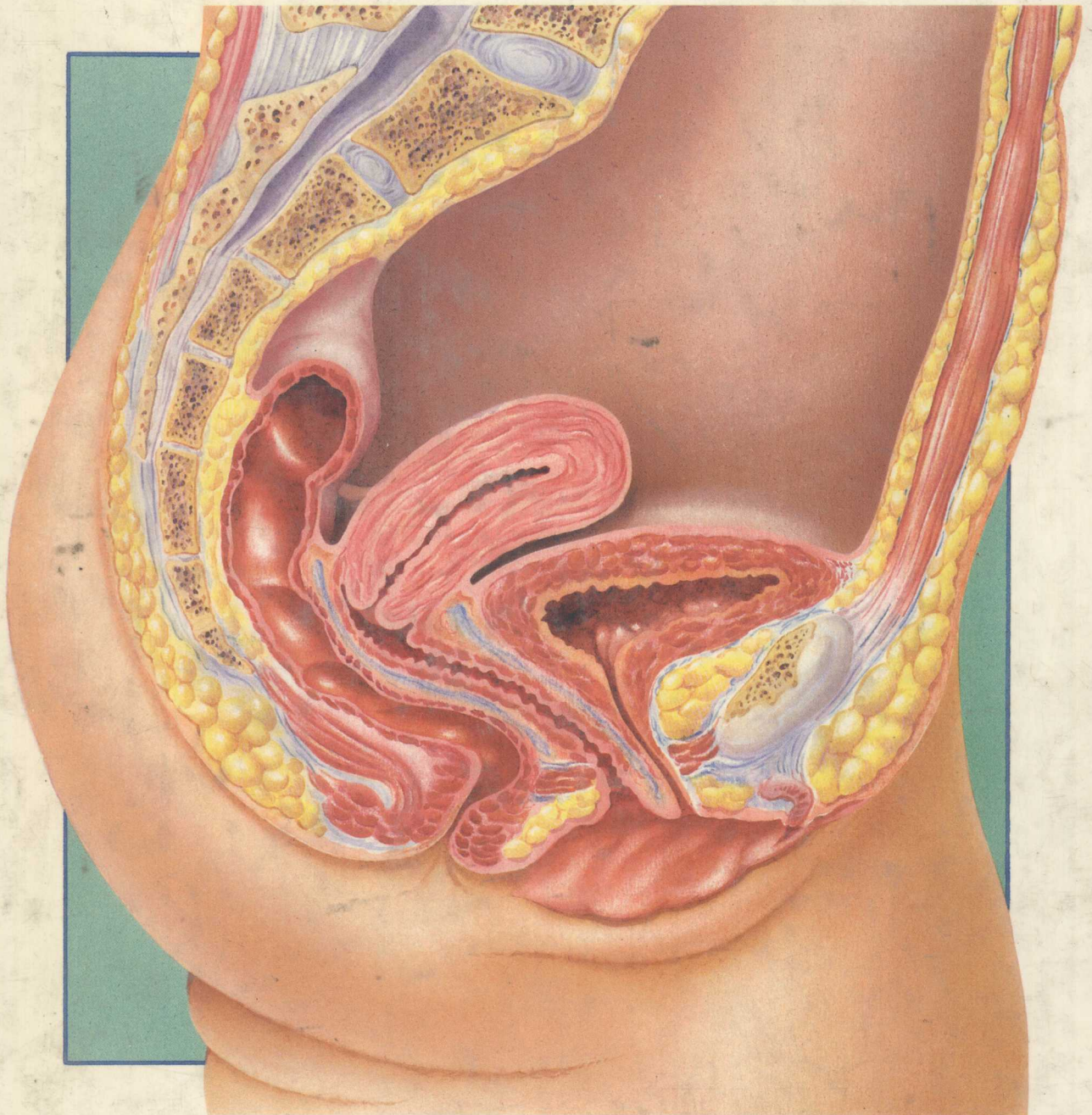


# GYNECOLOGY

*A clinical atlas*

J.L.H. Evers and M.J. Heineman



The C.V. Mosby Company

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*A clinical atlas*

J.L.H. Evers and M.J. Heineman

Illustrated by Inge van Noortwijk,  
Kevin Marks and Philip Wilson





**First edition**

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## Preface

Solving the various gynaecological problems with which one is confronted, first of all requires an adequate basic, pre-clinical understanding. In addition, one needs the opportunity to examine patients under the guidance of experienced clinicians, to formulate a differential diagnosis and to follow the clinical course. *Gynecology, a clinical atlas* is intended for medical students, for residents in gynaecology and for all those interested in a visual presentation of gynaecological problems. The book endeavours to be a *trait d'union* between the knowledge gained in the pre-clinical period and that gained at the bedside. A thread runs through the length of the book. Short descriptions of clinical situations are complemented by relevant illustrations and a commentary. All clinical cases described are derived from our own daily practice. Not only commonly occurring gynaecological conditions are presented but, occasionally, also more rare conditions. Both frequent confrontation with common gynaecological abnormalities and the profound study of less common conditions contribute to the acquisition of clinical competence.

During the compilation of this book it was decided to group and present the anatomy and physiology according to age. The first chapter furnishes basic information relative to the normal anatomy of the female reproductive system. The second chapter deals with gametogenesis, fertilization, pre-embryonic development and implantation. Chapters 3 and 4 are concerned with the normal and abnormal development of the female reproductive system and with the pathology of early pregnancy. Successive chapters deal with the gynaecological problems of the various age groups. These include the gynaecology of the neonate and of childhood, gynaecology of puberty and adolescence, gynaecology of the reproductive period, gynaecology of the climacteric and menopause and the gynaecology of old age.

Every patient with whom one is confronted is sufficient reason to explore her condition further. Textbooks and

medical journals are available in every hospital. Therefore, no attempt has been made to include specific references in the text. Gynaecology is presently undergoing a period of rapid transition from a static surgical speciality to a dynamic, comprehensive discipline. During the compilation of the text we have kept this combination of factual knowledge and recent progress in mind. We do recommend the use of this volume in conjunction with other texts. Clinical acumen however, one only gains at the bedside.

We take this opportunity to acknowledge that the compilation of this book was a combined effort of authors and artists. Inge van Noortwijk, Kevin Marks and Philip Wilson have translated the suggestions of the authors into pictures with much enthusiasm and devotion. We are also greatly indebted to the publisher, Lucas Bunge, who encouraged us from the conception of the project right through to its completion.

J.L.H. Evers and M.J. Heineman

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## The bony pelvis

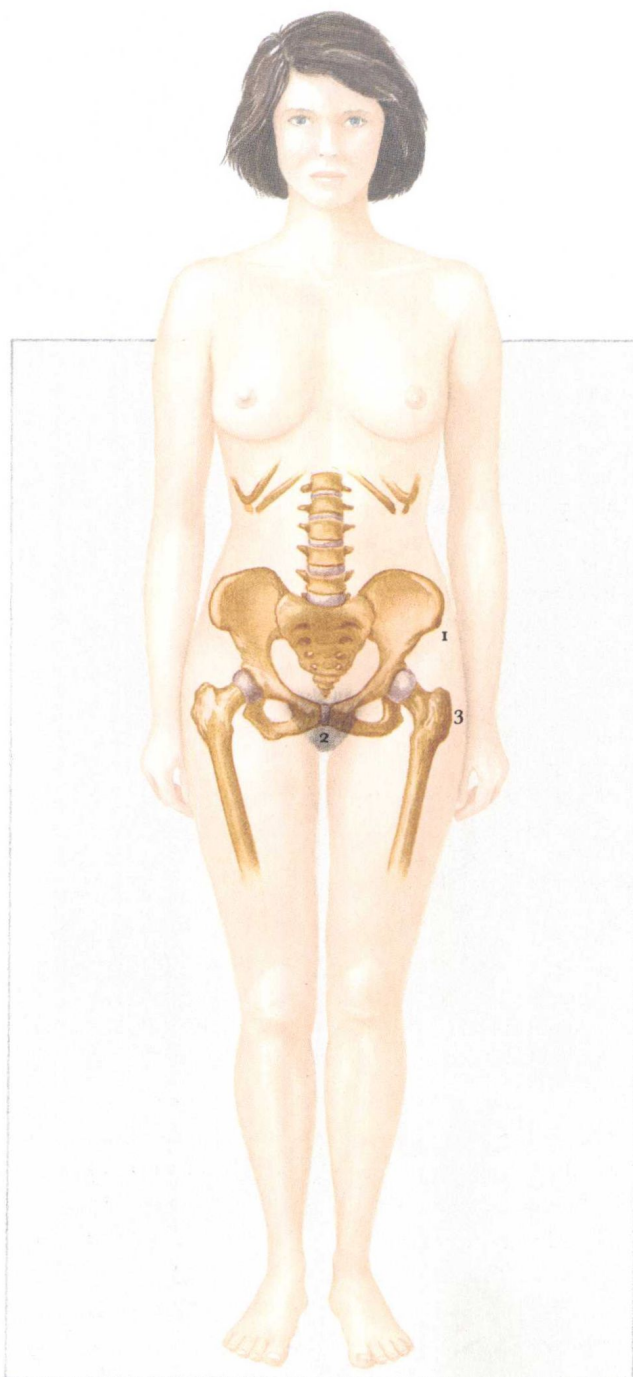
When studying the anatomy of the female reproductive system one should bear in mind that anatomy 'in vivo' does not always correspond with anatomy 'in vitro'. In this chapter an attempt is made to illustrate 'naturally' the anatomical structures relating to the female internal and external genitalia.

*Figure 1-1*

Secondary sexual characteristics in the woman in the erect position.

*Figure 1-2*

Secondary sexual characteristics in the erect position. The bony pelvis is illustrated. The anterior superior iliac spines (1), the pubic symphysis (2) and the femoral trochanters (3) are indicated.



*Figure 1-3*

Female patient in the gynaecological examination position.

*Figure 1-4*

Female patient in position for gynaecological examination. The bony pelvis is illustrated. During external examination of the woman in this position a number of points of identification of the bony pelvis become visible or palpable. Indicated in this figure are the pubic bone, the pubic symphysis and the coccyx. The anterior superior iliac spine and the iliac crest, although not indicated, are palpable. Indicated but not externally palpable are the femur and the sacrum.

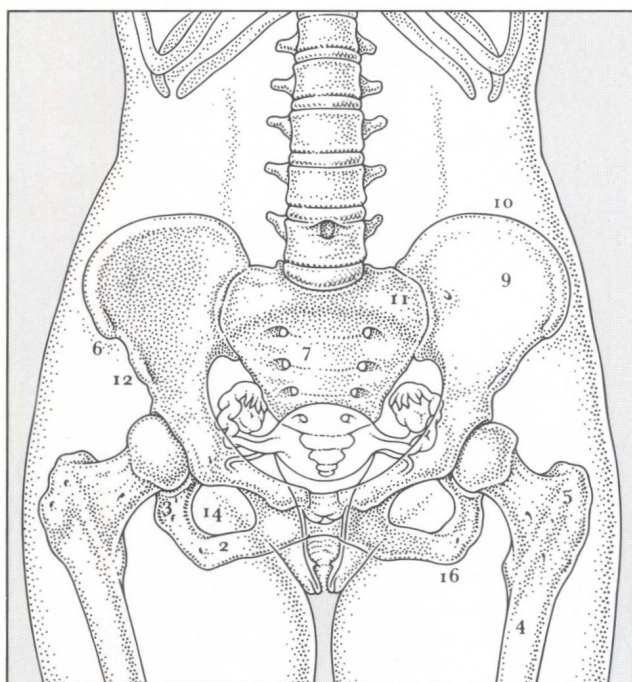
- 1 pubic bone
- 2 pubic symphysis
- 3 coccyx
- 4 femur
- 5 sacrum



Certain aspects of the bony pelvis can be recognized by observation of the woman in the standing position. In the absence of excessive hair the pubis can be identified in the midline. Laterally, the anterior superior iliac spines form fixed points of identification and between these and the pubis stretch the inguinal ligaments. The fold in the groin lies below the inguinal ligament. An additional structure which locates indirectly the bony pelvis 'in vivo' is the greater trochanter of the femur.

Gynaecological examination is generally conducted with the patient in the dorsal position.

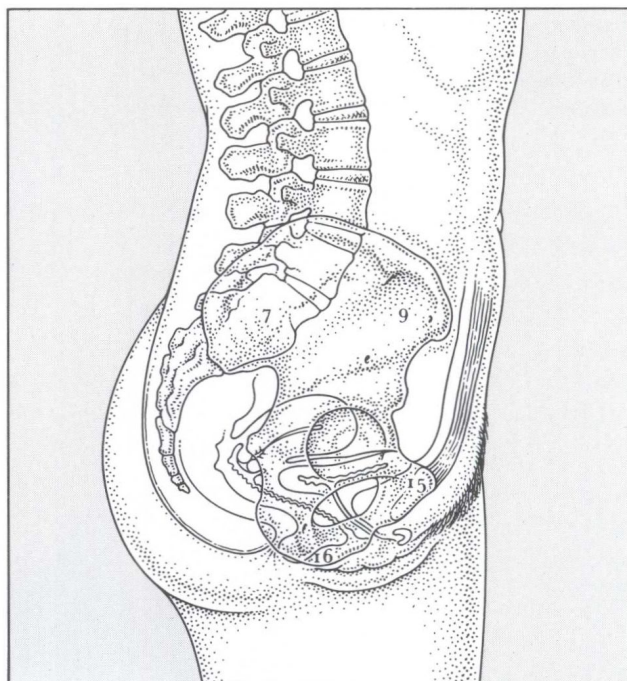
The angulation of the bony pelvis under these circumstances differs considerably from that in the standing subject. In the lithotomy position the most obvious externally visible or palpable identification points of the bony pelvis are the pubic bone, the pubic symphysis, the iliac crest, the anterior superior iliac spine and the tip of the coccyx.



*Figure 1-5*  
Anterior view of the female pelvis containing the internal genitalia.

Legend figures 1-5, 1-6  
and 1-7:

- |                 |                                 |
|-----------------|---------------------------------|
| 1 pubic bone    | 4 femur                         |
| 2 ischial ramus | 5 greater trochanter            |
| 3 ischial body  | 6 anterior superior iliac spine |
|                 | 7 sacrum                        |



*Figure 1-6*  
Side view of the female pelvis containing the internal genitalia.

- |                                  |                       |
|----------------------------------|-----------------------|
| 8 greater sciatic foramen        | 13 ischial spine      |
| 9 ilium                          | 14 obturator foramen  |
| 10 iliac crest                   | 15 pubic symphysis    |
| 11 sacroiliac joint              | 16 ischial tuberosity |
| 12 anterior inferior iliac spine |                       |

The bony pelvis is formed by the pubic, iliac and ischial bones on either side together with the sacrum and coccyx. Anteriorly, the pubic bones articulate with each other at the symphysis. Posteriorly, a strong connection between the os ilium and the sacrum is formed by the sacro-iliac joint on either side. The connection between the sacrum and the neighbouring bones of the pelvis is further strengthened by the sacrospinal and sacrotuberous ligaments.

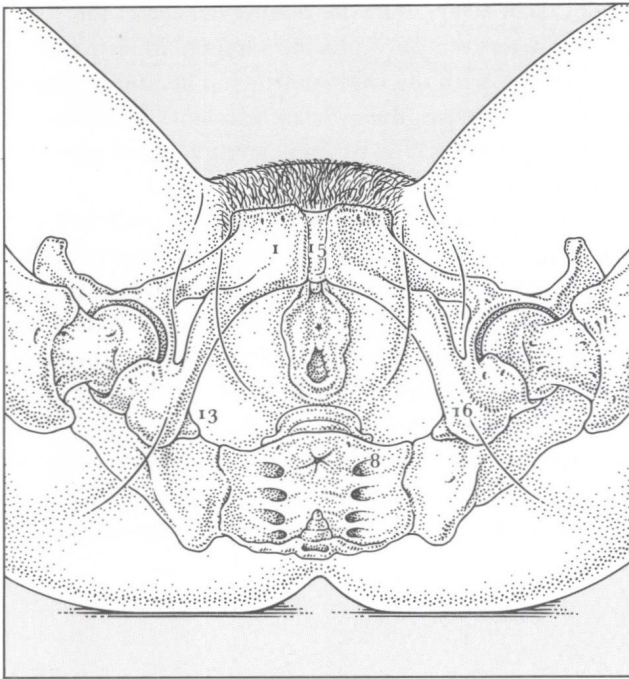
The bony pelvis may be compared to a funnel. The os ilium on both sides forms the upper part of the funnel, the inlet of the pelvis, which leads to the outlet below the level of the linea terminalis. The space within the pelvic outlet is bounded by the pubis, the os ilium, the sacrum and the coccyx. The terminal line runs from the pubic symphysis along the arcuate line to end at the sacral promontory.

The male and female bony pelvis differ in a number of respects. The space within the female pelvis is wider and rounder in shape. The pubic arch in the female is

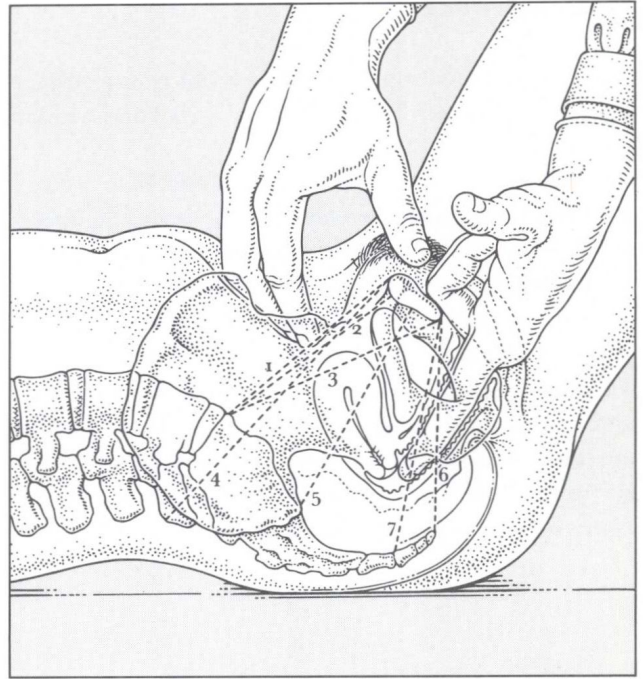
rounded whilst that of the male forms a more acute angle. The lateral boundaries of the female pelvic outlet are more or less parallel whilst the male outlet shows an obvious convergence.

Estimation of the pelvic measurements is of considerable importance to the obstetrician. A distinction is drawn between the external and internal measurements.

The intercrural diameter (the distance between the iliac crests) measures on average 29 cm. The interspinous diameter (the distance between the outer edges of the anterior superior iliac spines) is normally 26 cm. The external conjugate is measured from the tip of the spine of the fifth lumbar vertebra to the top of the front of the pubic symphysis and is about 20 cm. This measurement is smaller in cases of antero-posterior pelvic contraction. In practice measurement of this parameter during physical examination is not easy. The intertrochanteric diameter (the distance between the two greater trochanters) averages 31 cm. This measurement



*Figure 1-7*  
Illustration of the female pelvis as presenting during examination in the lithotomy position.



*Figure 1-8*  
The pelvic measurements.

is diminished in cases of lateral pelvic contraction. From an obstetric point of view the internal pelvic measurements are especially important. Particularly important are the diagonal conjugate (the distance between the postero-inferior edge of the symphysis and the promontory) which averages 13 cm; the true conjugate (the distance between the posterior surface of the symphysis and the promontory) which is normally 1.5-2 cm shorter than the diagonal conjugate just described; the coccygeopubic diameter (the distance between the lower edge of the symphysis and the tip of the coccyx) and the intertuberos diameter (the distance between the two ischial tuberosities). Estimation of the adequacy of the pelvis also includes examination of the shape of the subpubic arch. Indicated in figure 1-8 are the diameter of the pelvis inlet (1), the true conjugate (2), the diagonal conjugate (3), the external conjugate (4), the diameter of the plane of pelvic expansion (5), the coccygeopubic diameter (6) and the diameter of the pelvic outlet (7). The line connecting

the middle of the diameter of the pelvic inlet, the middle of the plane of pelvic expansion and the middle of the diameter of the pelvic outlet is termed the pelvic axis.

## The arteries and the veins

The arterial blood supply of the internal genital organs is derived mainly from the uterine, vaginal and ovarian arteries.

The uterine artery arises from the internal iliac artery and runs between the two layers of the broad ligament as far as the cervix. It thus crosses the ureter a few centimetres lateral to the cervix. On reaching the cervix the uterine artery divides into ascending and descending branches. The ascending branch climbs upwards in a tortuous manner to reach the fundus of the uterus. The tortuous nature of the vessel makes possible the provision of adequate blood to the gravid uterus. Having reached the fundus of the uterus, the uterine artery turns laterally and anastomoses with branches of

the ovarian artery. The descending branch of the uterine artery runs towards the vagina and forms an anastomosis with the vaginal artery. The uterine artery supplies the uterus, the ovarian ligament, the round ligament and, through its branches, the upper part of the vagina.

The vaginal artery may arise independently from the internal iliac artery but may arise also in common with the uterine artery. The vaginal artery runs towards the vagina supplying it and, through its branches, the base of the bladder and part of the rectum. The vaginal artery forms an anastomosis with the descending branch of the uterine artery.

The ovarian artery on both sides arises from the abdominal aorta a short distance below the origin of the renal arteries. This vessel passes between the layers of

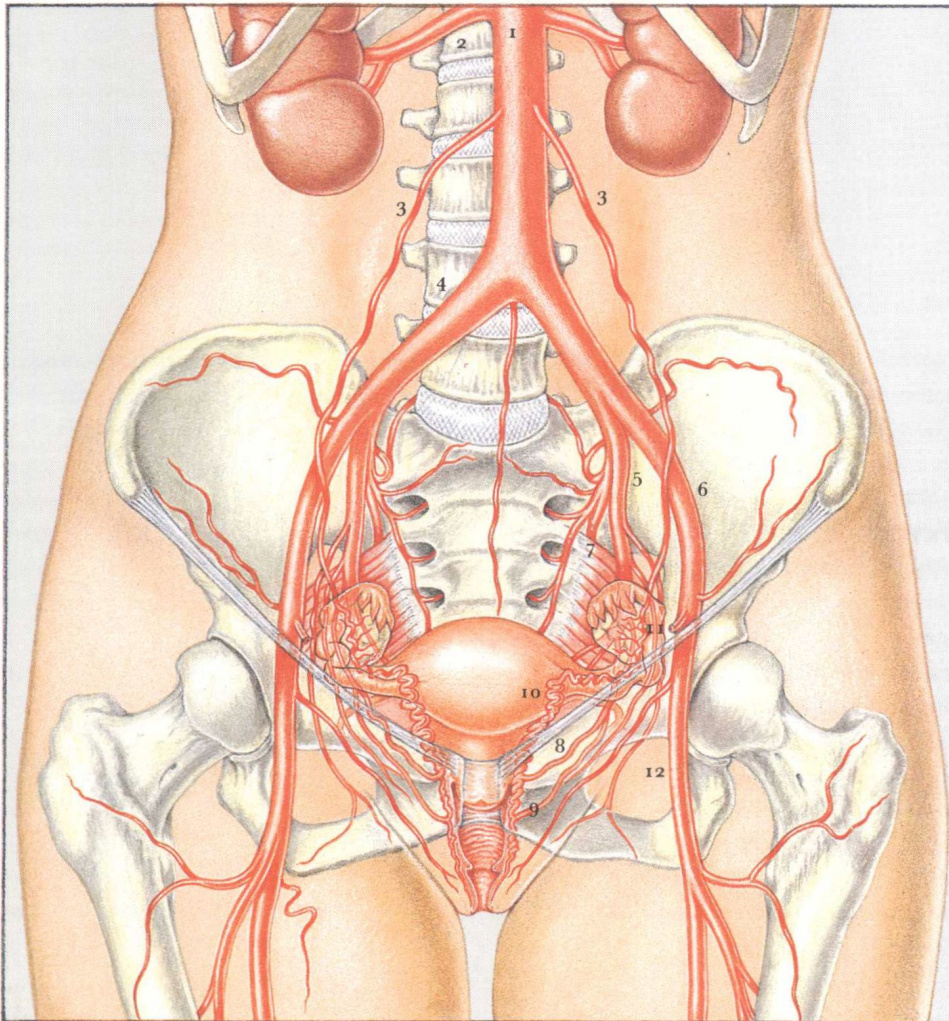


Figure 1-9

### The arteries

- 1 abdominal aorta
- 2 renal artery
- 3 ovarian artery
- 4 common iliac artery
- 5 internal iliac artery
- 6 external iliac artery
- 7 superior gluteal artery
- 8 uterine artery
- 9 vaginal artery
- 10 ovarian and tubal branches of the uterine artery
- 11 inferior epigastric artery
- 12 femoral artery

the infundibulo-pelvic ligament and runs medially to the level of the ovary where it anastomoses with branches of the uterine artery. The ovarian artery supplies the ovary, the uterine tube and, through its upper branches, part of the ureter.

The veins in the pelvis form dense networks around the various organs. The uterine plexus lies between the layers of the broad ligament and communicates with the vaginal and ovarian plexuses. The uterine plexus is drained by the uterine vein which passes backwards to end in the internal iliac vein.

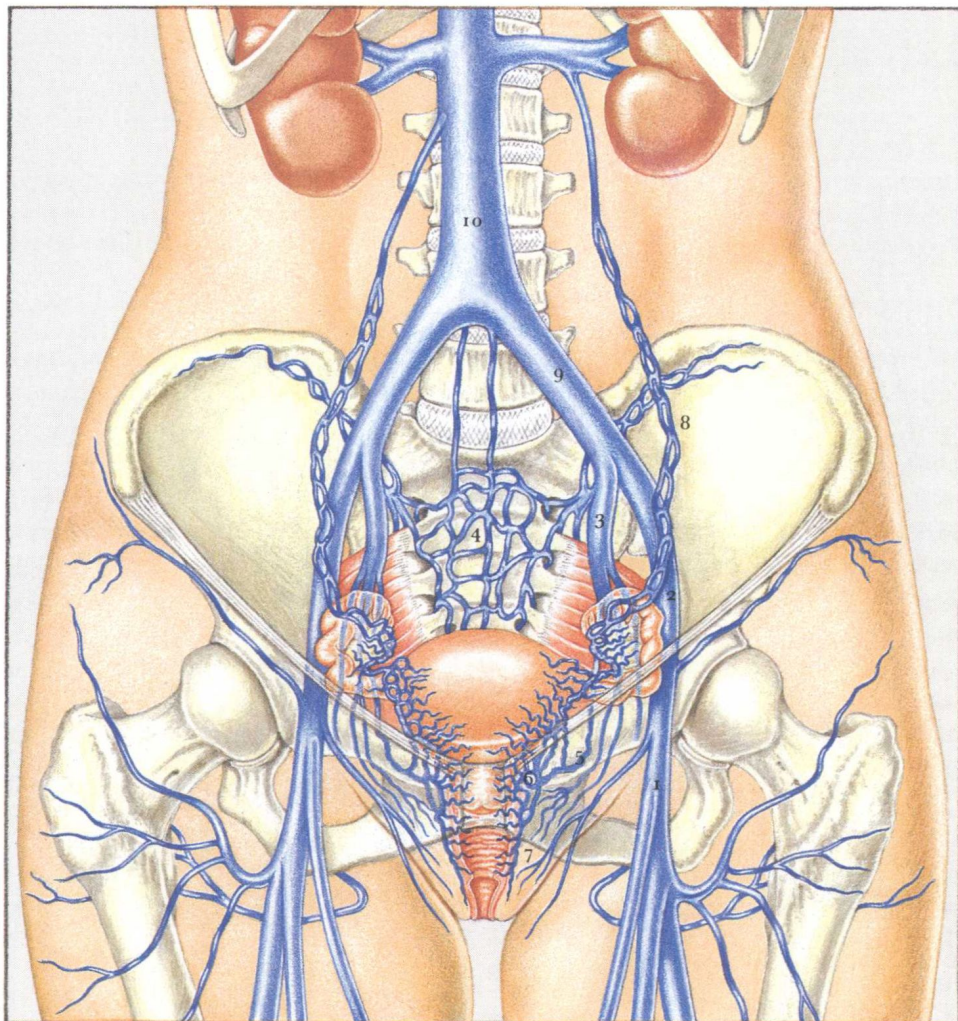
The vaginal plexus receives tributaries from the wall of the vagina and communicates with the venous plexus around the rectum and that of the bladder. The vaginal vein conveys blood from the vaginal plexus to the internal iliac vein.

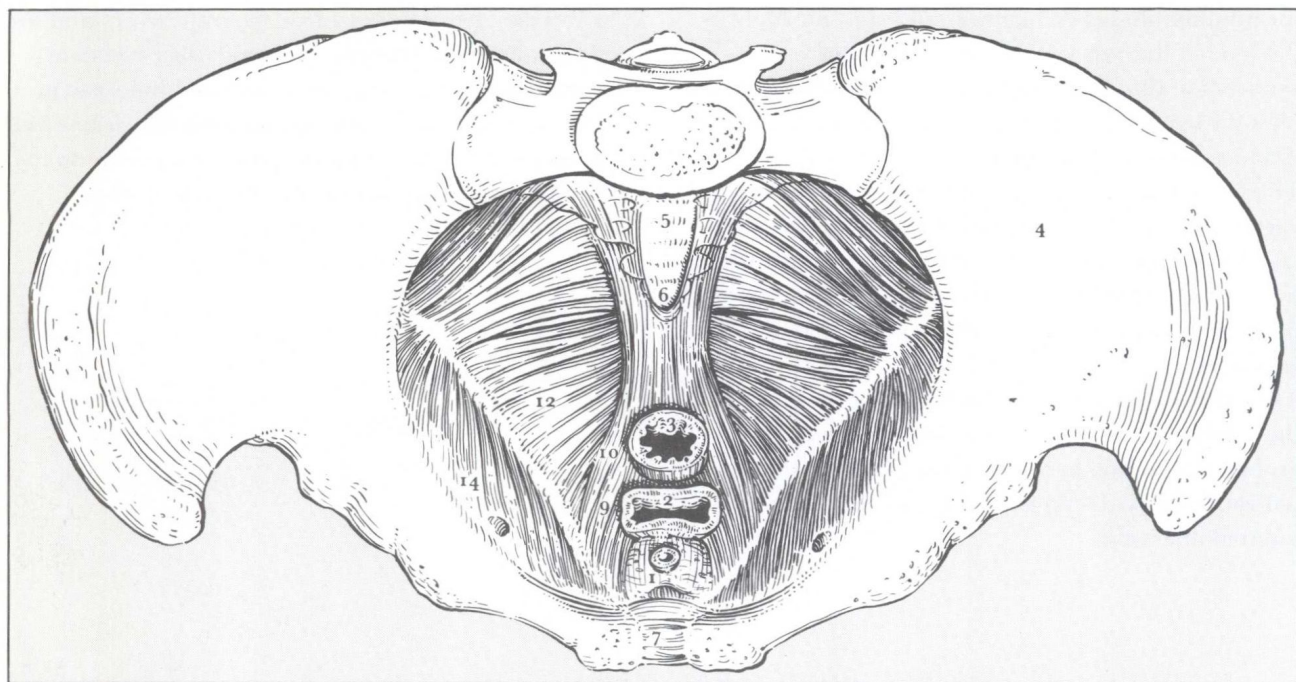
The ovarian vein conveys blood from the ovary and the uterine tube. This vessel accompanies the ovarian artery during its course through the infundibulo-pelvic ligament. The ovarian vein on the right side drains into the inferior vena cava, whereas the ovarian vein on the left side forms a tributary of the left renal vein.

Figure 1-10

The veins.

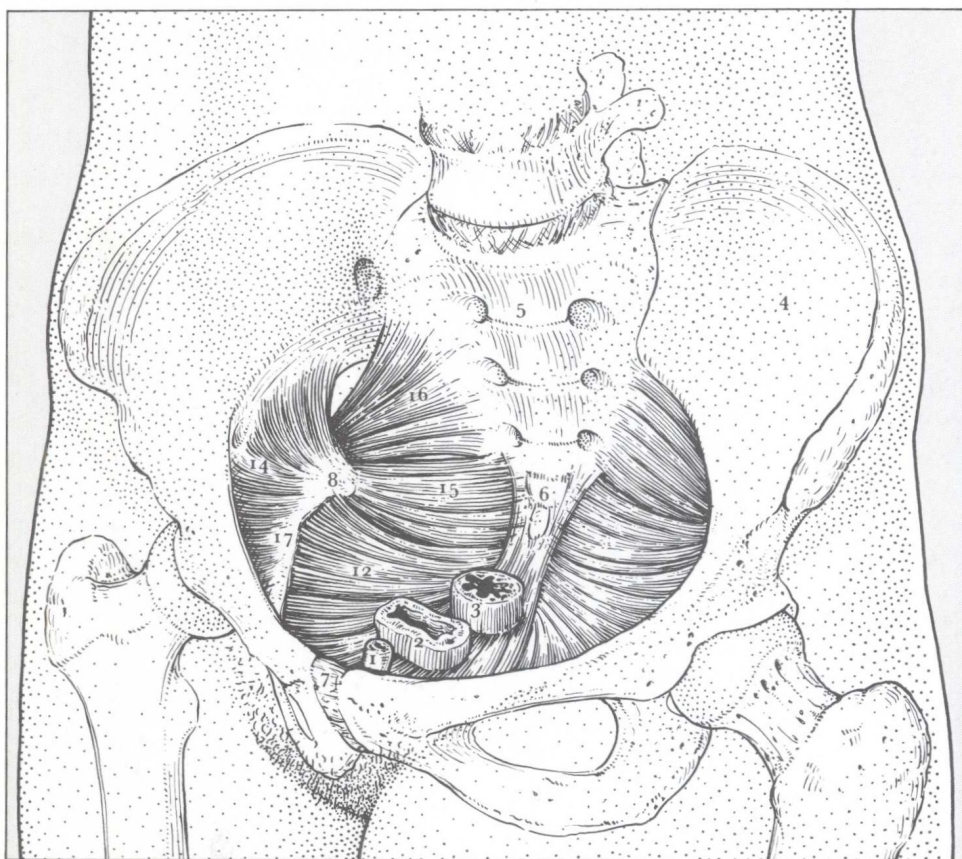
- 1 femoral vein
- 2 external iliac vein
- 3 internal iliac vein
- 4 sacral venous plexus
- 5 uterine veins
- 6 uterine venous plexus
- 7 vaginal venous plexus
- 8 ovarian veins
- 9 common iliac vein
- 10 inferior vena cava





*Figure 1-11*

Superior view of the pelvic floor. The muscles of the pelvic floor combine with the ligaments to form the pelvic diaphragm.



*Figure 1-12*

Oblique view of the pelvic floor in the standing female subject. The pelvic diaphragm is formed by a number of muscles which support the pelvic organs.

Legend figures 1-11 and 1-12:

- 1 urethra
- 2 vagina
- 3 rectum
- 4 os ilium
- 5 sacrum
- 6 coccyx
- 7 pubic symphysis
- 8 ischial spine
- 9 m. pubovaginalis
- 10 m. puborectalis
- 11 m. pubococcygeus (9 + 10)
- 12 m. ileococcygeus
- 13 m. levator ani (11 + 12)
- 14 m. obturator internus
- 15 m. coccygeus
- 16 m. piriformis
- 17 tendinous arch

## The pelvic floor

The pelvic floor is formed by a number of muscles. The extent to which these muscles are developed may vary. From a gynaecological point of view the levator ani is of particular importance. The pubococcygeus muscle (= pubovaginalis together with the puborectalis) and the iliococcygeus together form the levator ani. The uterus and the vagina are supported by the entire leva-

tor ani. The support of the bladder is derived principally from the coccygeus muscle whilst the rectum is supported by the puborectalis. The puborectalis is also of considerable importance in the maintenance of anal continence. In addition to the deeper muscles of the pelvic floor there exist a number of superficial muscles. During examination in the lithotomy position members of the superficial group of muscles of the pelvic floor can be felt.

Figure 1-13

The superficial musculature of the pelvic floor. The important muscles belonging to this group are the m.bulbocavernosus and the external anal sphincter. The ischiocavernosus and the transversus perinei can also be distinguished. The external anal sphincter is actually made up of three smaller muscles which run from the coccyx to the point at which the transversus perinei and the bulbocavernosus meet between the vagina and the anus.

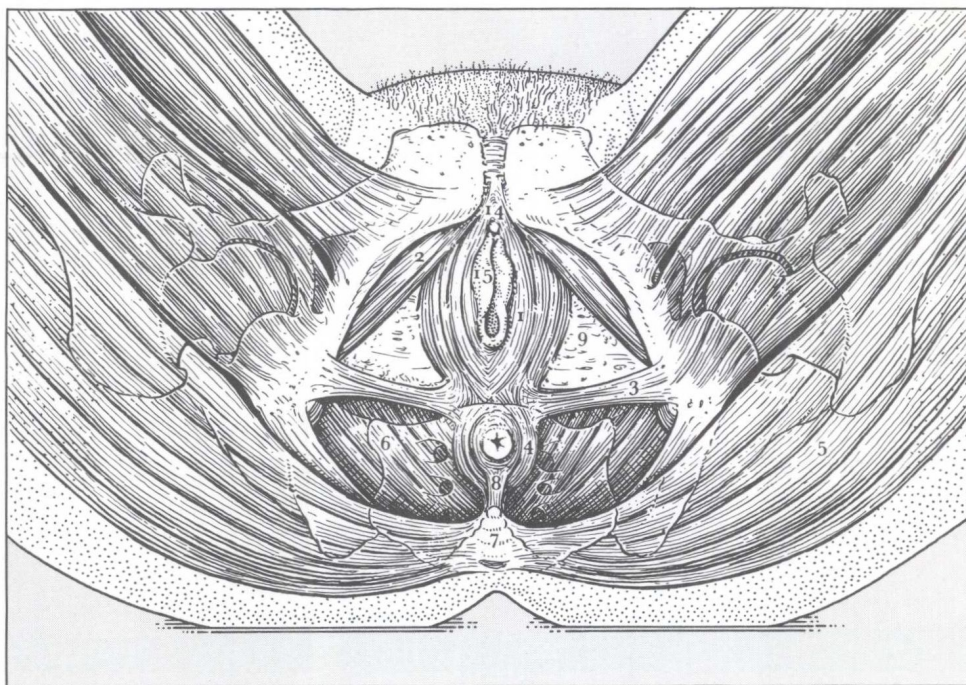
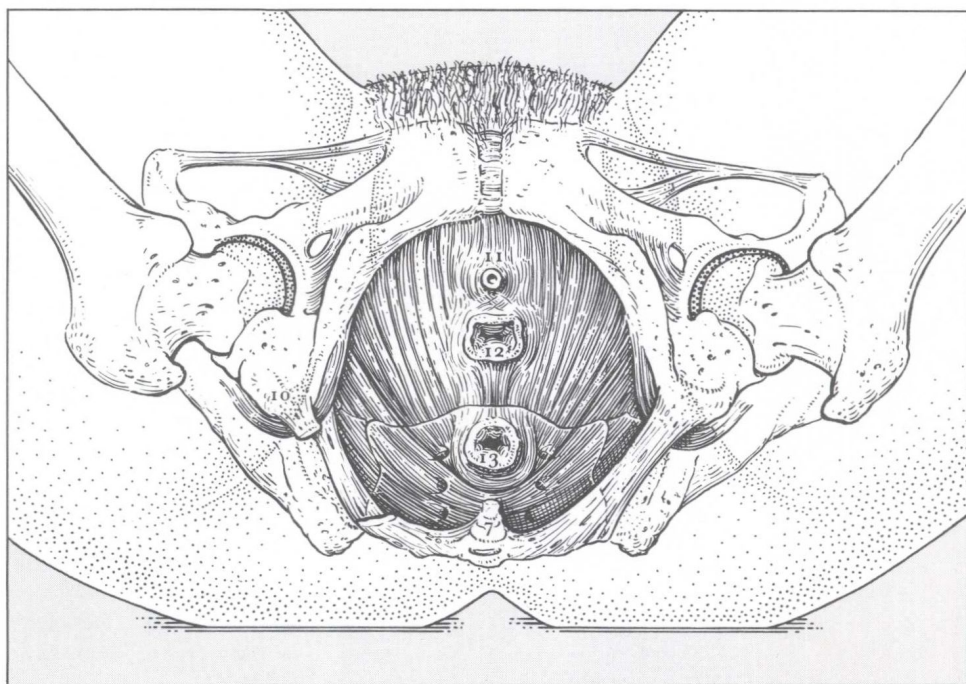


Figure 1-14

The more deeply situated muscles of the pelvic floor. The pelvic diaphragm as seen from below. The female internal organs of reproduction are in fact supported by the levator ani muscle (formed by the pubococcygeus and the iliococcygeus).



Legend figures 1-13 and 1-14:

- 1 m.bulbocavernosus
- 2 m.ischiocavernosus
- 3 m.transversus perinei superficialis
- 4 external anal sphincter
- 5 m.gluteus maximus
- 6 m.levator ani
- 7 coccyx
- 8 anococcygeal septum
- 9 urogenital diaphragm
- 10 ischial tuberosity
- 11 urethra
- 12 vagina
- 13 rectum
- 14 clitoris
- 15 labium minus

## The vulva, the vagina and the uterine cervix

The externally visible female genitalia enclose the vulva. The vaginal walls normally lie in apposition with each other. Longitudinally, the vagina has the shape of a 'stretched-out S' whilst the transverse section

takes the form of a 'flattened H'. As a result of this 'S-shape' and 'H-configuration' the vagina is capable of considerable distension. The appearance of the external os of the cervix differs depending on the woman's previous obstetric history.

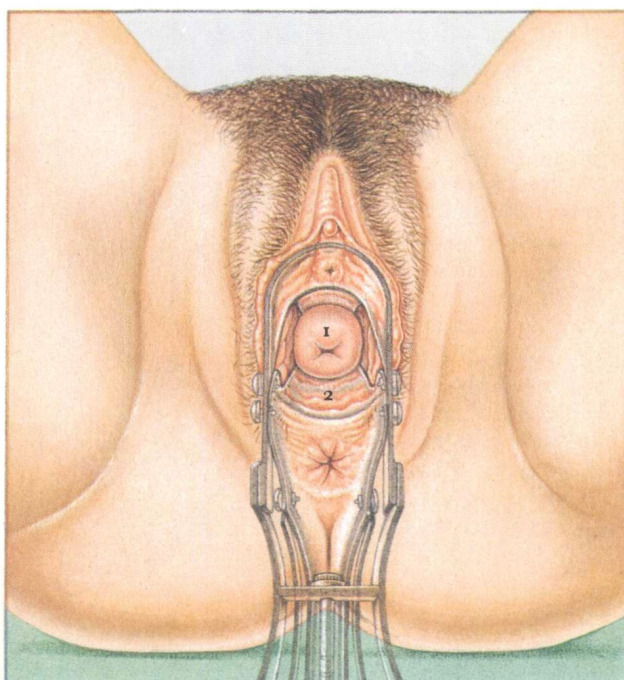
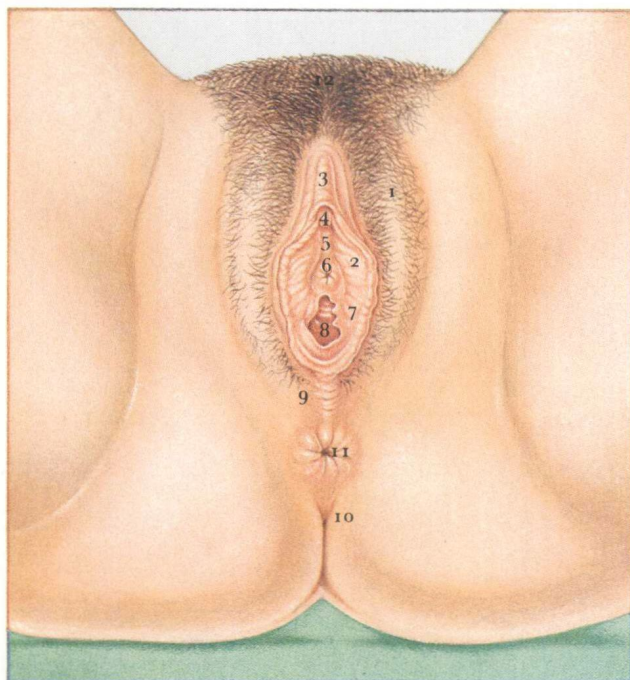


Figure 1-15

The external genitalia.

- 1 labium majus
- 2 labium minus
- 3 prepuce of the clitoris
- 4 glans clitoridis

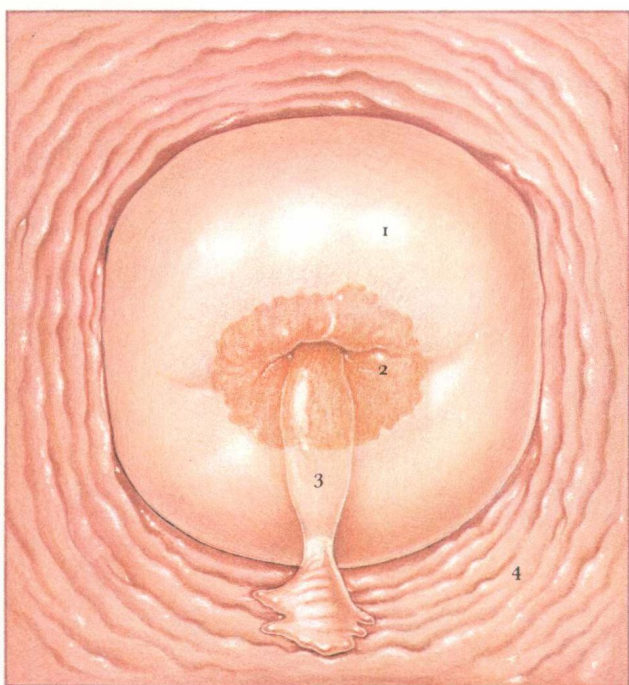
- 5 frenulum of the clitoris
- 6 external urethral meatus
- 7 carunculae hymenales
- 8 introitus
- 9 anterior perineum
- 10 posterior perineum
- 11 anus
- 12 mons pubis

Figure 1-17

The external os of the cervix. During examination of the cervix with the aid of the colposcope a number of superficial details can be determined. The transition from the ectocervical squamous epithelium (1) to the endocervical columnar epithelium (2) is recognizable. At the time of ovulation one can see a large bead of mucus (3). The vaginal rugae (4) are also readily visible.

Figure 1-16

The uterine cervix. The external os of the cervix comes into view on opening the blades of the speculum (1). A transparent speculum allows inspection of the vaginal wall. The vaginal wall is thrown into transverse folds or rugae (2). Gynaecological examination should always include inspection of the fornices of the vagina.



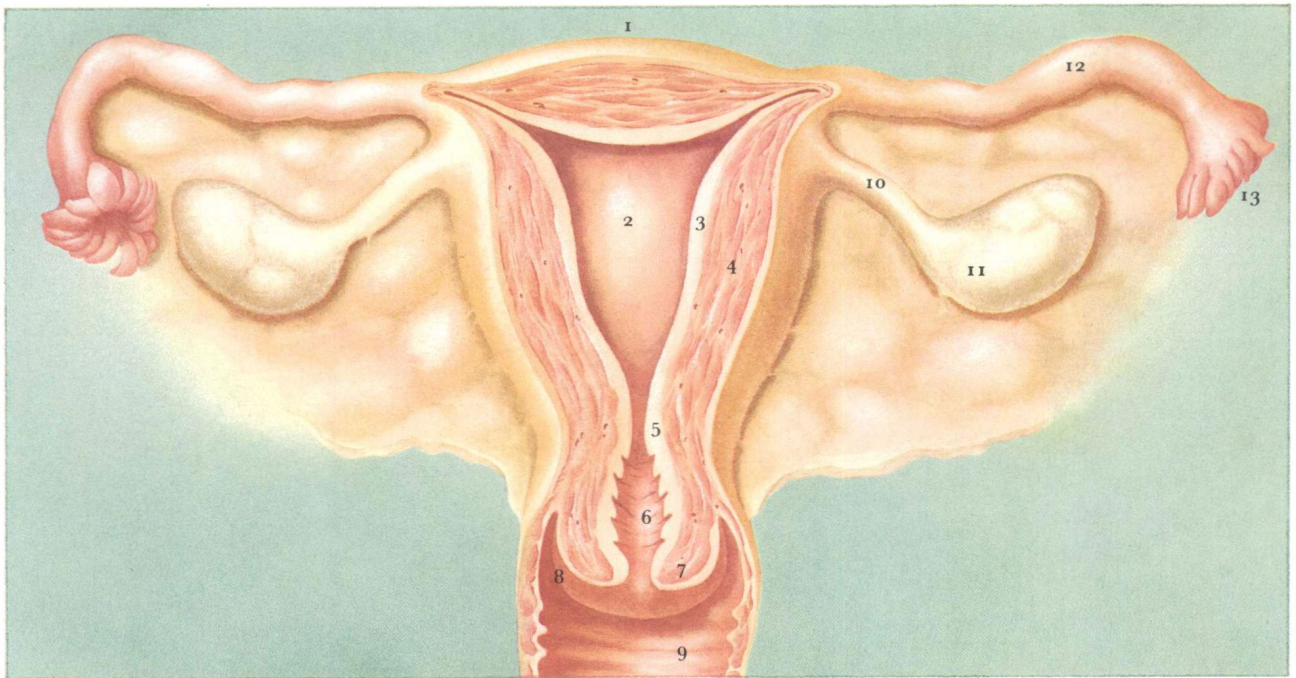


Figure 1-18

Transverse section of the uterus and upper part of the vagina with the ovaries on either side.

- 1 uterine fundus
- 2 cavity of the uterus
- 3 endometrium
- 4 myometrium
- 5 uterine isthmus

- 6 endocervix
- 7 ectocervix
- 8 lateral fornix
- 9 vagina
- 10 ovarian ligament

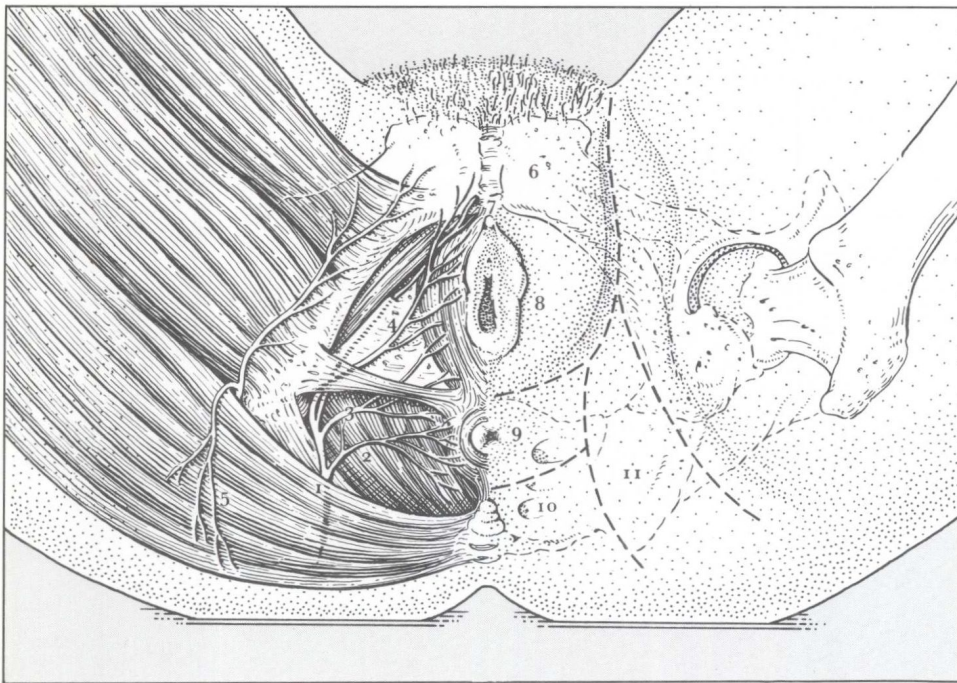
- 11 ovary
- 12 uterine tube
- 13 fimbriae of uterine tube

## The uterus

The uterus consists of the upper uterine body and the cervix. The relationship in size between the uterine body and the cervix is subject to change during a woman's life. During the childhood years it is 1:2, at the beginning of the fertile period 1:1, and following the first pregnancy 2:1. The menopause is followed by a reduction in the size of the uterine body until the latter reaches the pre-menarchal proportions. The changes which the uterus undergoes are the result of the reaction to alterations of oestrogen concentration during successive periods of life. In addition the myometrium and the endometrium experience changes during the menstrual cycle under the influence of oestrogens from the maturing follicle and the postovulation progesterone production. At the commencement of the menstrual cycle the uterus has a length of about 6.5 cm, a length which gradually increases parallel with the rise in estradiol concentrations to about 8 cm, only to be

followed in the luteal phase by a decrease in size. The thickness of the myometrium increases during the cycle from 1.5 to 2 cm while the thickness of the endometrium increases from 1 to 7 mm.

The lower part of the uterine body is referred to as the isthmus. The isthmus of the uterus is less susceptible to hormonal changes. It is from the isthmus that the lower uterine segment is formed towards the end of pregnancy.

*Figure 1-19*

The innervation of the pelvic floor. The pudendal nerve together with various branches is indicated on the left. The areas of skin supplied by the various branches are indicated on the right.

- |  |  |   |
|--|--|---|
| 1 pudendal nerve   | 6 area innervated by the ilioinguinal and genitofemoral nerves | 9 area innervated by inferior rectal nerves             |
| 2 inferior rectal nerves                                   | 7 area innervated by the dorsal nerve of the clitoris          | 10 area innervated by coccygeal nerve                   |
| 3 posterior labial nerves                                  | 8 area innervated by posterior labial nerves                   | 11 area innervated by posterior femoral cutaneous nerve |
| 4 dorsal nerve of the clitoris                             |  |   |
| 5 perineal branch of the posterior femoral cutaneous nerve |  |   |

### The innervation of the pelvic floor

The innervation of the muscles of the pelvic floor and of the perineum is derived largely from the pudendal nerve. The pudendal nerve arises in the pelvis usually by three roots from the second, third and fourth sacral nerves. The pudendal nerve divides into the inferior rectal nerves and the perineal nerves. The perineal nerves divide further into the posterior labial nerves and the dorsal nerve of the clitoris. The inferior rectal nerves supply the external muscle of the anal sphincter and the skin around the anus. The perineal nerves supply the muscles of the pelvic floor and the labia majora. The dorsal nerve of the clitoris supplies the area around the clitoris.

The ilioinguinal nerve contributes to the innervation of the labium majus via the anterior labial nerves. The genital branches of the genitofemoral nerve also contribute to the innervation of the external genitalia. Frequent use is made in obstetrics of perineal analgesia with the so-called 'pudendal block'. Local anaesthetic

injection around the pudendal nerve as it passes the ischial spine can anaesthetize the perineum. However, complete anaesthesia of the perineum is not achieved with a 'pudendal block'. The innervation of the perineum is subject to a certain variability, a fact which we have to bear in mind in obstetrics.