IMPLANTATION OF EMBRYO IN HUMANS

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16.3.4 Implantation

After entering the uterus and formation of ICM, the blastocyst begins to embed in the endometrium of the uterine wall. By one week after fertilization the trophoblast secretes enzymes that digest the tissues and blood vessels of the uterine wall. The invading trophoblast differentiates into two layers, the outer **syncytiotrophoblast** and the inner **cellular layer.** As the syncytiotrophoblast swallows more blood vessels in the uterine wall, lacunae develop in the syncytiotrophoblast which get filled up with blood from the mother and exchange of gases takes place here. Thus a primitive uteroplacental circulation is established (Fig.16.6). This nourishes the embryo till the placenta is formed.

By the 10^{th} day the blastocyst is completely embedded in the uterine wall. This type of implantation in which the embryo gets fully embedded is known as **interstitial implantation.** The trophoblast begins to secrete human chorionic gonadotropin (HCG). HCG causes the corpus luteum to be maintained and to continue to secrete estrogen and progesterone.

Sometimes implantation may occur outside the uterus at some other location. In that case it is an ectopic pregnancy. The implantation site may be the fallopian tube or even the abdominal cavity. In ectopic pregnancy the embryo has to be surgically removed because if it is not done, it can lead to tubal rupture, internal bleeding, shock and possible death.

At the start of the second week a small cavity appears between the trophoblast and ICM. This is the amniotic cavity which will grow around the embryo and later the foetus. It is a fluid filled cavity which acts as an insulator against shocks, cold and heat. At the same time the ICM also differentiates into two layers, the upper **epiblast** which gives rise to the embryo and the lower **hypoblast** which gives rise to the extraembryonic membranes. You can see the two primary germ layers and the beginning of third in Fig.16.6.

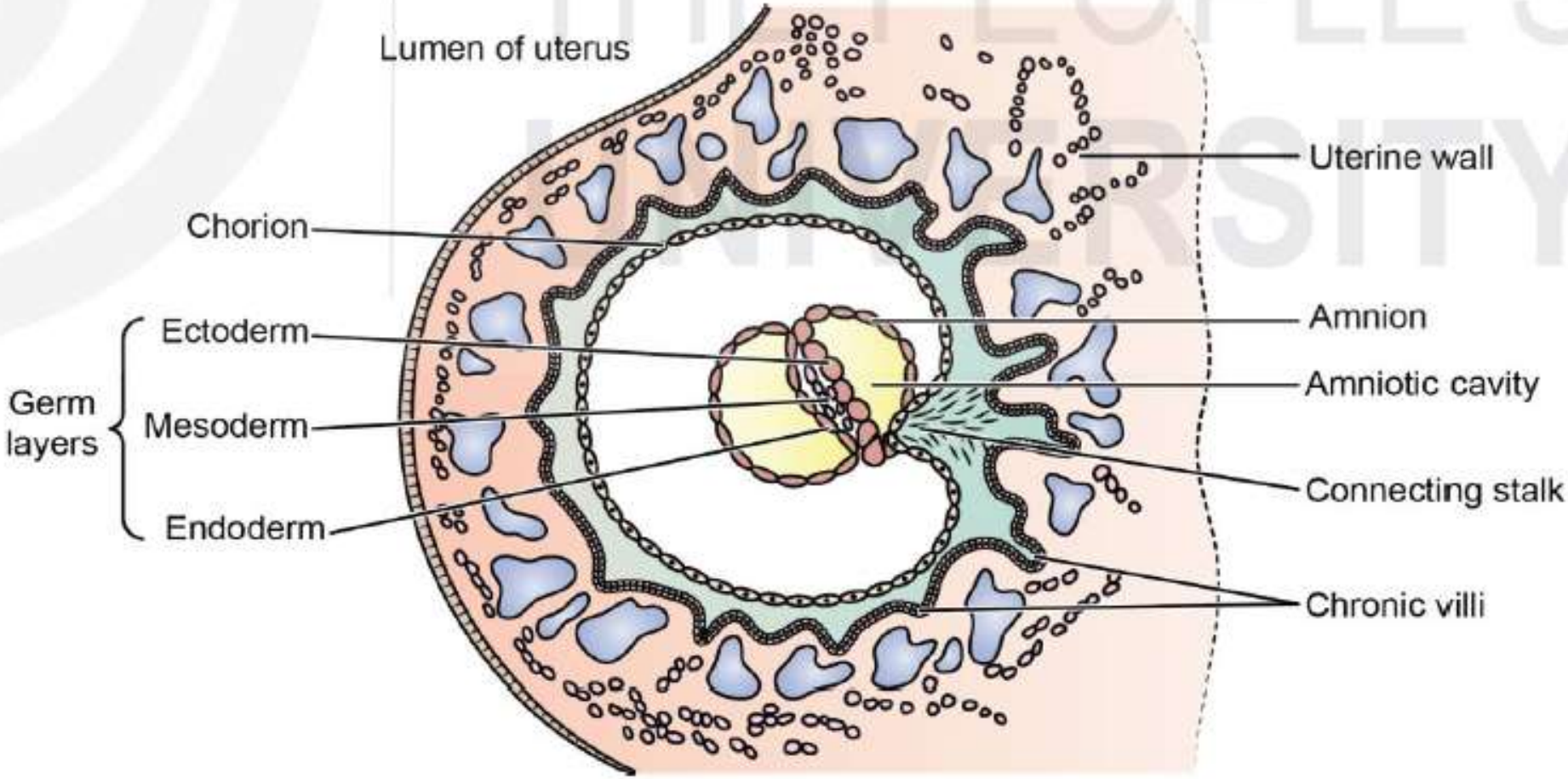

Fig. 16.6: Fully implanted embryo and formation of three germ layers.

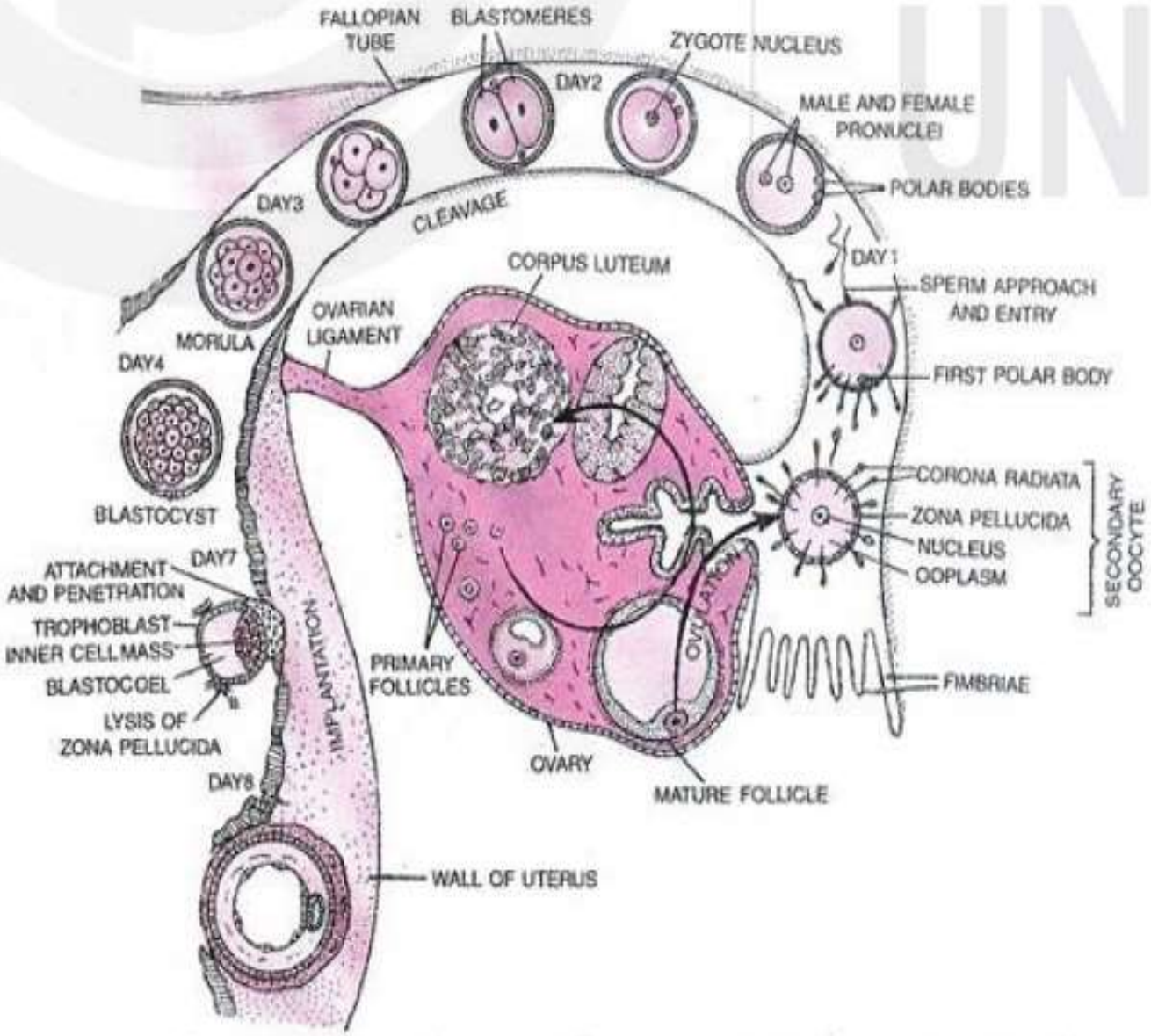

Diagram showing ovulation, fertilisation, cleavage and implantation of blastocyst.

Fig.16.5: Structure showing ovulation, fertilization, cleavage and implantation of blastocyst.

16.4 EMBRYONIC DEVELOPMENT

The embryonic stage extends from the second week through the eighth week and is characterised by formation of placenta, the development of internal organs and appearance of the major external body structures. During this period the embryo takes on a human shape by morphogenetic processes. The rudiments of various organs get established during the 3rd week but further development will take place from then on to 8th week by organogenesis, a process you are already familiar with. Because of the simultaneous developmental changes taking place during this period the developing embryo is particularly sensitive to teratogens, that is, certain agents like alcohol or drugs etc., can induce malformations in the rapidly forming tissues and organs.

16.4.1 Third Week

During the third week of development the ICM separates from the trophoblast and forms the flattened embryonic disc, which at first contains cells of all three germ layers, ectoderm, endoderm and mesoderm and is called the epiblast. From this a lower layer separates to form the endoderm. The second layer, mesoderm, is formed by migration of cells through the primitive streak which forms as the embryonic disc elongates. The cells remaining in the upper layer form the ectoderm.

The embryo's heart also begins its development as a pair of microscopic tubes. The cardiovascular system is the first system to become functional in the embryo. At the end of the third week the heart tubes fuse and become linked to the blood vessels in the embryo, body stalk, chorion and yolk sac, to form a primitive blood circulatory system. Chorionic villi (which will form the placenta later) also begin to form during this period.

16.4.2 Fourth Week to Eighth Week

The general changes in body shape and plan of the embryo from fourth week to eighth week are shown in Fig.16.9.

The fourth week embryo is cylindrical and has a blunt head with a very primitive brain (Fig.16.9). Vague rounded elevations on the lateral surfaces of the brain indicate the eye rudiments. The simple tube like heart which arose in the third week is functional, pumping blood through the umblical arteries to the placenta. Heartbeats, however, cannot be recorded yet. Oral and anal openings appear but are nonfunctional. At the end of fourth week the embryo is 1/4 of an inch long. A characteristic feature of the fourth week is the alternating series of elevated ridges and depressions, the pharyngeal pouches and grooves respectively. These 4 pharyngeal pouches correspond to the gill arches and grooves to the gill slits of fishes. However, these grooves in humans never become functional or perforated. The pharyngeal pouches in humans form the eustachian tubes (1st pair of pouches), walls of tonsils (2nd pair of pouches), thymus and parathyroids (3rd and 4th pair of pouch).

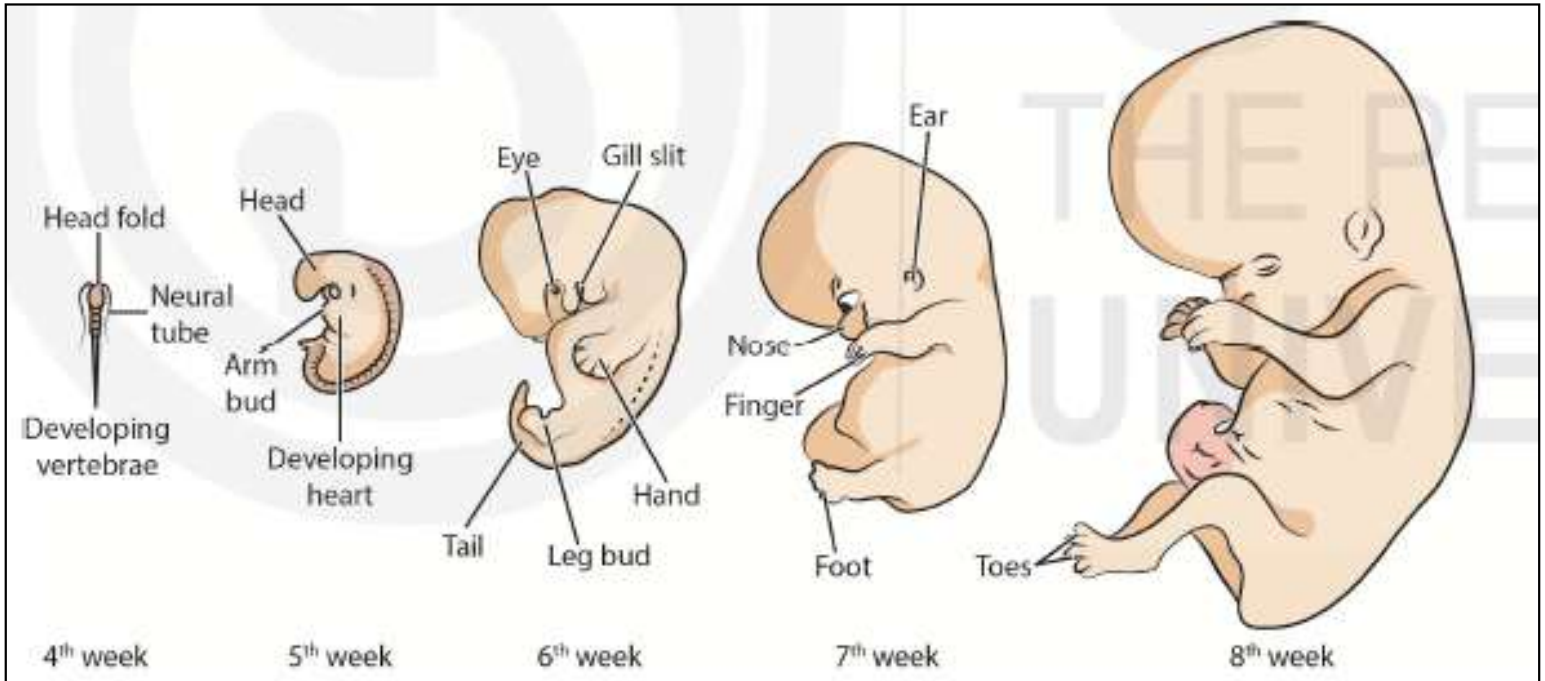

Fig.16.9: Human embryonic development from fourth to eight week.

During the **fifth** week the embryo becomes curled so that the head almost touches the tail (Fig.16.9). The rudimentary arms and legs (limb buds) appear about the middle of the fifth week. The head is now much larger than the trunk region. The brain is the most prominent feature of the embryo. Nerves spread out in the body, paired gonads form, .though not recognizable yet, as testes or ovaries.

In the **sixth week** the head is disproportionately large and the stomach bulges out because of the large liver. Future fingers are seen as indentations on the paddle shaped hands and feet. The hands develop faster than the feet. This is an expression of the general rule that anterior structures grow more rapidly than posterior structures (Fig.16.8). Rapid growth occurs in the facial region.

By the end of the sixth week, the main systems, nervous, muscular, circulatory, excretory, reproductive, digestive and skeletal have been initiated.

After the sixth week the embryo starts looking more human and all the internal organs are formed by the **seventh week** (Fig.16.8). Along with the development of brain, the head achieves its normal relationship with the body as the neck appears. The nervous system is developed enough to permit reflex actions such as the 'startle response' to touch. By the end of **eight week** of development, the embryo is usually 30 mm in length and weighs less than 5 mg (Fig.16.8).

16.5 FOETAL DEVELOPMENT

The foetal stage of development begins in the ninth week and lasts till birth. During this period the existing body structures continue to grow and mature and only a few new parts appear. Figure 16.10 shows that the growth rate is rapid during the foetal period and the body proportions also change greatly. You can also see from Figure 16.10 that at the beginning of the foetal period the size of the head is disproportionately large and legs are short but later the growth of the head slows down.

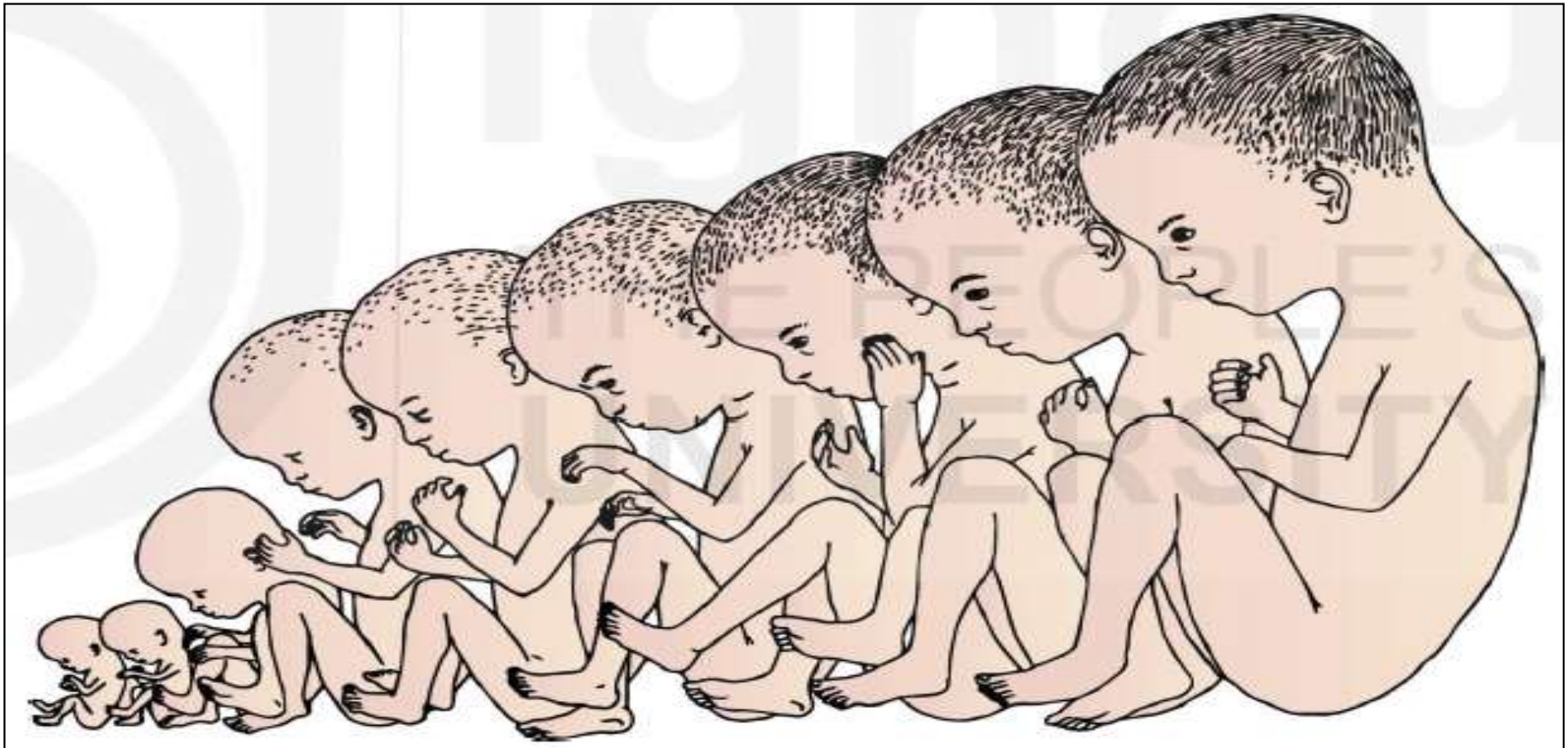

Fig.16.10: Growth during foetal period. The above 9 – 38 week fetuses are less than half actual size.

In the third month, the arms attain the relative length they will maintain during development. Cartilage is replaced by bone as ossification centres appear in most bones. By the end of third month, it is possible to distinguish male foetus from the female. The Y chromosome triggers the formation of a protein called the H-Y antigen that causes the differentiation of testes from the indifferent gonads. The testis secretes testosterone that stimulates the growth of external genitalia. In the absence of testosterone, female genitalia form. Estrogen need not be produced by foetal ovaries as there is enough maternal estrogen circulating in the blood.

In the **fourth month**, the body grows rapidly to reach a length of 13-17 cm, the legs lengthen and the heart beat is loud enough to be heard by the physician's stethescope.

In the **fifth month** the rate of growth decreases slightly. The legs achieve their final relative proportion, the skeletal muscles become active and the mother may feel the foetal movements. Some hair appear on the head and the skin is covered by downy hair. The skin is also covered by a cheesy coating made up of dead epidermal cells and secretions of sebaceous glands.

During the **sixth month**, the body gains substantial amount of weight. Eyebrows and eyelashes appear, skin is wrinkled and translucent.

In the **seventh month** fat gets deposited in the subcutaneous tissues. The eyelids that were fused together in the third month reopen. At the end of the seventh month a foetus is about 37 cm in length. If a baby is born in the seventh month, it is possible that it may survive.

In the **eighth month**, the testis of the male descends into the scrotal sac from regions near the kidney. During the **ninth month** the foetus reaches a length of about 47 cm. The skin becomes smooth and the body appears chubby due to accumulation of subcutaneous fat. An average full term foetus is about 50 cm long and weighs 2.5 to 3.6 kg. Fingers and toes have well developed nails. Fig.16.11 shows the full term foetus with its head positioned towards the cervix.

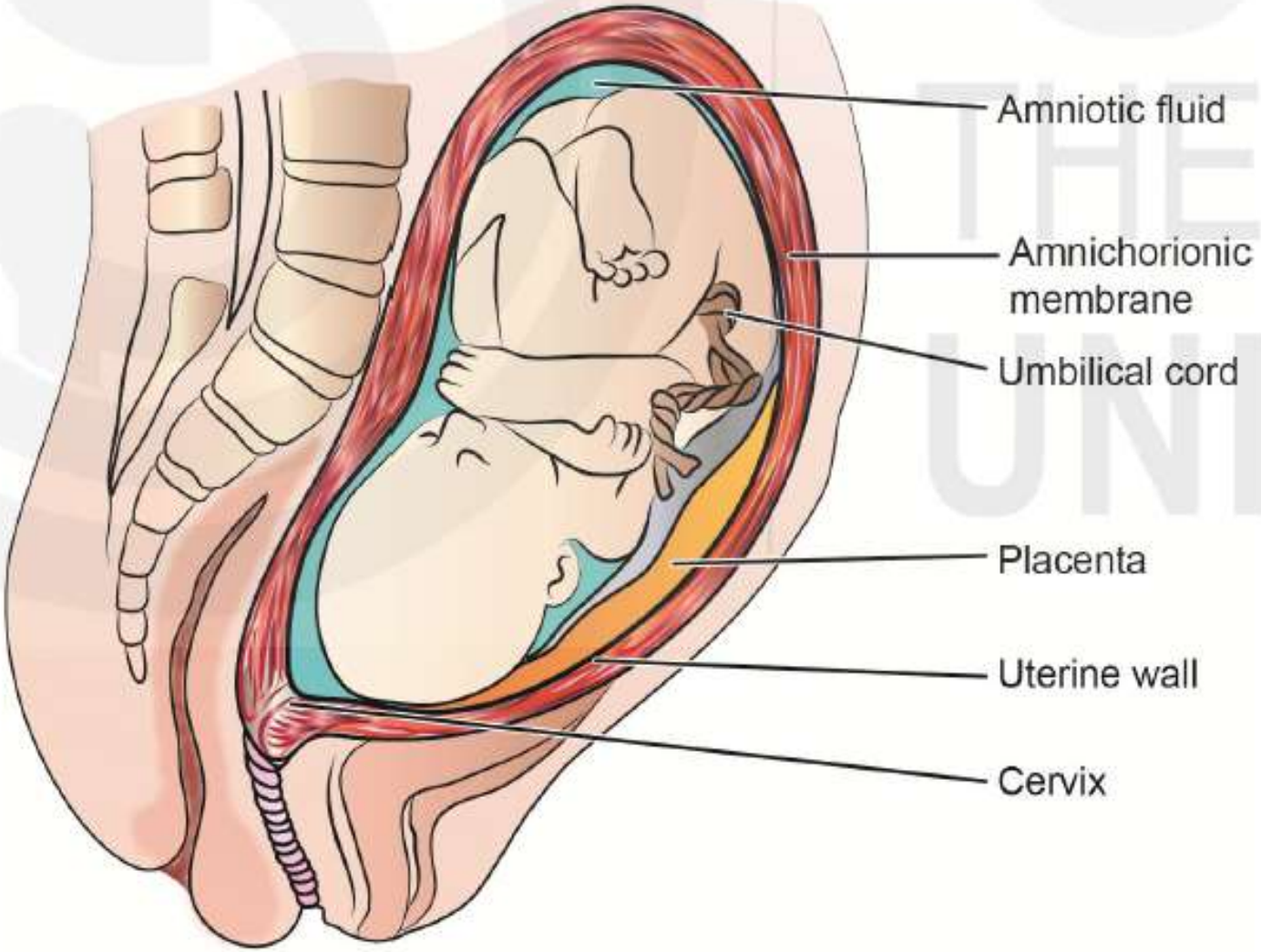

Fig.16.11: Full Term Foetus.

Birth takes place at the end of the third trimester, 38 weeks after conception. The uterus begins a series of powerful contractions. This is due to hormonal as well as mechanical changes in the uterus.