Female Sexual Anatomy and Physiology
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Summary

Until the seventh week of pregnancy, male and female embryos are indistinguishable. The male sex hormone testosterone causes the sexual organs to become male, while absence of testosterone causes the development of a female body. Even though male and female sexual organs are different, there are many points of resemblance.

Vulva consists of the outer and inner lips (labia), the vaginal opening and clitoris. The outer lips are covered by hairy skin, while the inner lips are covered with thin hairless skin. Even if the head of clitoris is the only visible part, clitoris is a large organ that consists of several large spongy bodies. Two bodies surround the vaginal opening and two runs from the clitoral head to each side under the bony pelvis. Frenulum is a small chord that connects the clitoral head to the inner lips and is transferring movement from the lips to the clitoris. The head of clitoris contains a huge amount of nerve endings and specific sensory bodies that are sensitive to pressure and vibration.

The researchers Masters and Johnson described four phases of sexual reactions. In the excitement phase the vagina is lubricated while the spongy bodies are filled with blood. The length and width of the vagina increase while pulse and blood pressure increase progressively as the sexual tension grows. In the plateau phase the spongy tissue around the vaginal opening is highly engorged with blood and narrowing the outer third of the vagina. During orgasm powerful involuntary contractions of pelvic muscles is accompanied with contractions of many muscles in the rest of the body. Pulse and blood pressure reach their peak during orgasm, and the respiration increases in depth as well as frequency. In the resolution phase the sexual tension subsides gradually to its original starting point.

There are different patterns of female sexual reactions. Some women get one orgasm and lose the sexual excitement quickly after their climax. Others may reach the plateau phase without ability to reach orgasm. Some women may even remain in the plateau phase for a long time and experience a row of multiple orgasms.

Even though the female genitalia look very different compared to the corresponding male organs, they offer many points of resemblance. Until the seventh week of gestation, there are no visible differences between male and female embryos. After seven weeks the male embryo starts its production of the male sex hormone testosterone which causes the embryological development of male sexual organs. In the absence of testosterone, a female body is developed.

What makes the two cavernous bodies in male embryos is developing to form the clitoris in females. The head of penis and the spongy body under the penis is becoming inner lips and spongy bodies around the vaginal opening in girls. The anatomical structure that becomes scrotum in boys is the basis for the outer lips in female embryos.

The female external sexual organs which are commonly called vulva consist of the inner and outer lips, the vaginal opening and the head of clitoris called glans.
Owing to the fact that the outer lips are developed from the same structure as the male scrotum, they have a lot in common. Both the outer lips and the scrotum are covered with hairy skin. The most obvious difference is that the lips are separated on each side of the vagina, while scrotum is joined in the middle and contains the testicles.

Because the inner lips have the same origin as the head of penis and the spongy body under the penis, the inner lips have thin hairless skin that is very touch sensitive as well. At the junction of the inner lips in front of the vaginal opening there is a skin chord called frenulum that connects the inner lips to the clitoris in the same way as it connects the male penile skin to the head of penis. Movement of the inner lips is transferred to the head of clitoris via the frenulum to increase the sexual stimulation during intercourse.

The size of the clitoral head is only a fraction of an inch, but under the surface clitoris is a large organ that is made of several spongy bodies. Under the inner lips on each side of the vaginal opening, women have two spongy bodies that resemble the spongy body containing the urethra in the penis. In women this spongy body is separated and penetrated by the vaginal opening and the urethral orifice.

The head of clitoris is covered by a foreskin in the same way as the uncircumcised head of penis. The clitoral head consists of a spongy body that is a continuation of the two crura or legs of clitoris that resemble the cavernous bodies in the male.

Two great nerves provide sensitivity to the clitoral head. Even in newborn girls these nerves have a diameter of a twelfth of an inch. The head of clitoris contain a large amount of nerve endings and sensory bodies that are transmitting sensory information to the brain.

Many clitoral nerves are ending in the so called Vater Pacini sensory bodies that
are particularly sensitive to deep pressure and vibration.

These receptors are intercepting direct stimulation of the clitoris as well as indirect stimulation via the inner lips and frenulum. The large amount of Vater Pacini bodies make the clitoris very sensitive to electric massagers and vibrators, easily providing orgasms for many women who otherwise have difficulties with reaching orgasm under sexual intercourse.

When a woman is sexually aroused, she gets an erection in the same way as a man. The most striking difference is that her spongy tissue is invisible outside the body. The head of clitoris moves upwards and is covered by the foreskin. The spongy tissue around the vaginal opening swells and makes the opening narrower as well as deeper. The legs of the clitoris are also being filled with blood and increase their size significantly.

The vestibular glands are located on each side of the vaginal opening and resemble the glands of Cowper in the male. They produce a clear fluid when the woman is sexually aroused. The so called hymen is a mucosal fold that partially covers the vaginal opening. This opening is generally narrower in virgins than in women who have had their sexual debut, unless the hymen has been widened by other reasons. If the vaginal opening is narrow, the first sexual intercourse may cause a little pain and some drops of bleeding when the hymen is penetrated by the penis. During labor the opening of the hymen may be further extended.

The vaginal wall consists of a thin muscular layer covered by a mucous membrane. The wall has few sensory nerves and the sensitivity to touch and other stimulation is highest in the outer third of the vagina. During intercourse the major part of sensory stimulation comes via the inner lips and the frenulum that is connected to the head of clitoris.

Most women are not capable of reaching orgasm by the stimulation of penetration and penile thrusting alone. Women usually need direct stimulation of the clitoris as well to reach climax. While an average man may reach orgasm after one or two minutes of sexual intercourse, most women need twenty to thirty minutes of sexual stimulation to reach orgasm.
Many women experience intense erotic feelings when an area at the foremost part of the vagina is being stimulated. This area lies approximately two inches inside the vaginal opening and was first described by the gynecologist Grafenberg. The spot has been named after him and is usually called the G-spot. Doctors disagree about the existence of this mystery spot, but some women state that they may have intense and deep orgasms when their G-spot is correctly stimulated.

The cervix is located at the deepest level of the vagina and represents the entrance of the uterus. After an ejaculation sperm cells may find their way through the cervix up via the uterus and oviducts chasing for an egg to fertilize. The oviducts end at the ovaries which are responsible for the production of eggs and female sex hormones. The uterus mainly consists of smooth muscle cells and may not be contracted by voluntary control. During orgasm the muscle tissue contracts in rhythmic contractions. In precisely the same way as in the male, female pelvic muscles do also contract rhythmically with regular intervals.

The female pelvic muscles have much in common with their male counterparts. In the same way as in the man, there are small muscles surrounding the spongy bodies, and the pelvic floor itself is made of strong muscles. The PC-muscle, or *pubococcygeus muscle*, runs from the foremost part of the pelvis to the tail bone or *coccyx*. In the woman these muscles surround the urethra, vagina and the rectum.
During labor these muscles are considerably stretched when the baby passes through the birth canal. It may be necessary to perform pelvic exercises after delivery to regain optimal function of the pelvic muscles. Impaired muscle function may lead to urinary incontinence, while a well functioning PC-muscle may give the woman increased pleasure during sexual intercourse. During intercourse she may also voluntarily contract the PC-muscle to increase the grip around penis which in turn enhances the sexual stimulation for both the man and the woman.

**Female Sexual Response**

The researchers William Masters and Virginia Johnson mapped the sexual reactions in both men and women. They accurately observed the sexual bodily response of several hundred humans. In their book *Human Sexual Response* they describe four phases of sexual reactions that are common to men and women: Excitement, plateau, orgasm and resolution (1).

1. **Excitement**

   The first sign of sexual excitement in a woman is vaginal lubrication. Masters and Johnson observed secretion of vaginal fluid as early as 10 to 30 seconds with sexual stimulation. The fluid is mainly secreted through the mucosal membrane of the vagina as a response to increased blood flow. In addition fluid is produced by the vestibular glands at the vaginal opening. The researchers described the vaginal lubrication as “small sweat like droplets” appearing along the vaginal wall. After more sexual stimulation the whole vaginal wall is covered with fluid. Some women produce so much fluid that sexual intercourse is possible without discomfort after a short time. Other women need much more time and many benefit from the use of artificial lubricant to avoid unpleasant friction between the penis and vagina.

   ![Diagram of Early Uterine Elevation](image)

   At an early stage of the excitement phase there happens an increase of the length as well as width of the inner two thirds of the vaginal canal. Masters and Johnson wrote that the uterus in most cases raise and contribute to a stretching of the front wall of the vagina.

   ![Diagram of Vaginal Lengthening](image)

   They observed 100 women who had never given birth to children and found that the length of the vagina was increased from 3 inches prior to sexual stimulation to a length of 4 inches in the
excitement phase. The width in the deepest part of the vagina increased from less than one inch before stimulation to 2.5 inches at the end of the excitement phase.

In these women they also observed that the outer lips flattened and moved forwards and away from the vaginal opening. In women who had given birth this movement was less apparent. They also observed that the vaginal wall changed its color to dark red or even purple as the congestion of blood was increasing. The mucosal folds of the vaginal wall called rugae became less prominent during the expansion of the vagina caused by increased sexual tension.

Pulse and blood pressure increase parallel to the rising sexual excitement. Many women experience blushing of the abdominal skin that spreads to the breasts and neck. The tension increases in many muscle groups and a lot of women get involuntary contractions in the abdominal and other areas with increased excitement. The nipples become erect, and particularly in women that have not been giving birth there is a significant enlargement of their breasts as well.

2. Plateau

During the plateau phase there are considerable changes in the outer third of the vagina. The congestion of blood increases in this part of the vagina, and the spongy bodies on each side are enlarged due to blood engorgement. These changes make the vaginal entrance become narrower.

Masters and Johnson measured a narrowing of at least one third of the vaginal diameter compared to the excitement phase. This tightening of the vagina is a sure sign of the plateau phase. At the same time the inner lips are swelling and contributing to the total enlargement of the outer sexual organs that Masters and Johnson called the orgasmic platform.

The excretion of lubrication is most prominent in the excitement phase and subsides during the plateau phase, especially if the plateau phase lasts for a long time. This implicates that even women who easily become lubricated during excitement phase may profit from the use of artificial lubricants in case of prolonged intercourse.

The pulse and blood pressure increase further during the plateau phase and many women get widespread skin flushing at the upper part of the body. Often women get involuntary contractions in the face and abdominal muscles. The nipples become hard and the enlargement of the breasts continues to increase.
3. Orgasm

The orgasm is an explosive physiological reaction that causes powerful involuntary contractions of the pelvic floor. At the peak of sexual tension, called *status orgasmus*, the woman may experience a powerful contraction that lasts 2-4 seconds prior to the regular contractions that follow. These contractions come with a regular interval of 0.8 seconds in the outer third of the vagina.

According to Masters and Johnson a female orgasm usually consists of between 3-5 and 10-15 muscular contractions. After 3-6 contractions the interval between them increases and the strength of the contractions subsides. However, the nature of an orgasm may vary from time to time and from woman to woman.

As in the man, the whole body takes part in the orgasm. The woman loses control over large muscle groups and may have strong convulsive movements. In the supine position she may also experience the typical *carpopedal spasms* with powerful flexion of the arms and legs. The hands and feet are pressed backwards with great strength.

Pulse as well as blood pressure is at its peak level during orgasm as the woman is breathing deeply and heavily. Three fourths of women have flushing on the upper part of the body and the redness may become more prominent the more powerful an orgasm is.

4. Resolution

During the resolution phase all the bodily changes return to its former state. At first the orgasmic platform in the outer third of the vagina disappears. Then the widening of the deeper part of the vagina subsides.

According to Masters and Johnson it takes 3-4 minutes before the uterus has returned to its original position. The deep color of the vaginal wall disappears after 10-15 minutes and the folds of the vaginal walls become visible again.
Different Patterns of Response

The blue graph illustrates a pattern of response where the sexual tension is increasing with varying speed until the woman has an orgasm. After the climax her sexual arousal rapidly returns to its basic level. This pattern reminds of a typical male pattern where the tension builds rapidly and almost suddenly disappears after the orgasm.

![Blue Graph]

Many women react as illustrated by the red graph. Their sexual tension is increasing gradually until the plateau phase which may last for a rather long time. However, by some reason the woman does not get an orgasm in spite of a high level of arousal and continued sexual stimulation. She cannot manage to climb over the top even though she wants to. In some cases this is caused by her fear of losing control when she is approaching orgasm. In other cases the woman needs more intense sexual stimulation to reach her climax. It is typical for many of these women that the sexual tension subsides slowly during a prolonged resolution phase after intercourse making it difficult to relax than if she had experienced an orgasm.

![Red Graph]

The green graph illustrates a woman that has an increasing arousal through the excitement phase and stays at a certain level through the plateau phase. In contrast to the woman illustrated by the red graph, this woman gets an orgasm after some time at the plateau level. Unlike most men women usually do not have a refractory period after the orgasm. This fact implies that a woman may have more than one orgasm if she is in the mood for it and the sexual stimulation is continued. Some women may have several following orgasms of different strength and character with intervals of plateau phase between them. Finally the sexual tension gradually decreases through the resolution phase.

![Green Graph]

References