

LEARNING OBJECTIVES

- Understand that sexual differentiation and development begin in early embryonic life.
- Understand the embryonic development and the anatomy of the perineum, the vagina, cervix and uterus, the adnexa and ovary and the bladder and ureter
- Describe the blood supply and lymphatics of the perineum and pelvis.
- Understand the innervation of the perineum and pelvis.

Embryology

Both the urinary and genital systems develop from a common mesodermal ridge running along the posterior abdominal wall. It is important to remember that congenital anomalies of the genital tract may also be associated with congenital anomalies of the urinary tract.

The gonadal rudiments appear as the 'genital ridge' overlying the embryonic kidney in the intermediate mesoderm during the fourth week of embryonic life, and they remain sexually indifferent until the seventh week.

The undifferentiated gonad has the potential to become either a testis or an ovary, and hence is termed **bipotential**, and the chromosomal complement of the zygote determines whether the gonad becomes a testis or an ovary.

Following fertilization the normal embryo contains 23 sets of chromosomes, including 22 autosomes and one sex chromosomes from each parent

46 XY embryo will develop as a male

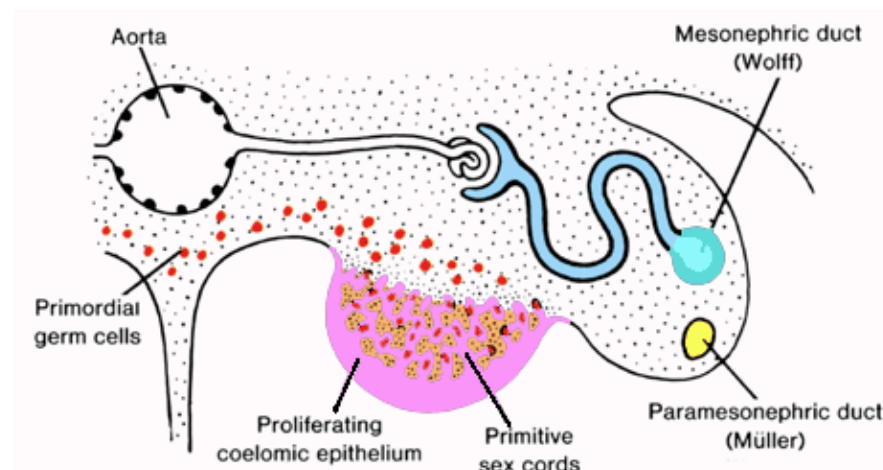
46XX embryo will develop as a female

It's the presence or the absence of the Y chromosome which determines whether the undifferentiated gonad becomes a testis or an ovary

By the 6th week embryonic life, both male and female embryos start to develop the following structures on either side of the midline: 1. Genital ridge (proliferation of coelomic epithelium)

2. Mesonephric (Wolffian) duct (lateral to the genital ridge)

3. Paramesonephric (Mullerian) duct



Male sex determination is controlled by the SRY gene,

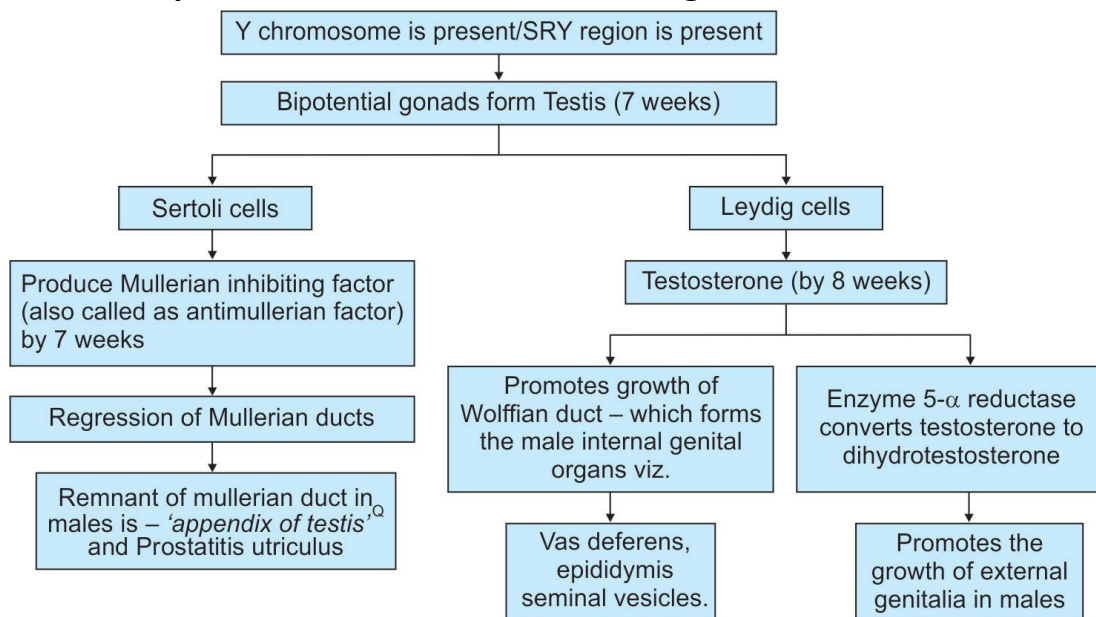
Y chromosome contains the SRY (sex-determining region on Y) gene on its short arm. The SRY protein is the testis-determining factor; its presence influences the male development, while its absence establishes the female development.

SRY gene product act as a transcription factor that induces expression of downstream genes leading to production of Mullerian inhibiting substance (MIS), and testosterone .

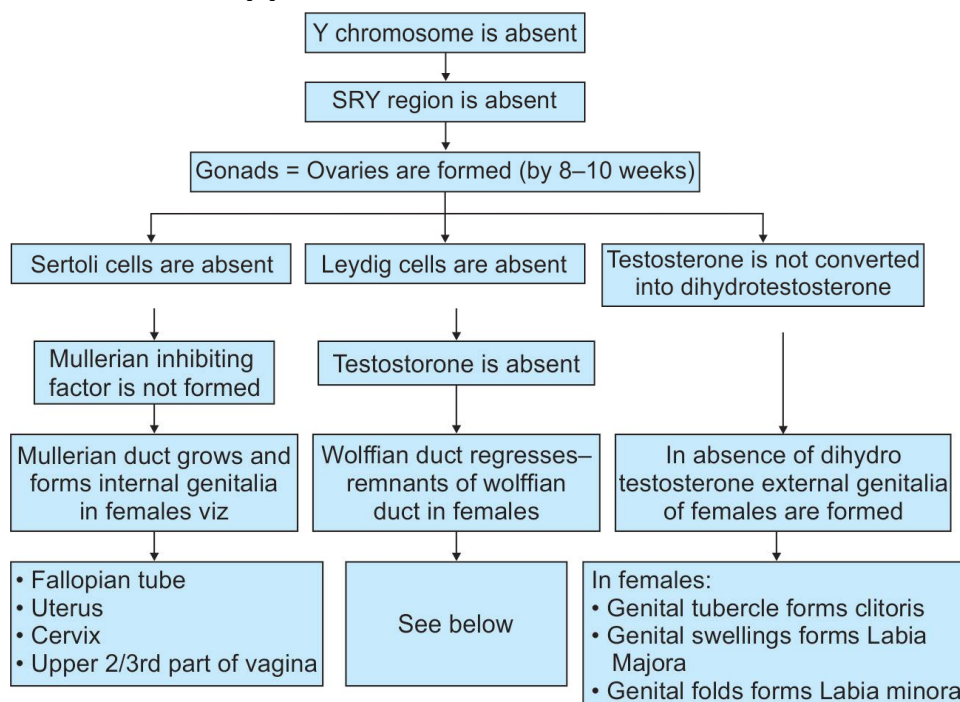
Differentiation of male internal organs

- The Mullerian Inhibiting Hormone (MIH) (Sertoli cells): responsible for regression of the ipsilateral paramesonephric ducts

- Testosterone (Leydig cells): responsible for development of the mesonephric duct into the male internal genitalia



— **Differentiation of Female Internal Organs** In the absence of y chromosom and absence of (sex-determining region gene on its short arm). There is no production of (MIF and testosterone), So the mesonephric system regress and the Mullerian duct develop to give the fallopian tube vagina, uterus, and upper



Ovary

The primitive gonad is formed between 5 and 7 weeks of gestation.

The maximum number of primordial follicles is reached at 20 weeks gestation when at this time there are six to seven million primordial follicles present .

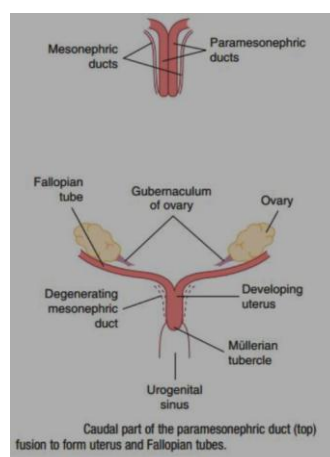
The numbers of these reduce by atresia and by birth to one to two million are present. Atresia continues throughout childhood and by menstruation 300 000 to 400 000 are present

The uterus and vagina

In the female fetus the Wolffian system regresses. The female reproductive tracts develop from paired ducts which are adjacent to the mesonephric duct and so are called the paramesonephric ducts (or Mullerian ducts).

These fuse in the midline distally to form the uterus, cervix and proximal two thirds of the vagina. The unfused caudal segments form the Fallopian tubes.

The distal vagina is formed from the sinovaginal bulbs in the upper portion of the urogenital sinus

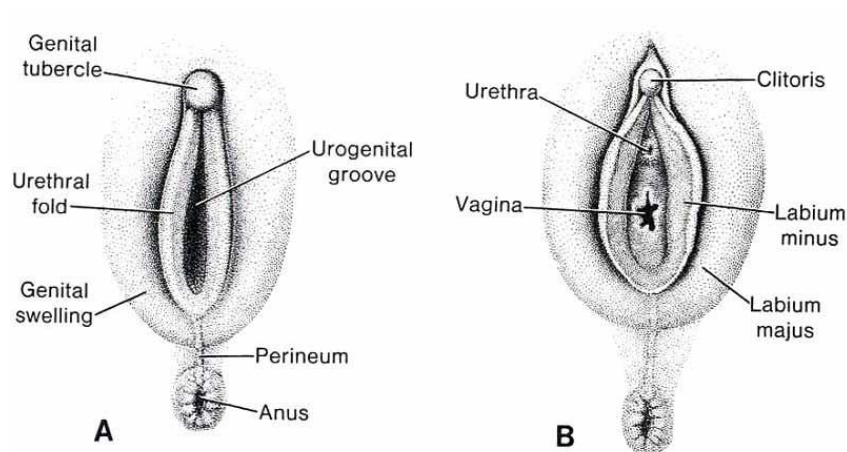


The external genitalia

Between the fifth and seventh weeks of life, the cloacal folds which are a pair of swellings fuse anteriorly to become the genital tubercle. This will become the clitoris. so Genital tubercle form the clitoris

Urethral folds form labia minora

Genital swelling enlarge to form labia majora. Urogenital groove is open to form vestibule



Primitive structure	Female	Male
Un differentiated gonads	Ovary	Testis
Mullerian system (paramesonephric)	Uterus , tubes , and upper 4/5 of the vagina	Appendices testis (hydatid cyst of morgagni)and prostetic utricle
Wolffian system (mesonephric)	<u>epoophoron</u> , and the <u>paroöphoron</u> , of <u>rudimentary</u> , <u>mesosalpinx</u> .	Epidydimis vas deference , trigone of the bladder , prostetic urethra above the ejaculatory duct
Genital tubercle	Clitoris	Penis
Genital fold	Labia minora	Penile urethra
Genital swelling	labia majora and bartholines gland	Scrotum and bulbo-urethral glands

ANATOMY OF GENITAL TRACT

The external genitalia

The external genitalia is commonly called the vulva and includes the mons pubis, labia majora and labia minora, the vaginal vestibule, the clitoris and the greater vestibular glands.

Mons pubis : fatty area overlying pubic symphysis .

Labia majora: hair-covered,fatty skin folds.

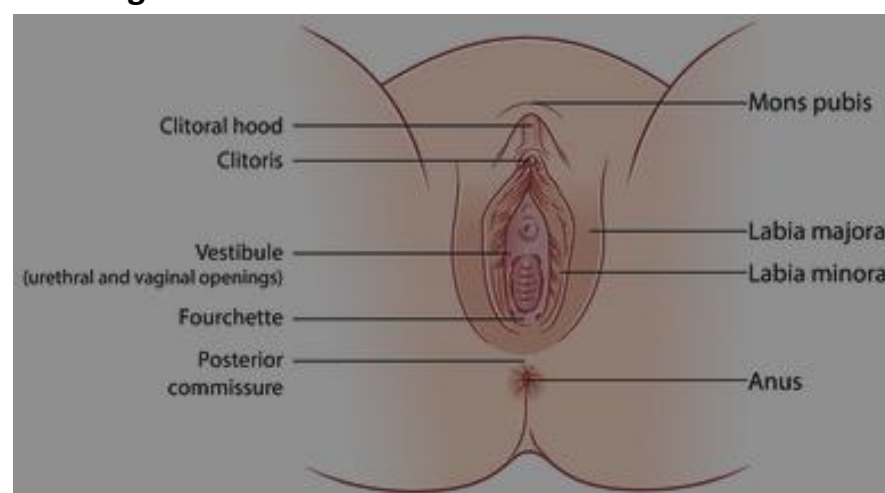
The labia minora are two thin folds of skin that lie between the labia majora.

Vestibule: is the cleft between the labia minora. It contains openings of the urethra, the Bartholin's glands and the vagina.

Fourchette : ridge formed by joining of posterior vestibule and labia minora.

The clitoris : is an erectile structure measuring approximately 0.5–3.5 cm in length. The body of the clitoris is the main part of the visible clitoris .

The Bartholin's glands: are bilateral and about the size of a pea. They open via a 2-cm duct into the vestibule below the hymen and contribute to lubrication during intercourse. The hymen : is a thin covering of mucous membrane across the entrance to the vagina



The internal reproductive organs

The vagina

The vagina is a fibromuscular canal lined with stratified squamous epithelium that leads from the uterus to the vulva. It is longer in the posterior wall (approximately 9 cm) than in the anterior wall (approximately 7 cm).

The vault of the vagina is divided into four fornices: posterior, anterior and two lateral.

The vaginal walls are lined with transverse folds. The vagina has no glands and is kept moist by secretions from the uterine and cervical glands and by transudation from its epithelial lining. The epithelium is thick and rich in glycogen which increases in the post-ovulatory phase of the cycle.

Doderlein's bacillus is a normal commensal of the vaginal flora and breaks down glycogen to form lactic acid.

The uterus

The uterus is shaped like an inverted pear. It is hollow and has thick, muscular walls. It is approximately 7.5 cm long, 5 cm wide and 3 cm thickness. An adult uterus weighs approximately 70 g.

In the upper part, the uterus is termed the body or 'corpus'. The area of insertion of each Fallopian tube is termed the 'cornu' and that part of the body above the cornu is called the 'fundus'.

The uterus tapers to a small constricted area, the isthmus, and below this is the cervix.

The longitudinal axis of the uterus is approximately at right angles to the vagina and normally tilts forward. This is called 'anteversion'.

In around 20 per cent of women, the uterus is tilted backwards – retroversion and retroflexion. This has no pathological significance.

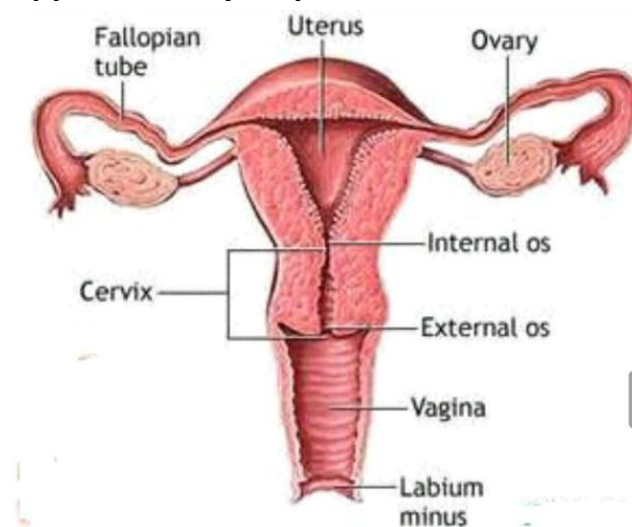
The uterus consists of three layers: the outer serous layer (peritoneum), the middle muscular layer (myometrium) and the inner mucous layer) endometrium .

The muscular myometrium forms the main bulk of the uterus..

The cervix

The cervix is narrower than the body of the uterus and is approximately 2.5 cm in length. Lateral to the cervix lies cellular connective tissue called the parametrium. The ureter runs about 1 cm laterally to the supravaginal cervix within the parametrium. The upper part of the cervix mostly consists of involuntary muscle, whereas the lower part is mainly fibrous connective tissue.

The epithelium of the endocervix is columnar and is also ciliated in its upper two thirds. This changes to stratified squamous epithelium around the region of the external os and the junction of these two types of epithelium is called the 'squamocolumnar junction ' or transformation zone. This is an area of rapid cell division and approximately 90 per cent of cervical cancers arise



The Fallopian tubes The Fallopian tube extends outwards from the uterine cornu to end near the ovary. The Fallopian tube runs in the upper margin of the broad ligament part of which, known as the mesosalpinx

Each tube is about 10 cm long and is described in four parts:

1. The interstitial portion
2. The isthmus
3. The ampulla
4. The infundibulum or fimbrial portion.

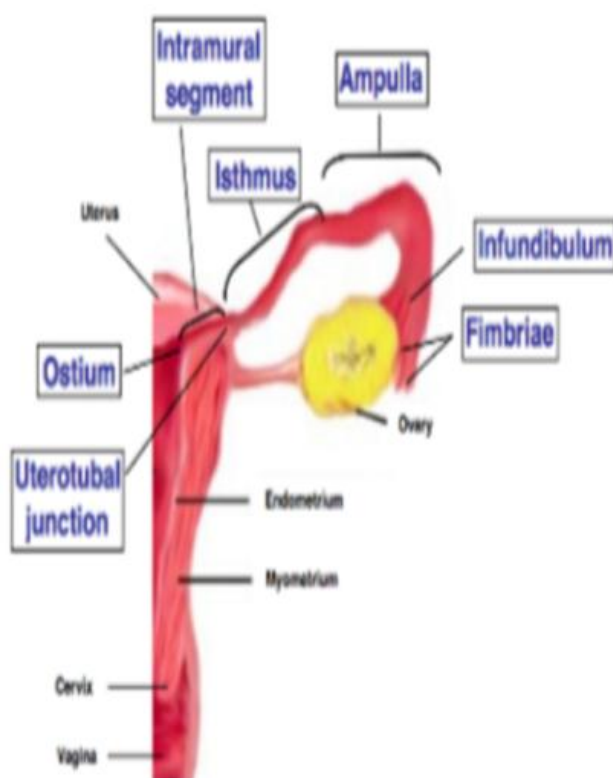
The interstitial portion lies within the wall of the uterus, while the isthmus is the narrow portion adjoining the uterus.

The opening of the tube into the peritoneal cavity is surrounded by finger-like processes, known as fimbria

The inner surfaces of the fimbriae are covered by ciliated epithelium which is similar to the lining of the Fallopian tube itself.

The muscular fibers of the wall of the tube are arranged in an inner circular and an outer longitudinal layer.

Changes occur under the influence of the menstrual cycle, but there is no cell shedding during menstruation



The ovaries

they are almond-shaped and measure approximately 3cm long, 1.5 cm wide and 1 cm thickness.,located in the ovarian fossa on the lateral pelvic wall.

The ovary is the only intra-abdominal structure not to be covered by peritoneum.

Each ovary is attached to the cornu of the uterus by the ovarian ligament and to the broad ligament by the mesovarium(which contains its supply of nerves and blood vessels),and to the lateral pelvic wall by infundibulopelvic ligament.

The ovary has a central vascular medulla consisting of loose connective tissue. It has an outer thick cortex. The surface of the ovaries is covered by a single layer of cuboidal cells, the germinal epithelium.

The blood supply of the genital tract

Internal iliac artery is the main feeding vessel of the pelvis and pelvic organs. It divided into anterior and posterior division.

Only the anterior division supply the pelvic viscera.

Uterus : supplied by *uterine*(branch of ant. division of internal iliac artery) and *ovarian artery*.

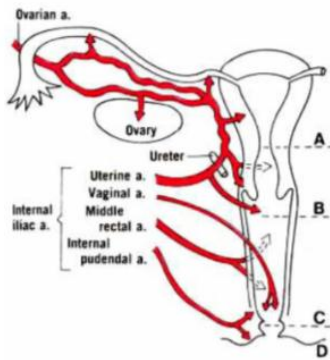
Cervix :descending cervical artery (branch of uterine artery)

Vagina :vaginal artery(separate branch of internal iliac A or may come from uterine artery),branch of internal pudendal A,middle rectal A and inferior rectal A.

Fallopian tube :medial 2/3 uterine A and lat.1/3 ovarian A.

Ovary :ovarian A (branch from aorta).

Vulva:internal pudendal artery(terminal branch of int.ilic A)



The nerve supply :

The major nerve supply of the pelvis comes from the pudendal nerves which arise from the second, third and fourth sacral nerves (S2, S3, S4).

Also from ilio-inguinal nerve (L1, L2), genital branch of genitofemoral nerve (L1, L2), and posterior cutaneous nerve of the thigh.

the innervation of pelvic viscera is complex, from both sympathetic and parasympathetic.

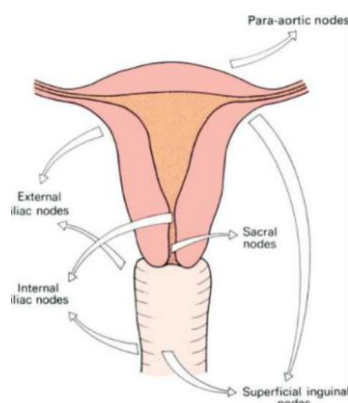
The ovary is innervated by ovarian plexus which joins the preaortic plexus high up.

The lymphatic drainage

Ovaries and tubes _____ para aortic LN.

Uterus, cervix and upper $\frac{2}{3}$ of vagina _____ internal iliac, obturator and external iliac LN, common iliac and para aortic LN.

Vulva, lower $\frac{1}{3}$ of vagina. _____ superficial inguinal and femoral



The pelvic muscles ,ligaments and fascia :

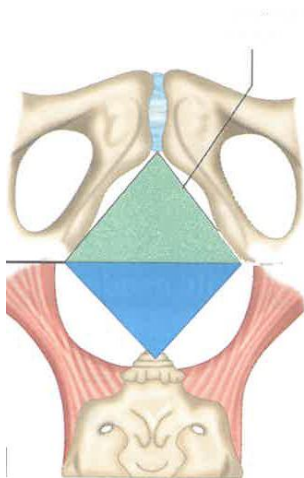
The pelvic floor : is formed by the funnel shaped pelvic diaphragm and it support the pelvic viscera.

It separate the pelvic cavity above from the perineal region below.

Pelvic diaphragm is a muscular partition formed by the levator ani & coccygei.

The perineumThe anatomical or true perineum is a diamond shaped area that extends from pubis anteriorly to coccyx posteriorly and the ischial tuberosities laterally. This is divided by an imaginary line between the two ischial tuberosities into;

- 1)anterior or urogenital triangle
- 2)and posterior or anal triangle.



Perineal body

This is a fibromuscular structure between the anus and the lower vagina. Several muscles are inserted into it.

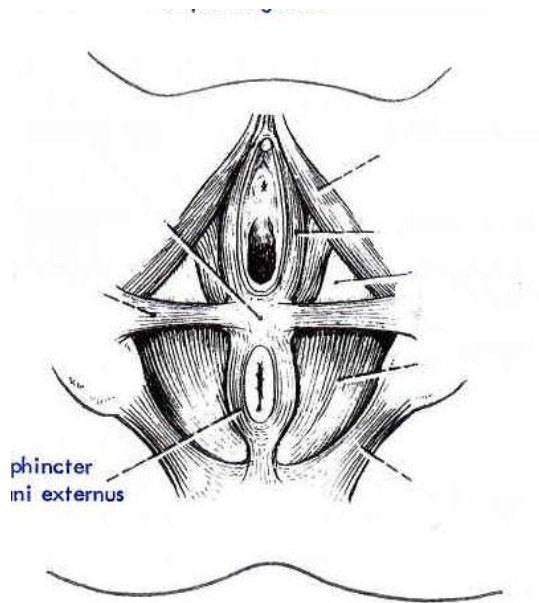
Muscles inserted into perineal body

- ☐ Sphincter ani externus
- ☐ Bulbospongiosus
- ☐ Superficial transverse perinei

☐ Deep transverse perinei

☐ Levator ani

Damage to perineal body causes a deficient perineum, gaping of the introitus with resultant sexual problems and loss of support for lower one third of vagina.



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