L.5 Mosaicism

Is the presence of two or more populations of cells with different genotypes in one individual who has developed from a single fertilized egg . This condition can be result from non-disjunction or chromosomal lagging during mitosis in the zygote or in the nuclei in the early embryo, as a result forming a mosaic including male and female phenotypes ,has special name true hermaphrodite is an individual ,with male and female reproductive organs. The main chromosomal mosaics are known in human, is xx/xy.

In human, xx/xy mosaic that resulted from of the fusion of two zygotes, one formed by a sperm fertilizing an ovum and the other formed by a second sperm fertilizing a polar body. Another rare condition occurs when two separate embryos fuse together. This can result in a person with some XX cells and some XY cells. Such a person can have testes and ovaries. This condition is extremely rare.

In some cases, hermaphrodite result from androgen insensitivity: the cells respond a little bit to testosterone produced by the testes. The embryo develops with ambiguous genitalia, neither completely male not completely female.

Another condition, congenital adrenal dysplasia, causes the adrenal glands to produce an abnormally large amount of testosterone in a female embryo; this can also cause development of ambiguous genitalia, a hermaphrodite.

The other type **pseudohermaphroditism**:

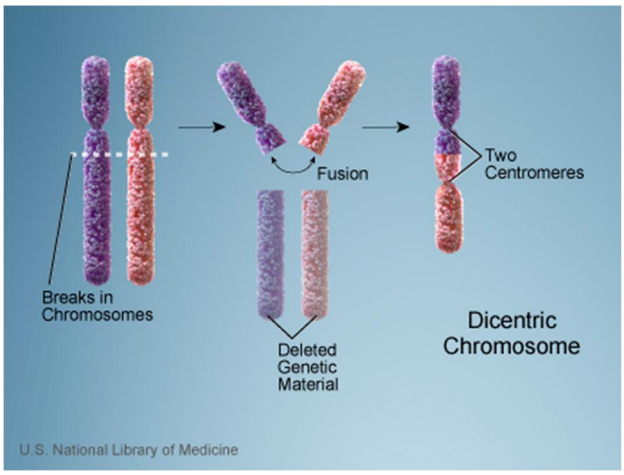
Unlike true hermaphroditism, having gonadal tissue of only one sex:

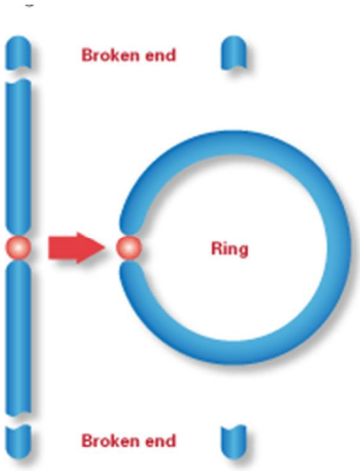
Male pseudohermaphroditism: Have 46, xy and have only testicular tissue.

Female pseudohermaphroditism : Have 46,xx karyotype and have only ovarian tissue. The sexual organ of all pseudohermaphroditisms are ambiguous, have anomalies which tend to make them resemble those of the opposite sex.

Abnormal chromosome structure

Besides crossover ,the chromosome breakage followed by reunion lead to may be either stable chromosome (capable to passing through cell division) or unstable (fail to undergo cell division) such as dicentric , a centric and rings.





There are five types of these aberrations:

1. **Deletion or deficiencies:**

A deletion is the loss of a portion of chromosome there are two types:

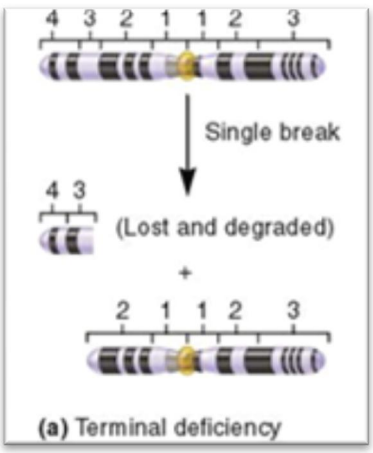
a- **Terminal deletion**

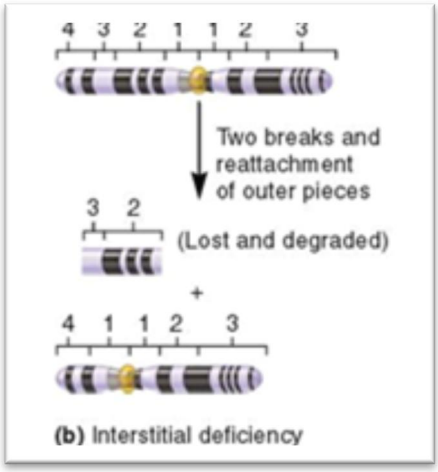
The deletion which occurs at the end of the segments

b- Interstitial deletion

This occurs between two breaks in the centric chromosome.

From these types results either acentric fragment which fail to move on the spindle because it has no centromere or a ring chromosome: is a type of deletion which both end have been lost and the two broken ends have reunited to form a ring shaped figure.

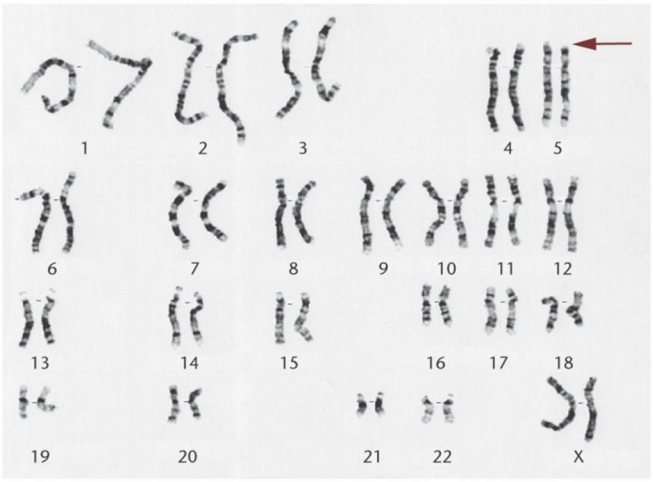


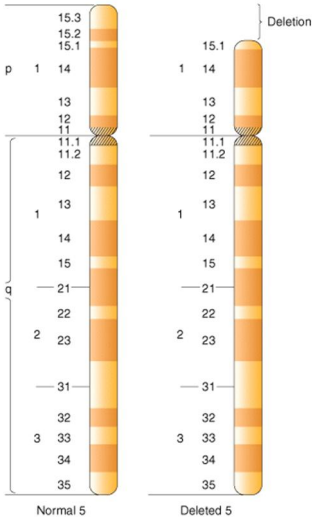


Deletions are usually lethal when homozygous even when heterozygous causes abnormalities such as in human:

Cri du chat (cat cry) syndrome:

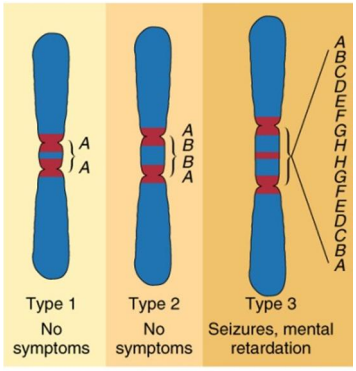
Caused by deletion of part of the short arm of one copy of chromosome 5(46,5p) . The affected individual has small head, mentally retarded, facial abnormalities and the infant cry resemble to a cat .





2-Duplication:

Is the presence of an extra piece of chromosome this extra piece may be result from duplication within a chromosome ,or it may be attached to a non-homologous chromosome called translocation .Sometimes a piece break off on chromosome and fuses on to end of the other homologous chromosome. This process lead to duplication of one chromosome and deletion of segment in another . Duplications like deletions, are more likely to cause symptoms if they are extensive. For example, duplications of chromosome 15 do not produce a phenotype unless they repeat several genes. Shows three duplicated chromosome 15s, with increasing amounts of material repeated . Many people have the first two types of duplications and have no symptoms. However, several unrelated individuals with the third, larger duplication have seizures and mental retardation. .



3-Inversion:

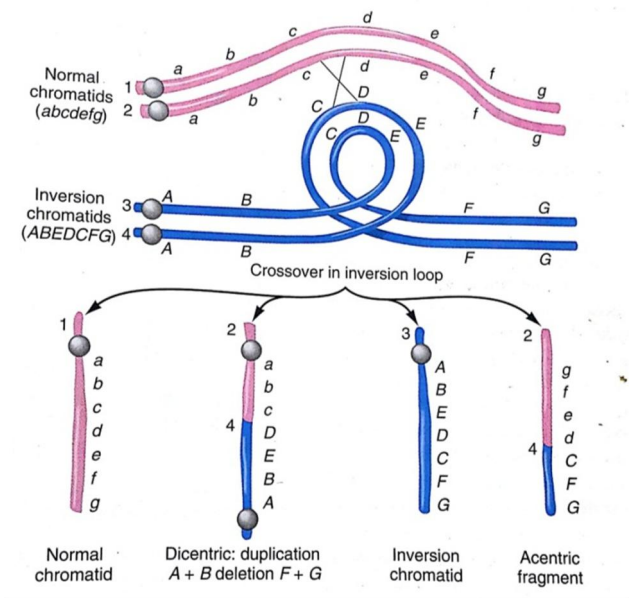
An inversion involves fragmentation of a chromosome followed by reconstitution, but with a section of the chromosome inverted (the segment of chromosome is turned around 180^{o}). Two types of inversions are distinguished by the position of the centromere:

a- Paracentric inversion:

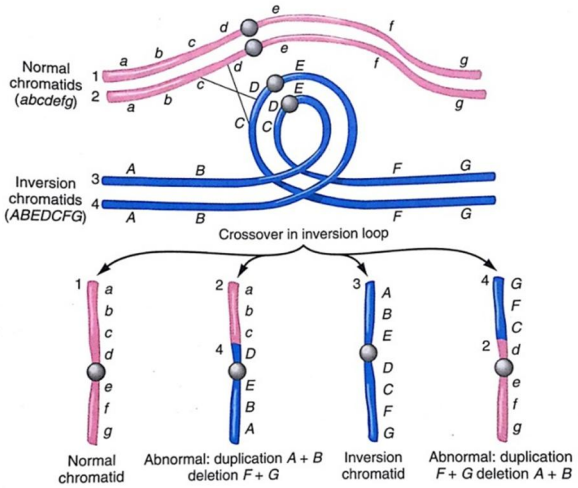
The centromere does not include within the inverted segment. A single crossover within the inverted segment gives rise to two very abnormal chromosomes, one of them dicentric and the other acentric.

b- Pericentric :

The centromere included within the loop. A crossover in it produces two chromosomes that have duplications and deletions, but one centromere each.



Paracentric



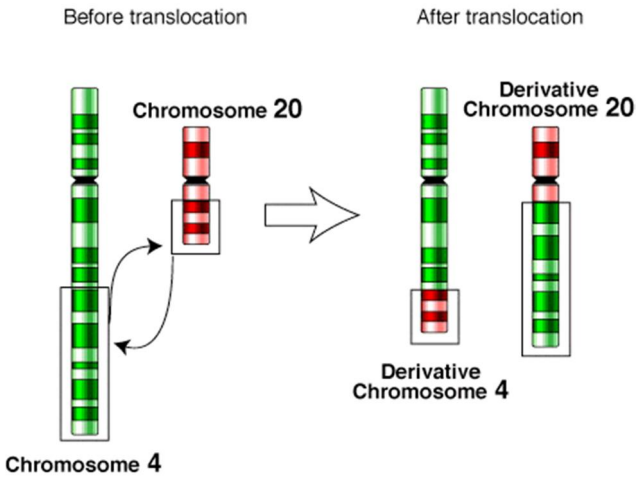
Pericentric

4-Translocation:

is a chromosome abnormality caused by rearrangement of parts between non-homologous chromosomes. There are three types of translocations:

a- Reciprocal translocation:

Two different chromosomes exchange parts without centromere . This type may or may not be harmful. The translocation between chromosome 2 and 20 cause Alagille syndrome that produces distinctive facial features, abnormalities of the eyes and ribs .

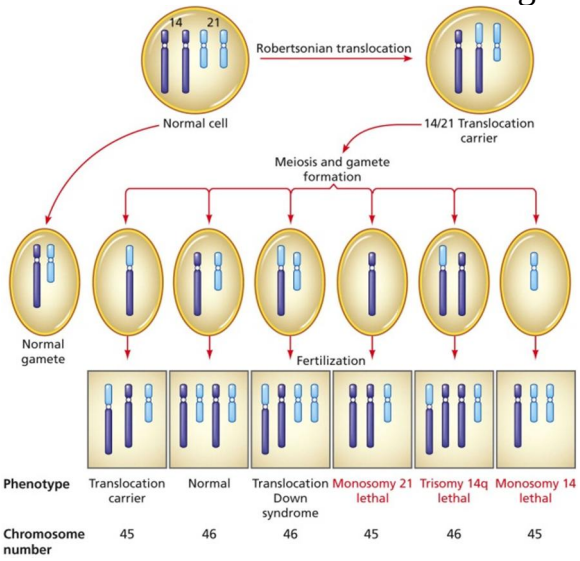


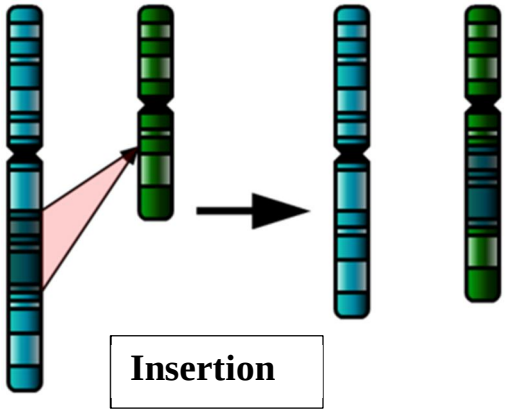
b- Robertsonian translocation:

The breakage occurs at the centromere region. The short arms of two different acrocentric chromosomes breaks, leaving sticky ends that cause the two long arms to join, forming single, large chromosome with two long arms. For example: translocation between 14 and 21 chromosome in Down's syndrome translocation. The individual with translocation produces some gametes that lack either of chromosomes and some gametes that have extra material from one of translocate chromosomes.

c- Insertion:

This type of structural changes requires three breaks, followed by insertion of the segment between the breaks of one chromosome into the break in the non-homologous chromosome .





5- Isochromosome and Ring chromosomes:

During the cell division the centromere of chromosome may divided perpendicular to the long axis of the chromosome instead of parallel to it . If this mistake in division occurs in a submedian centromere (x or 21 chromosomes) the chromosome, instead of dividing into two identical halves, divides into a long a short chromosome, both with metacentric.

Ring chromosomes may arise when telomeres are lost, leaving sticky end that adhere . Ring chromosomes can produce symptoms. For example, a small ring chromosome of DNA from chromosome 22 causes cat eye syndrome.