├ intermediate cell layer of ventral pelvic urethra of male
EMAPA:32261 TS23-TS28 | | | | | | └ basal cell layer of ventral pelvic urethra of male
EMAPA:28703 TS23-TS28 | | | | | ├ mesenchymal layer of pelvic urethra of male
EMAPA:36125 TS25-TS28 | | | | | | ├ lamina propria of pelvic urethra of male (syn: peri-epithelial mesenchymal layer of pelvic urethra of male; sub-epithelial mesenchymal layer of pelvic urethra of male)
EMAPA:36126 TS25-TS28 | | | | | | ├ muscularis mucosa of pelvic urethra of male
EMAPA:36127 TS25-TS28 | | | | | | ├ submucosa of pelvic urethra of male
EMAPA:31552 TS23-TS28 | | | | | | ├ mesenchymal layer of dorsal pelvic urethra of male
EMAPA:32311 TS25-TS28 | | | | | | | ├ lamina propria of dorsal pelvic urethra of male (syn: peri-epithelial mesenchymal layer of dorsal pelvic urethra of male; sub-epithelial mesenchymal layer of dorsal pelvic urethra of male)
EMAPA:32312 TS25-TS28 | | | | | | | ├ muscularis mucosa of dorsal pelvic urethra of male
EMAPA:32293 TS25-TS28 | | | | | | | └ submucosa of dorsal pelvic urethra of male
EMAPA:31550 TS23-TS28 | | | | | | ├ mesenchymal layer of ventral pelvic urethra of male
EMAPA:32294 TS25-TS28 | | | | | | | ├ lamina propria of ventral pelvic urethra of male (syn: peri-epithelial mesenchymal layer of ventral pelvic urethra of male; sub-epithelial mesenchymal layer of ventral pelvic urethra of male)
EMAPA:32297 TS25-TS28 | | | | | | | ├ muscularis mucosa of ventral pelvic urethra of male
EMAPA:32298 TS25-TS28 | | | | | | | └ submucosa of ventral pelvic urethra of male
EMAPA:32280 **TS24**-TS27 | | | | | | └ mesenchymal pad of pelvic urethra of male
EMAPA:36128 TS24-TS27 | | | | | | | └ anterior mesenchymal pad of male
EMAPA:36129 TS24-TS27 | | | | | | | └ dorsal mesenchymal pad of male
EMAPA:36130 TS24-TS27 | | | | | | | └ ventral mesenchymal pad of male
EMAPA:28709 TS23-TS28 | | | | | ├ muscle layer of pelvic urethra of male
EMAPA:31556 TS23-TS25 | | | | | | ├ muscle layer of dorsal pelvic urethra of male
EMAPA:31555 TS23-TS25 | | | | | | └ muscle layer of ventral pelvic urethra of male
EMAPA:36131 TS23-TS28 | | | | | ├ adventitia of pelvic urethra of male
EMAPA:32262 **TS23**-TS28 | | | | | ├ vasculature of pelvic urethra of male
EMAPA:31565 TS23-TS28 | | | | | ├ nerve of pelvic urethra of male
EMAPA:32286 TS25-TS27 | | | | | └ neural crest derivative of pelvic urethra of male

EMAPA:xxxxx TS24-TS26 | | | | | └ ventral epithelial bud of male
EMAPA:xxxxx TS24-TS26 | | | | | | └ ventral prostate bud
EMAPA:xxxxx TS24-TS26 | | | | | | └ anterior male urethral gland bud
EMAPA:xxxxx TS24-TS26 | | | | | └ male urethral gland bud
EMAPA:xxxxx TS24-TS26 | | | | | | └ anterior male urethral gland bud
EMAPA:xxxxx TS24-TS26 | | | | | | └ posterior male urethral gland bud
EMAPA:xxxxx TS24-TS28 | | | | | ├ verumontanum (syn: seminal colliculus)
EMAPA:29645 **TS27**-TS28 | | | | └ male urethral gland
EMAPA:xxxxx TS27-TS28 | | | | | ├ urethral gland of male pelvic urethra
EMAPA:xxxxx TS27-TS28 | | | | | ├ urethral gland of penile urethra

Alternative tree layout for pelvic urethra epithelial and mesenchymal layers (female is shown as an example);

EMAPA:28759 TS23-TS28 | | | | | ├ epithelium of pelvic urethra of female
EMAPA:xxxxx TS23-TS28 | | | | | | ├ superficial cell layer of pelvic urethra of female
EMAPA:32266 TS23-TS28 | | | | | | | ├ superficial cell layer of dorsal pelvic urethra of female
EMAPA:32291 TS23-TS28 | | | | | | ├ superficial cell layer of ventral pelvic urethra of female
EMAPA:xxxxx TS23-TS28 | | | | | | ├ intermediate cell layer of pelvic urethra of female
EMAPA:32306 TS23-TS28 | | | | | | | ├ intermediate cell layer of dorsal pelvic urethra of female
EMAPA:32305 TS23-TS28 | | | | | | ├ intermediate cell layer of ventral pelvic urethra of female
EMAPA:xxxxx TS23-TS28 | | | | | | └ basal cell layer of dorsal urethra of female
EMAPA:32267 TS23-TS28 | | | | | | | └ basal cell layer of dorsal pelvic urethra of female
EMAPA:32292 TS23-TS28 | | | | | | └ basal cell layer of ventral pelvic urethra of female
EMAPA:32264 TS23-TS28 | | | | | | ├ epithelium of dorsal pelvic urethra of female
EMAPA:xxxxx TS23-TS23 | | | | | | | ├ urogenital sinus ridge of female
EMAPA:xxxxx TS23-TS23 | | | | | | | ├ rest of epithelium of dorsal pelvic urethra of female
EMAPA:32282 TS23-TS28 | | | | | | └ epithelium of ventral pelvic urethra of female

EMAPA:28765 TS23-TS28 | | | | | ├ mesenchymal layer of pelvic urethra of female
EMAPA:xxxxx TS25-TS28 | | | | | | ├ lamina propria of pelvic urethra of female (syn: peri-epithelial mesenchymal layer of pelvic urethra of female; sub-epithelial mesenchymal layer of elvic urethra of female)
EMAPA:32296 TS25-TS28 | | | | | | | ├ lamina propria of dorsal pelvic urethra of female (syn: peri-epithelial mesenchymal layer of dorsal pelvic urethra of female; sub-epithelial mesenchymal layer of dorsal pelvic urethra of female)
EMAPA:32310 TS25-TS28 | | | | | | | ├ lamina propria of ventral pelvic urethra of female (syn: peri-epithelial mesenchymal layer of ventral pelvic urethra of female; sub-epithelial mesenchymal layer of ventral pelvic urethra of female)
EMAPA:xxxxx TS25-TS28 | | | | | | ├ muscularis mucosa of pelvic urethra of female
EMAPA:32295 TS25-TS28 | | | | | | | ├ muscularis mucosa of dorsal pelvic urethra of female
EMAPA:32309 TS25-TS28 | | | | | | | ├ muscularis mucosa of ventral pelvic urethra of female
EMAPA:xxxxx TS25-TS28 | | | | | | ├ submucosa of pelvic urethra of female
EMAPA:32313 TS25-TS28 | | | | | | | └ submucosa of dorsal pelvic urethra of female
EMAPA:32308 TS25-TS28 | | | | | | | └ submucosa of ventral pelvic urethra of female
EMAPA:31554 TS23-TS28 | | | | | | ├ mesenchymal layer of dorsal pelvic urethra of female
EMAPA:31553 TS23-TS28 | | | | | | ├ mesenchymal layer of ventral pelvic urethra of female

Urethra of male/female (TS23-28): from TS23 to 27, urethra is comprised of pelvic urethra of male/female and phallic urethra of male/of female. At TS28, urethra of male is comprised of prostatic urethra, pelvic urethra of male and penile urethra. At TS28, urethra

of female is comprised of pelvic urethra of female and clitoral urethra of female (syn: external urethra).

Pelvic urethra of male/female: (TS23-28) Part of urethra of male/female. Cranially joined to the bladder and caudally joined to the phallic urethra of male/female (TS23-27) which becomes the penile urethra/clitoral urethra of female (TS28). Comprised of epithelium (subdivided into 3 layers), mesenchymal layer [subdivided into lamina propria, muscularis mucosa, submucosa (TS25-28) and also contains mesenchymal pad of male/female (TS25-27)], muscle layer and adventitia. Also contains vasculature and nerve of pelvic urethra of male/female, and neural crest derivative of pelvic urethra of male/female (TS25-27). Also contains ventral epithelial bud of male/female and male/female urethral gland bud (TS24-26), which become urethral gland of male/female pelvic urethra (TS27), which develop from the epithelium of pelvic urethra of male/female. The pelvic urethra of female (TS28) also contains a rhabdosphincter as part of the muscle layer of pelvic uretha of female. In the TS28 male, the rhabdophincter is part of the prostatic urethra.

Epithelium of pelvic urethra of male/female (TS23-28): the innermost layer of the pelvic urethra, a stratified epithelium lining the lumen. It is subdivided into dorsal and ventral. It is also subdivided into three epithelial cell layers; superficial, intermediate and basal cell layer of dorsal/ventral pelvic urethra. At TS23, the epithelium of dorsal pelvic urethra of male/female is also comprised of urogenital sinus ridge of male/female and rest of dorsal epithelium of pelvic urethra of male/female. The urogenital sinus ridge becomes the the sinovaginal bulb in females and verumontanum in males from TS24. *Cytokeratin 14* and *Cadherin 1* are markers of all layers of the epithelium.

urogenital sinus ridge of male (TS23): part of the epithelium of pelvic urethra of male (TS23). The thickened and raised, dorsal portion of the epithelium of dorsal pelvic urethra of male located at the site where the nephric ducts join the pelvic urethra. Derived from the urogenital sinus ridge, part of the pelvic urethra (TS21-22) (derived from cloacal endoderm). At TS24, it becomes the verumontanum (syn: seminal colliculus), the protrusion of the urethra where the prostate gland and ejaculatory ducts join.

urogenital sinus ridge of female (TS23): part of the epithelium of pelvic urethra of female (TS23). The thickened and raised, dorsal portion of the epithelium of dorsal pelvic urethra of female located at the site where the nephric and paramesonephric ducts join the pelvic urethra. Derived from the urogenital sinus ridge, part of the pelvic urethra (TS21-22) (derived from cloacal endoderm). In females, the urogenital sinus ridge blocks the originally patent opening of the nephric ducts to the urethra, and assists in the caudal migration of the paramesonephric ducts and later the vagina, towards the clitoris. It may be a source of inductive signals regulating vaginal outgrowth. At TS24, it becomes the sinovaginal bulb (syn: vaginal bulb, lower vagina, sinus vagina).

Verumontanum (TS24-28) (syn: seminal colliculus): the raised, dorsal portion of the male urethra where the prostate glands and orifices of the ejaculatory ducts enter the urethra. Part of the pelvic urethra of male (TS24-27), and in the adult is part of the prostatic urethra (TS28). Also part of the male urethra. Derived from the urogenital sinus ridge of male (TS23).

Sinovaginal bulb (TS24-27) (syn: vaginal bulb, lower vagina, sinus vagina): a solid epithelial cord derived from the urogenital sinus ridge, located adjacent to the dorsal epithelium of the pelvic urethra and connects the epithelium of the pelvic urethra to the epithelium of the paramesonephric duct-derived upper vagina. Part of pelvic urethra of female and part of vagina. In males, androgens stop the caudal growth of the nephric ducts. In females, the remaining cells of the nephric duct and the paramesonephric duct-derived upper vagina continue to migrate down the pelvic urethra and have fused to the sinovaginal bulb by E18 (TS26). In newborn mice, the nonpatent, vagina is comprised of the sinovaginal bulb and PND-derived vaginal epithelium fused together. By P3, the proportion of PND-derived vaginal epithelium is larger than the proportion made up by the sinovaginal bulb and the downward migration of the upper vagina continues along the pelvic urethra. Throughout this time, the sinovaginal bulb is a solid, flat epithelial cord. The vagina reaches the perineum by P8 and opens during puberty (~P28). The entire vaginal epithelium of adult is derived from *Hoxb7-Cre* expressing PND and does not contain epithelia derived from the sinovaginal bulb or nephric duct epithelium. Vulvar epithelium does contain cells derived from urogenital sinus. The solid cord of the vagina canalises at the time of vaginal opening and the sinovaginal bulb becomes part of the vulvar epithelium.

EMAPA:18999 TS24-**TS27** | | | | | ├ sinovaginal bulb (syn: lower ~~part of~~ vagina, sinus vagina, vaginal bulb, ~~sinovaginal bulb~~)
EMAPA:29058 TS24-**TS27** | | | | | | ├ epithelium of sinovaginal bulb
~~EMAPA:29935 **TS24-TS27** | | | | | | | ├ gland of lower vaginal epithelium~~
~~EMAPA:29937 **TS24-TS27** | | | | | | | └ rest of epithelium of lower vagina~~
EMAPA:32259 **TS24-TS27** | | | | | ├ ~~mesenchymal layer~~ lamina propria of sinovaginal bulb ~~lower part of vagina~~
~~EMAPA:29061 TS24-TS27 | | | | | | ├ muscular layer of sinovaginal bulb lower part of vagina~~
EMAPA:29939 **TS24-TS27** | | | | | ├ adventitia of sinovaginal bulb ~~lower part of vagina~~
EMAPA:31224 **TS24-TS27** | | | | | └ vasculature of sinovaginal bulb ~~lower part of vagina~~

mesenchymal layer of pelvic urethra of male/female (TS23-28): the mesenchymal layer of the pelvic urethra located between the epithelium and muscle layers. Contains smooth muscle cells and mesenchymal/fibroblastic/stromal cells, blood vessels and nerves and mesenchymal pads of male/female (TS25-27). Subdivided from TS23-28 into dorsal and ventral. Subdivided from TS25-28, into lamina propria, musclaris mucosa and submucosa.

Lamina propria of dorsal/ventral pelvic urethra of male/female (TS25-28): the thin mesenchymal/fibroblastic/stromal cell layer of the pelvic urethra located immediately adjacent to the epithelium, between the epithelium and the muscularis mucosa. Contains

connective tissue, marked by pro-collagen. Marked by *Snai1*, *Bmp2* and *Foxf1a* mRNA at E17. *Foxf1a* is a marker present in both lamina propria and submucosa of pelvic urethra at E17.

Muscularis mucosa of dorsal/ventral pelvic urethra (TS25-28): a thin, discontinuous layer comprised of wisps of smooth muscle, located between the lamina propria and the submucosa. Expresses markers of smooth muscle including ACTA2-protein and smooth muscle alpha actin (Acta2), desmin and actin.

Submucosa of dorsal/ventral pelvic urethra (TS25-28): the mesenchymal layer located below the muscularis mucosa of dorsal/ventral pelvic urethra, between the muscularis mucosa and muscle layer of pelvic urethra of male/female, comprised of mesenchymal/fibrablastic cells. Marked by *Foxf1a* mRNA at E17. Can be distinguished from the lamina propria of dorsal/ventral pelvic urethra of male/female as it does not express *Snai1* mRNA at E17.

Mesenchymal pad of pelvic urethra of male/female (TS24-27): three distinct clusters of condensed mesenchyme, centred on the midline of the pelvic urethra develop in the mesenchymal layer of the pelvic urethra of male/female and can be seen from TS24 to birth (TS27). Subdivided into anterior mesenchymal pad of pelvic urethra, dorsal mesenchymal pad of pelvic urethra and ventral mesenchymal pad of pelvic urethra of male/female. The mesenchymal pads are located where the prostate buds develop in males and are thought to play a role in prostate differentiation. Female mesenchymal pads are smaller and more elongated than those in the male. The pads are visible in haematoxylin and eosin stained tissue and are marked by certain genes; all 3 pads are marked at E17 by *Fgf10* mRNA (also present in non-mesenchymal pad mesenchyme) and *Scmh1* mRNA specifically marks the ventral mesenchyma pad of pelvic urethra of male/female.

Muscle layer of pelvic urethra of male (TS23-28) (syn: muscularis propria of pelvic urethra): the thicker layer of smooth muscle towards the outside of the pelvic urethra. Subdivided into dorsal/ventral (to TS27). Marked by proteins expressed by smooth muscle cells, such as smooth muscle alpha actin (Acta2).

Muscle layer of pelvic urethra of female (TS23-28) (syn: muscularis propria of pelvic urethra): the thicker layer of smooth muscle towards the outside of the pelvic urethra. Subdivided into dorsal/ventral (to TS27). At TS28, subdivided into smooth muscle layer of pelvic urethra of female and rhabdosphincter of female (syn: striated muscle layer of pelvic urethra of female).

smooth muscle layer of pelvic urethra of female (TS28): the smooth muscle layer towards the outside of the pelvic urethra. Part of the pelvic urethra, part of the urethra of female. Marked by proteins expressed by smooth muscle cells, such as smooth muscle alpha actin (Acta2).

rhabdosphincter of female (syn: striated muscle layer of pelvic urethra of female) (TS28): the striated muscle layer towards the outside of the pelvic urethra of female. Part of the pelvic urethra, part of the urethra of female. Marked by proteins expressed by skeletal muscle cells, such as skeletal muscle alpha actin (Acta1).

adventitia of pelvic urethra of female/male (TS23-28): the outer connective tissue layer of the pelvic urethra. The pelvic urethra is not surrounded by an outer serous membrane or serosa.

Prostatic urethra:

EMAPA:18692 TS23-TS28 | | | ├ urethra of male
EMAPA:30942 TS28-TS28 | | | | ├ prostatic urethra
EMAPA:30952 TS28-TS28 | | | | | ├ epithelium of prostatic urethra
EMAPA:32268 TS28-TS28 | | | | | | ├ superficial cell layer of prostatic urethra (syn: superficial epithelial layer of prostatic urethra)
EMAPA:32299 TS28-TS28 | | | | | | ├ intermediate cell layer of prostatic urethra
EMAPA:32271 TS28-TS28 | | | | | | └ basal cell layer of prostatic urethra
EMAPA:36136 TS28-TS28 | | | | | | ├ epithelium of dorsal prostatic urethra
EMAPA:36137 TS28-TS28 | | | | | | | ├ verumontanum (syn: seminal colliculus)
EMAPA:36138 TS28-TS28 | | | | | | | ├ rest of epithelium of dorsal prostatic urethra
EMAPA:36139 TS28-TS28 | | | | | | └ epithelium of ventral prostatic urethra
EMAPA:30954 TS28-TS28 | | | | | ├ mesenchymal layer of prostatic urethra
EMAPA:32303 TS28-TS28 | | | | | | ├ lamina propria of prostatic urethra
EMAPA:32302 TS28-TS28 | | | | | | ├ muscularis mucosa of prostatic urethra
EMAPA:32301 TS28-TS28 | | | | | | └ submucosa of prostatic urethra
EMAPA:30956 TS28-TS28 | | | | | ├ muscle layer of prostatic urethra
EMAPA:32278 TS28-TS28 | | | | | | ├ smooth muscle layer of prostatic urethra
EMAPA:32269 TS28-TS28 | | | | | | └ rhabdosphincter of male (syn: striated muscle layer of prostatic urethra)
EMAPA:36140 TS23-TS28 | | | | | ├ adventitia of prostatic urethra of male
EMAPA:32265 TS28-TS28 | | | | | ├ vasculature of prostatic urethra
EMAPA:32279 TS28-TS28 | | | | | └ nerve of prostatic urethra
EMAPA:29639 TS28-TS28 | | | | ├ bulbar part of urethra of male
~~EMAPA:29641 TS28-TS28 | | | | | distal region of urethra of male~~ (merged with penile urethra)

prostatic urethra (TS28): the subregion of the urethra of male where the prostate glands enter the urethra. Cranially joined to the bladder and caudally joined to the pelvic urethra of male. Comprised of epithelium (subdivided into 3 layers and into dorsal and ventral), mesenchymal layer (subdivided into lamina propria, muscularis mucosa, submucosa), muscle layer (subdivided into smooth muscle and rhabdosphincter) and adventitia. Also contains vasculature and nerve of prostatic urethra. The verumontanum (the raised portion of the dorsal epithelium of prostatic urethra where the ejaculatory duct orifices enter the urethra) is also part of the prostatic urethra.

epithelium of prostatic urethra (TS28): the innermost layer of the prostatic urethra, a stratified epithelium lining the lumen. It is subdivided into dorsal and ventral. It is also

subdivided into three epithelial cell layers; superficial, intermediate and basal cell layer of prostatic urethra. The raised, dorsal portion of the male urethra where the prostate glands and orifices of the ejaculatory ducts enter the urethra is the verumontanum (syn: seminal collilucullus).

mesenchymal layer of prostatic urethra (TS28): the mesenchymal layer of the prostatic urethra located between the epithelium and muscle layers. Contains smooth muscle cells and mesenchymal/fibroblastic/stromal cells, blood vessels and nerves. Subdivided into lamina propria, musclaris mucosa and submucosa.

Lamina propria of prostatic urethra (TS28): the thin mesenchymal/fibroblastic/stromal cell layer of the prostatic urethra located immediately adjacent to the epithelium, between the epithelium and the muscularis mucosa. Contains connective tissue, marked by pro-collagen.

Muscularis mucosa of prostatic urethra (TS28): a thin, discontinuous layer comprised of wisps of smooth muscle, located between the lamina propria and the submucosa. Expresses markers of smooth muscle including ACTA2-protein and smooth muscle alpha actin (Acta2).

Submucosa of prostatic urethra (TS28): the mesenchymal layer located below the muscularis mucosa of prostatic urethra, between the muscularis mucosa and muscle layer of prostatic urethra, comprised of mesenchymal/fibroblastic cells.

Muscle layer of prostatic urethra (TS28): the thick layer of muscle towards the outside of the prostatic urethra. Subdivided into smooth muscle layer of prostatic urethra and rhabdosphincter of male (syn: striated muscle layer of prostatic urethra).

smooth muscle layer of prostatic urethra (TS28): the smooth muscle layer towards the outside of the prostatic urethra. Part of the prostatic urethra, part of the urethra of male. Marked by proteins expressed by smooth muscle cells, such as smooth muscle alpha actin (Acta2).

rhabdosphincter of male (syn: striated muscle layer of prostatic urethra) (TS28): the striated muscle layer towards the outside of the prostatic urethra. Part of the prostatic urethra, part of the urethra of male. Marked by proteins expressed by skeletal muscle cells, such as skeletal muscle alpha actin (Acta1).

adventitia of prostatic urethra (TS28): the outer connective tissue layer of the prostatic urethra. The prostatic urethra is not surrounded by an outer serous membrane or serosa.

bulbar part of urethra of male (TS28-TS28): The portion of male urethra that drains the bulbourethral glands and is positioned between the pelvic and penile portions of urethra.

Glands in the urethra:

EMAPA:28747 TS23-TS28 | | | ├ urethra of female
EMAPA:28753 TS23-TS28 | | | | ├ pelvic urethra of female (syn: cranial urethra, internal urethra)
EMAPA:36132 TS24-TS26 | | | | | ├ ventral epithelial bud of female
EMAPA:36133 TS27-TS28 | | | | | ├ urethral gland of pelvic urethra of female

EMAPA:29653 **TS27**-TS28 | | | | └ female urethral gland (syn: Skene's gland)
EMAPA:36133 TS27-TS28 | | | | | ├ urethral gland of female pelvic urethra (syn: Skene's gland of pelvic urethra)
EMAPA:36134 TS27-TS28 | | | | | ├ urethral gland of clitoral urethra (syn: Skene's gland of clitoral urethra)

EMAPA:18692 TS23-TS28 | | | ├ urethra of male
EMAPA:18995 TS23-TS28 | | | | ├ pelvic urethra of male
EMAPA:36135 TS24-TS26 | | | | | └ ventral epithelial bud of male
EMAPA:36144 TS24-TS26 | | | | | | └ ventral prostate bud
EMAPA:36426 TS24-TS26 | | | | | | └ anterior male urethral gland bud
EMAPA:36425 TS24-TS26 | | | | | └ male urethral gland bud
EMAPA:36426 TS24-TS26 | | | | | | └ anterior male urethral gland bud
EMAPA:36427 TS24-TS26 | | | | | | └ posterior male urethral gland bud
EMAPA:29645 **TS27**-TS28 | | | | └ male urethral gland
EMAPA:36423 TS27-TS28 | | | | | ├ urethral gland of male pelvic urethra
EMAPA:36424 TS27-TS28 | | | | | ├ urethral gland of penile urethra

ventral epithelial bud of male (TS24-26): part of urethra of male, part of the pelvic urethra of male. Epithelial glands that bud from the pelvic urethra of male, develop from the cloacal endoderm-derived epithelium located in the ventral, anterior pelvic urethra, close to the bladder neck. In male mice, these buds represent both anterior male urethral gland buds and ventral prostate buds, which will develop into male urethral glands and ventral prostate glands respectively (TS27). These two gland types are grouped together because, during development, urethral and prostate glands cannot be distinguished from each other and both express the same markers, such as the early prostate marker, *Nkx3-1*. *Edar* and *Wnt10b* mRNA staining intensity can be used to separate prostatic gland buds (High *Edar* and *Wnt10b* mRNA expression) from urethral gland buds (Low to not detectable *Edar* and *Wnt10b* mRNA) in male mice during development. By TS27 (birth), ventral prostate buds can be distinguished from male urethral gland buds as they are longer, having started to enlongate, and are seen in two lateral rows, with the smaller, shorter male urethral gland buds present medially and not aligned into rows. Ventral prostate bud is also part of the prostate bud (TS24-26, part of prostate gland) and becomes ventral prostate gland (TS27). Anterior male urethral gland buds become urethral gland of male pelvic urethra (TS27).

ventral epithelial bud of female (TS24-26): part of urethra of female and part of the pelvic urethra of female. In female mice, epithelial buds develop from the epithelium of the pelvic urethra. These buds develop in the ventral pelvic urethra in females, anterior to the sinovaginal bulb connection to the pelvic urethra in the same location as ventral prostate buds in the male. At birth, these buds are short, only a few cells in diameter and extend out from the epithelium of pelvic urethra, however they are more numerous than the ventral epithelial bud of male. Unlike in the male, where some of these ventral epithelial buds are ventral prostate buds and develop into the ventral prostate gland, in the female, these buds do not elongate. Female mice can develop functional prostate glands if exposed to exogenous androgens. Sometimes these buds are called rudimentary prostate buds or female prostate buds. However during normal female developmental, they most likely develop into urethral gland of female pelvic urethra (syn: Skene's gland of pelvic urethra, TS27).

Male urethral gland bud (TS24-26): numerous epithelial urethral glands bud from the epithelium of the pelvic urethra. Part of the urethra of male and pelvic urethra of male. Subdivided into anterior and posterior male urethral gland bud (in the male only). In males, anterior male urethral gland buds are also a part of ventral epithelial bud of male, because at early stages, they cannot be distinguished from ventral prostate buds. These two gland types both express the early prostate marker, *Nkx3-1*. *Edar* and *Wnt10b* mRNA staining intensity can be used to separate prostatic gland buds (High *Edar* and *Wnt10b* mRNA expression) from urethral gland buds (Low to not detectable *Edar* and *Wnt10b* mRNA) in male mice during development. At TS27, develop into urethral gland of male pelvic urethra.

male urethral gland (TS27-TS28): numerous epithelial urethral glands develop from the epithelium of the urethra. Develop from male urethral gland bud (TS24-26). Part of the urethra of male, subdivided into urethral gland of pelvic urethra of male (part of the pelvic urethra) and urethral gland of penile urethra (part of the penile urethra).

female urethral gland (syn: Skene's gland) (TS27-TS28): epithelial urethral glands develop from the epithelium of the urethra. Develop from female urethral gland bud (TS24-TS26). Part of the urethra of female, subdivided into urethral gland of pelvic urethra of female (part of the pelvic urethra) and urethral gland of clitoral urethra (part of the clitoral urethra).

bulbourethral gland of male/female (TS23-28) (Cowper's gland): paired epithelial secretory glands develop at the junction of the phallic/penile/clitoral and pelvic urethra in males and females. First seen at E15.5 (TS23), budding out from the epithelium of the urethra in both sexes. They are larger in the male. Growth is dependant on androgens and in males, they canalise after birth (TS27, P1) opening into the urethra and then branch and enlarge during the neonatal period. Comprised of epithelium and a thin interstitium (or connective tissue) which also contains the vasculature (blood vessels). The epithelium of

bulbourethral gland is derived from cloacal endoderm. Part of urethra of male/female, and also part of male/female accessory gland. Also called Cowper's gland in human males and not present in human females. It is likely they remain only rudimentary in the adult female mouse.

Prostate gland (TS24-28): part of the urethra of male and part of the male accessory gland. Divided into layers (epithelium of prostate gland and peri-prostatic mesenchyme of prostate gland), developmental stages (prostate bud and prostate gland) and regions by location (anterior, dorsal, ventral and lateral). From TS24-27, the glands are called prostate buds, subdivided into anterior, dorsal (TS24-27) and ventral and lateral prostate bud (TS25-27). At TS28, the prostate gland is divided into anterior, dorsal, ventral and lateral prostate gland.

prostate bud (TS24 to TS27) (syn: prostatic bud, prostate gland bud): androgens produced by the male, leads to the formation of numerous prostate buds, which develop from the epithelium of the pelvic urethra in distinct locations. Anterior and dorsal prostatic buds are the first to emerge at E16.5 (TS24) and later lateral and ventral buds at E17.5 (TS25). Prostate buds emerge from the epithelium in the location of the mesenchymal pads. Comprised of epithelium of prostate bud (derived from the urogenital sinus epithelium) and peri-prostatic mesenchyme of prostate bud. Epithelial layer of prostate bud is selectively marked by *Wnt10b* (E17 to P0, in all prostate bud regions) and is also marked by *Nkx3-1* at E16 to P0 (also expressed in urethral gland buds, E16 to P0). In the prostate gland, *Bmp2* is selectively expressed by epithelium of ventral prostate bud at E17. Prostate bud formation is complete by E18.5 (TS26) and elongation and differentiation continues after birth. The different prostate bud regions show differences in size, patterning and location.

Anterior, dorsal, ventral, lateral prostate gland (TS28): prostate glands are subdivided into four bilaterally symmetrical regions (known as lobes in the human); anterior, dorsal, lateral and ventral prostate gland. The regions have different morphology and gene expression profiles which are specified during development via both common and region-specific genetic pathways. The 3D anatomy of the prostate gland is extremely complex.

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EMAPA:18692   TS23-TS28 | | | ├ urethra of male
EMAPA:19285   TS23-TS28 | | | | ├ male accessory gland
EMAPA:19286   TS23-TS28 | | | | | ├ bulbourethral gland of male (syn: Cowper's gland of male)
EMAPA:29790   TS23-TS28 | | | | | | ├ epithelium of bulbourethral gland of male
EMAPA:29792   TS23-TS28 | | | | | | ├ lamina propria of bulbourethral gland of male
EMAPA:30801   TS23-TS28 | | | | | | ├ vasculature of bulbourethral gland of male
EMAPA:35055   TS27-TS28 | | | | | | └ nerve of bulbourethral gland of male
EMAPA:19287   TS24-TS28 | | | | | └ prostate gland
EMAPA:32290   TS24-TS28 | | | | |   ├ epithelium of prostate gland
EMAPA:32281   TS24-TS28 | | | | |   ├ peri-prostatic mesenchyme of prostate gland
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EMAPA:36141 TS24-TS27 | | | | | | └ prostate bud (syn: prostatic bud, prostate gland bud)
EMAPA:36142 TS24-TS27 | | | | | | | ├ anterior prostate bud
EMAPA:36146 TS24-TS27 | | | | | | | | ├ epithelium of anterior prostate bud
EMAPA:36147 TS24-TS27 | | | | | | | | └ peri-prostatic mesenchyme of anterior prostate bud
EMAPA:36143 TS24-TS27 | | | | | | | ├ dorsal prostate bud
EMAPA:36148 TS24-TS27 | | | | | | | | ├ epithelium of dorsal prostate bud
EMAPA:36149 TS24-TS27 | | | | | | | | └ peri-prostatic mesenchyme of dorsal prostate bud
EMAPA:36144 TS24-TS27 | | | | | | | ├ ventral prostate bud
EMAPA:36150 TS24-TS27 | | | | | | | | ├ epithelium of ventral prostate bud
EMAPA:36151 TS24-TS27 | | | | | | | | └ peri-prostatic mesenchyme of ventral prostate bud
EMAPA:36145 TS24-TS27 | | | | | | | ├ lateral prostate bud
EMAPA:36152 TS24-TS27 | | | | | | | | ├ epithelium of lateral prostate bud
EMAPA:36153 TS24-TS27 | | | | | | | | └ peri-prostatic mesenchyme of lateral prostate bud
EMAPA:29794 TS28-TS28 | | | | | ├ anterior prostate gland (syn: coagulating gland)
EMAPA:29796 TS28-TS28 | | | | | | ├ anterior prostatic epithelium
EMAPA:29798 TS28-TS28 | | | | | | | ├ glandular epithelium of anterior prostate (syn: luminal epithelium; secretory epithelium)
EMAPA:29800 TS28-TS28 | | | | | | | └ basal epithelium of anterior prostate
EMAPA:29802 TS28-TS28 | | | | | | └ anterior prostatic interstitium
EMAPA:29804 TS28-TS28 | | | | | | ├ smooth muscle of anterior prostate
EMAPA:29806 TS28-TS28 | | | | | | └ rest of interstitium of anterior prostate
EMAPA:29808 TS28-TS28 | | | | | ├ dorsal prostate gland
EMAPA:29810 TS28-TS28 | | | | | | ├ dorsal prostatic epithelium
EMAPA:29812 TS28-TS28 | | | | | | | ├ glandular epithelium of dorsal prostate (syn: luminal epithelium; secretory epithelium)
EMAPA:29814 TS28-TS28 | | | | | | | └ basal epithelium of dorsal prostate
EMAPA:29816 TS28-TS28 | | | | | | └ dorsal prostatic interstitium
EMAPA:29818 TS28-TS28 | | | | | | ├ smooth muscle of dorsal prostate
EMAPA:29820 TS28-TS28 | | | | | | └ rest of interstitium of dorsal prostate
EMAPA:29822 TS28-TS28 | | | | | ├ lateral prostate gland
EMAPA:29824 TS28-TS28 | | | | | | ├ lateral prostatic epithelium
EMAPA:29826 TS28-TS28 | | | | | | | ├ glandular epithelium of lateral prostate (syn: luminal epithelium; secretory epithelium)
EMAPA:29828 TS28-TS28 | | | | | | | └ basal epithelium of lateral prostate
EMAPA:29830 TS28-TS28 | | | | | | └ lateral prostatic interstitium
EMAPA:29832 TS28-TS28 | | | | | | ├ smooth muscle of lateral prostate
EMAPA:29834 TS28-TS28 | | | | | | └ rest of interstitium of lateral prostate
EMAPA:29836 TS28-TS28 | | | | | ├ ventral prostate gland
EMAPA:29838 TS28-TS28 | | | | | | ├ ventral prostatic epithelium
EMAPA:29840 TS28-TS28 | | | | | | | ├ glandular epithelium of ventral prostate (syn: luminal epithelium; secretory epithelium)
EMAPA:29842 TS28-TS28 | | | | | | | └ basal epithelium of ventral prostate
EMAPA:29844 TS28-TS28 | | | | | | └ ventral prostatic interstitium
EMAPA:29846 TS28-TS28 | | | | | | ├ smooth muscle of ventral prostate
EMAPA:29848 TS28-TS28 | | | | | | └ rest of interstitium of ventral prostate
EMAPA:30805 TS28-TS28 | | | | | ├ vasculature of prostate gland
EMAPA:32285 TS28-TS28 | | | | | └ nerve of prostate gland

EMAPA:36428 TS23-TS28 | | | | ├ female accessory gland
EMAPA:36429 **TS23**-TS28 | | | | | ├ bulbourethral gland of female (syn: Cowper's gland of female)
EMAPA:36430 **TS23**-TS28 | | | | | | ├ epithelium of bulbourethral gland of female
EMAPA:36431 **TS23**-TS28 | | | | | | ├ lamina propria of bulbourethral gland of female

EMAPA:36432 **TS23**-TS28 | | | | | └ vasculature of bulbourethral gland of female

Phallic urethra

Phallic urethra of male/female TS21-24, part of the urinary system, and part of the genital tubercle of male/female. Becomes clitoral and penile urethra at TS25-28.

EMAPA:17366 TS19-TS28 | | ├ urinary system
EMAPA:28747 TS21-TS28 | | | ├ urethra of female
EMAPA:36433 TS21-TS24 | | | | └ phallic urethra of female (syn: external urethra of female)
EMAPA:30470 TS21-TS24 | | | | | ├ epithelium of phallic urethra of female
EMAPA:31536 TS21-TS24 | | | | | ├ urethral plate epithelium of female (syn: urethral plate of female, distal urethral epithelium of female)
EMAPA:31530 TS21-TS24 | | | | | ├ urethral tube epithelium of female (syn: proximal urethral epithelium of female)
EMAPA:31531 TS21-TS24 | | | | | └ proximal urethral meatus of female (syn: proximal urethral opening of female, urethral duct)
EMAPA:30927 TS20-TS24 | | | | | ├ urethral fold of female
EMAPA:30917 **TS25**-TS28 | | | | ├ ~~phallic~~ clitoral urethra ~~of female~~ (syn: external urethra of female)
EMAPA:30930 TS25-TS28 | | | | | ├ ~~urothelium of phallic~~ epithelium of clitoral urethra ~~of female~~
EMAPA:30924 **TS25-TS25** | | | | | | ├ urethral plate epithelium of clitoral urethra ~~of female~~ (syn: urethral plate of female, distal urethral epithelium of female)
EMAPA:xxxxx TS25-TS25 | | | | | | ├ urethral tube epithelium of clitoral urethra (syn: proximal urethral epithelium of female
EMAPA:xxxxx TS25-TS28 | | | | | | └ proximal urethral meatus of clitoral urethra (present to P7) (syn: proximal urethral opening of female, urethral duct)
EMAPA:xxxxx TS27-TS28 | | | | | | └ urethral meatus of clitoral urethra (syn: distal urethral opening of female)
EMAPA:30927 TS25-TS27 | | | | | └ urethral fold of female

EMAPA:17366 TS19-TS28 | | ├ urinary system
EMAPA:18692 **TS21**-TS28 | | | ├ urethra of male
EMAPA:17956 **TS21-TS24** | | | | ├ phallic urethra of male (syn: external urethra of male)
EMAPA:30467 **TS21-TS24** | | | | | ├ ~~urethral~~ epithelium of male phallic urethra ~~(syn: urethral plate; urethral seam~~)
EMAPA:31507 **TS20-TS24** | | | | | | ├ urethral plate epithelium of male (syn: distal urethral epithelium of male; urethral plate)
EMAPA:31508 TS21-**TS24** | | | | | | ├ urethral tube epithelium of male (syn: proximal urethral epithelium of male)
EMAPA:31505 TS21-TS24 | | | | | | └ proximal urethral meatus of male (syn: proximal urethral opening of male, urethral duct)
EMAPA:36421 TS24-TS28 | | | | | ├ urethral seam (syn: urethral raphe)
EMAPA:18693 TS20-TS24 | | | | | └ urethral fold of male
EMAPA:30944 **TS25**-TS28 | | | | ├ penile urethra
EMAPA:30946 **TS25**-TS28 | | | | | ├ ~~urothelium~~ epithelium of penile urethra
EMAPA:xxxxx TS25-TS25 | | | | | | ├ urethral tube epithelium of male (syn: proximal urethral epithelium of male)
EMAPA:xxxxx TS25-TS28 | | | | | | └ urethral meatus of penile urethra (syn: urethral opening of male)
EMAPA:36421 TS24-TS28 | | | | | ├ urethral seam (syn: urethral raphe)
EMAPA:18693 TS25-TS27 | | | | | └ urethral fold of male

Terms to be deleted in female:

~~EMAPA:30934 TS25-TS28 ├ ├ ├ ├ ├ ├ mesenchymal layer of phallic urethra of female~~
~~EMAPA:30938 TS25-TS28 ├ ├ ├ ├ ├ ├ muscle layer of phallic urethra of female~~

Terms to be deleted in male:

EMAPA:28853 TS25-TS27 ├ ├ ├ ├ ├ ├ urothelium of phallic urethra of male = EMAPA:30467
~~EMAPA:28856 TS25-TS27 ├ ├ ├ ├ ├ ├ mesenchymal layer of phallic urethra of male~~
~~EMAPA:28859 TS25-TS27 ├ ├ ├ ├ ├ ├ muscle layer of phallic urethra of male~~
EMAPA:18998 TS23-TS24 ├ ├ ├ ├ ├ ├ urethral plate of male = EMAPA:31507

~~EMAPA:30948 TS28-TS28 ├ ├ ├ ├ ├ ├ mesenchymal layer of penile urethra~~
~~EMAPA:30950 TS28-TS28 ├ ├ ├ ├ ├ └ muscle layer of penile urethra~~

Terms merged:

EMAPA:31551 TS23-TS28 ├ ├ ├ ├ ├ └ nerve of phallic urethra of female
EMAPA:31568 TS23-TS27 ├ ├ ├ ├ ├ └ nerve of phallic urethra of male

Nerve of phallic urethra of male/female is actually the nerve of penis/clitoris and these terms have been merged.

phallic urethra of male/female (TS21-24): part of the genital tubercle of male/female and part of the urethra of male/female. Comprised of epithelium and anatomically located within the genital tubercle of male/female. From TS25, as the genital tubercle becomes the penis and clitoris, the phallic urethra becomes the penile or clitoral urethra in male and females respectively. The phallic urethra is anatomically located within the genital tubercle and is surrounded by the tissue of the genital tubercle, therefore only the epithelial components are necessary parts of phallic urethra.

epithelium of phallic urethra of male/female (TS20-25): derived from cloacal endoderm and derived from the urethral plate epithelium (TS19). Located within the genital tubercle of male/female. At TS20, the urethral plate epithelium has not canalised and only the plate is seen. At TS21, as the plate begins to canalise and form a tube, it is subdivided into the urethral plate epithelium of male/female (syn: urethral plate), the bilaminar epithelium located distally, and into the phallic urethral tube epithelium (syn: proximal phallic urethral epithelium) which is the part of the urethral epithelium that has septated into a canalised tube proximally, and it is open at the proximal urethral meatus. The proximal urethral meatus closes in males, a process which begins around TS23 and is not present in males at TS25. In females, the proximal urethral meatus remains open to TS27 (closed by TS28, p8). The epithelium of phallic urethra of male/female becomes the epithelium of penile urethra/clitoral urethra at TS26.

penile urethra (syn: external urethra of male) (TS25-TS28): comprised of epithelium of penile urethra. Epithelium of penile urethra (TS25-TS28) derived from epithelium of phallic urethra of male/female (TS21-TS24). The urethral plate epithelium of male (syn: distal

urethral epithelium of male; urethral plate) completely canalises by TS25 and the plate is no longer present in males from TS25. By TS25, the penile urethra opens at the urethral meatus of penile urethra (syn: urethral opening of male) and the proximal urethral meatus has closed. The penile urethra is anatomically located, centrally within the penis and is surrounded by the tissue of the penis, therefore only the epithelial components are necessary parts of penile urethra.

clitoral urethra (syn: external urethra of female) (TS25-TS28): comprised of epithelium of clitoral urethra. Epithelium of clitoral urethra (TS25-28) derived from epithelium of phallic urethra of male/female (TS21-24). At TS25, the epithelium is subdivided into along its distal-proximal length into urethral plate epithelium (distal) and urethral tube epithelium (proximal). The urethral plate epithelium of female (syn: distal urethral epithelium of female; urethral plate of female) is no longer present from TS26. The clitoral urethra is open proximally at the proximal urethral meatus (present to P7) (syn: proximal urethral opening of female or urethral duct) located at the base of the clitoris. The proximal urethral meatus closes after birth (closed by P8). In adults and from birth, the urethra of female is open externally at the urethral meatus of clitoral urethra (syn: distal urethral opening of female) which is anatomically located within the clitoris. (This is different to humans, where the urethral opening is located between the clitoris and vagina.) The clitoral urethra is anatomically located ventrally within the clitoris and is surrounded by the tissue of the clitoris, therefore only the epithelial components are necessary parts of clitoral urethra.

proximal urethral meatus of male/female (syn: proximal urethral opening or urethral duct): the proximal opening in the epithelium of male/female phallic urethra (TS21 to TS24). In females, it becomes the proximal urethral meatus of clitoral urethra, part of the epithelium of clitoral urethra from TS25 to TS28, and is present to P7. By P8, the proximal urethral meatus is closed in females and the urethra opens at the urethral meatus. In males, the proximal urethral meatus of male, is only present up to TS24. In males from TS25, the penile urethra has completely canalised and opens at the urethral meatus of penile urethra (syn: urethral opening of male) and the proximal urethral meatus has closed.

urethral meatus of clitoral urethra (syn: urethral opening of clitoral urethra or distal urethral opening of female) TS27-28: the opening of the clitoral urethra, located within the clitoris. The clitoral urethra is open proximally at the proximal urethral meatus (present to P7) (syn: proximal urethral opening of female or urethral duct) located at the base of the clitoris. The proximal urethral meatus closes after birth (closed by P8). In adults and from birth, the urethra of female is open externally at the urethral meatus of clitoral urethra (syn: distal urethral opening of female) which is anatomically located within the clitoris. (This is different to humans, where the urethral opening is located between the clitoris and vagina.)

urethral meatus of penile urethra (syn: urethral opening of penile urethra or distal urethral opening of male) (TS25-28): the opening in the penile urethra, located near the distal tip of the penis.

urethral seam (syn: urethral raphe, ventral seam) (TS24 -TS28): in the male, growth from mesenchyme ventral to the phallic urethra closes the proximal urethral meatus and septates the epithelium of phallic urethra. This results in the centrally positioned phallic urethra and the ventrally positioned urethral seam. The urethral seam is a solid epithelial cord present underneath the skin along the ventral midline of the penis. Septation moves in a proximal to distal direction along the penis during development and the urethral seam is retained in the adult penis. Part of the genital tubercle of male (TS24), part of the penis (TS25-TS28) and also part of phallic urethra of male (TS24) and penile urethra.

urethral fold of male/female (TS20-TS27): the mesenchyme adjacent to the epithelium of phallic urethra that is thought to fuse during internalization of the urethra in males, however whether or not this mesenchyme fuses is unclear. Present in both males and females from E12.5 (Suzuki et al., 2002). Part of the genital tubercle of male/female, part of the urethra of male/female and part of the phallic urethra of male/female. As the genital tubercle becomes the penis/clitoris, the urethral folds become part of the penile/clitoral urethra. Absent after internalisation of the urethra in postnatal males. Absent from postnatal females.