**Embryology**

**Second year Dental students/University of Kerbala,2017-2018**

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**Embryology is the** [**science**](http://en.wikipedia.org/wiki/Science) **of the development of an** [**embryo**](http://en.wikipedia.org/wiki/Embryo) **from the** [**fertilization**](http://en.wikipedia.org/wiki/Fertilization) **of the** [**ovum**](http://en.wikipedia.org/wiki/Ovum) **to the** [**fetus**](http://en.wikipedia.org/wiki/Fetus) **stage.**

**In human, prenatal (intrauterine) development begins at the time of fertilization and continues until the birth of the child.**

**Why studying embryology:**

**All of us were once human embryos, so the study of human embryology is the study of our own prenatal origins and experience.**

**3% to 4% of all live-born children will be diagnosed (usually within the first two years) with a significant malformation (i.e., birth defect). Understanding birth defects requires a thorough grasp of the molecular genetics, cellular, and tissue events underlying normal human embryology.**

**Introduction**

**In humans, the term embryo refers to the ball of dividing cells from the moment the** [**zygote**](http://en.wikipedia.org/wiki/Zygote) **until the end of the eighth week after conception. Beyond the eighth week after conception (9th week of pregnancy), the developing human is then called a fetus.The female gamete or the ovum which contains haploid number of chromosomes (23)combined with the male gamete (sperm) which contains haploid number of chromosomes(23) in process called fertilization.The formed egg after fertilization is called zygote which contains diploid number of chromosomes (46=44 somatic chromosomes and pair of sex chromosomes).** ****

***Human development is a continuous process* that begins when an oocyte (ovum) from a female is fertilized by a sperm (spermatozoon) from a male. The *development is continuous inside the uterus and it is called prenatal development . Development does not stop at birth.* Important changes, in addition to growth, occur after birth infancy i.e. during childhood, adolescence, and early adulthood (postnatal development) (e.g., development of teeth female breast, completion of development of the central nervous system (CNS),and respiratory system).Thus the combination of pre and postnatal development is termed developmental anatomy, which means:**

***The study of the structural changes of an individual from fertilization to adulthood.***

**There are many process occurring during development which include:**

**Cell division, cell migration, apoptosis or programmed cell death, differentiation, growth, and cell rearrangement to form tissues and organs of the body.**

**Prenatal development is the process that occurs inside the uterus during the 40 weeks prior to the birth of a child.**

**Aim of fertilization:**

1. **Restore the diploid number of chromosomes (46 in human).**
2. **Production of zygote which contain new genetic map, different from that of the mother and the father. 3. Activating the zygote which allowing subsequent phases of human embryology to occur.** ****

**Who is going to determine the sex of the embryo?**

**For the sperm there are two types: male sperm contains Y chromosome ; and female sperm contain X chromosomes. For the ovum there is only one type of sex chromosome i.e.: X chromosome; thus when the male sperm is combined with the ovum the resulting zygote will gives rise to a male embryo. On contrast when the female chromosome combine with the ovum the resulting zygote will gives rise to a female embryo. In summary the sperm is responsible for the determination of the sex of the embryo.**

**How and when the different characters of the human being going to be determined?**

**It is going to be determined five hours after fertilization .The genetic coding for the shape and characters of each part of our body usually are coming partially from the father and partially from the mother.**

**Early Developmental Stages**

**Prenatal development consists of three distinct periods:**

1. **Preimplantation period: During the first two weeks.**
2. **Embryonic period : From the second to the eighth week.**
3. **Fetal period : From the 9th week till the end of**

**pregnancy(birth).**

1. **Preimplantation period**:

**It is a period of unattached conceptus. Human development begins when the ovum units with the sperm and form the zygote, in a process called fertilization.Zygot is having diploid number of chromosome of 46.After fertilization, the zygote then undergoes mitosis. After series mitosis the morula is formed.**

**Fluid start to accumulate within the morula, then the zygote becomes a vesicle known as blastocyst.As it grows by cleavage, the blastocyst travels from the site of fertilization in the uterine tube to the uterus. By the end of first week the blastocyst undergoes implantation and thus become embedded in the endometrium.**

***Clinical Note: Developmental disturbances occur in meiosis during fertilization resulting in chromosomal abnormalities which lead to congenital malformations. One of these malformations is the Down syndrome or triosomy 21; an extra chromosome number 21 is present after meiotic division. Children with Down syndrome may have increased level of periodontal diseases and fewer abnormally shaped teeth. The arched palate and poor use of tongue muscles lead to an open mouth position and protrusion of normally sized tongue. Therefore articulate speech is often difficult.***

1. **Embryonic period :**

**This period is extending from the beginning of second week to the end of eighth week. Most organs and organ system are formed during this period and verities of tissues start too development, including the teeth, face and palate. This period is also characterized by the appearance of the branchial arches, which are important for the development of the face, teeh, mandible, maxilla, and endocrine glands.**

**Central nervous system starts development during this period. Along with the CNS a mass of cells called neural crest also developed.**

**Certain physiological processes occur during this period. These physiological processes include proliferation, differentiation and morphogenesis. These physiological processes allow the teeth and associated structures, as well as other organs to develop in the embryo.**

**Neural Crest*:* Also during the third week, another specialized group of cells, the neural crest cells, develop from the neuroectoderm. These cells are differentiated and separated from the dorsolateral aspect of the neural tube.**

**Origin: These cells are originated from neuroectoderm during development of the CNS.**

**The neural crest cells migrate away from the neuroectoderm in a form of waves.**

**The migrations are initiated at about 4 week in human embryo.**

**These migrated cells have the capacity to differentiate extensively within the developing embryo to form many structures and cells in the head and neck and other parts of the body, including the branchial arches and their derivatives. On reaching their predetermined destination, the neural crest cells undergo differentiation into diverse cells types. Many embryologists consider the neural crest cells to be fourth embryonic layer.**

**Embryonic connective tissue elsewhere is derived from mesoderm and is known as mesenchyme, whereas in the head it is known as ectomesenchyme, reflecting its origin from neuroectoderm.**

**In the head region, these cells are involved in the formation of cranial supporting connective tissues, cartilage (like the Meckel's cartilage of first branchial arch), bone and all tissues of the tooth such as the pulp, dentin, cement and periodontal ligament(except the enamel) are derived from neural crest cells.**

**The migrating neural crest cells move in waves or stream directed toward the branchial arches, which are important structures necessary for the development of orofacial structures.**

**Then neural crest cells that are migrated in trunk and head regions form mostly the following component: spinal and cranial sensory ganglia, sympathetic neurons, Schwann cells, pigment cells and meninges.**

**In Treacher Collins syndrome full facial development does not occur because the neural crest cells fail to migrate properly to the facial region. The migration of neural crest cells to the correct location is very sensitive and important process. In the human the period of migration is extending between 22-49 days.**

**During the third week three germ layers present in the embryo, they are the ectoderm, mesoderm and endoderm*.***

***The embryo during this period is vurnable to many developmental disturbance caused by teratogens .These are environmental factors include infection, drugs, and radiation which cause malformation in the embryo.***

Teratogens

What is a teratogen?

**A teratogen is defined as any environmental factor that can produce a permanent abnormality in structure or function, restriction of growth, or death of the embryo or fetus. A dose-response relationship should be demonstrated in animals or humans so that the greater the exposure during pregnancy, the more severe the phenotypic effects on the fetus . Factors comprise medications, drugs, chemicals, and maternal conditions or diseases, including infections.**

**A teratogen is an agent, which can cause a birth defect. It is usually something in the environment that the mother may be exposed to during her pregnancy. It could be a prescribed medication, a street drug, alcohol use, or a disease present in the mother which could increase the chance for the baby to be born with a birth defect. About 4 to 5 percent of birth defects are caused by exposure to a teratogen.**

What are the most sensitive periods for teratogens in pregnancy?

**Most structural defects caused by teratogenic exposures occur during the embryonic period, which is when critical developmental events are taking place and the foundations of organ systems are being established. The primary target for the teratogens during this period is the migrating neural crest cells**

**Exposure to teratogens during fetal period tends to produce less sever defects since this is a period of maturation rather than a period of formation.**

