Chromosomal Aberrations

NUMERICAL

&

STRUCTURAL

Different Cell Line

(Mosaicism,Chimera)

Chromosomal Aberrations

- Causes - Ionizing radiation
  - Viral infection
  - Chemicals
  - Age related
  - Iatrogenic

Chromosomal Aberrations

- **Balanced-** Chromosomal content is the Same
- **Unbalanced-** Addition or Subtraction

Chromosomal Aberrations

Stable- Presence of Centromere
They pass through cell division
Inherited by the next generation

Unstable- Absence of Centromere
Unable to pass through cell division
Not inherited by the next generation

Numerical Aberration

- **Normal Diploid - 2n**

A) Euploidy- Exact multiple of-'n'-Don't survive

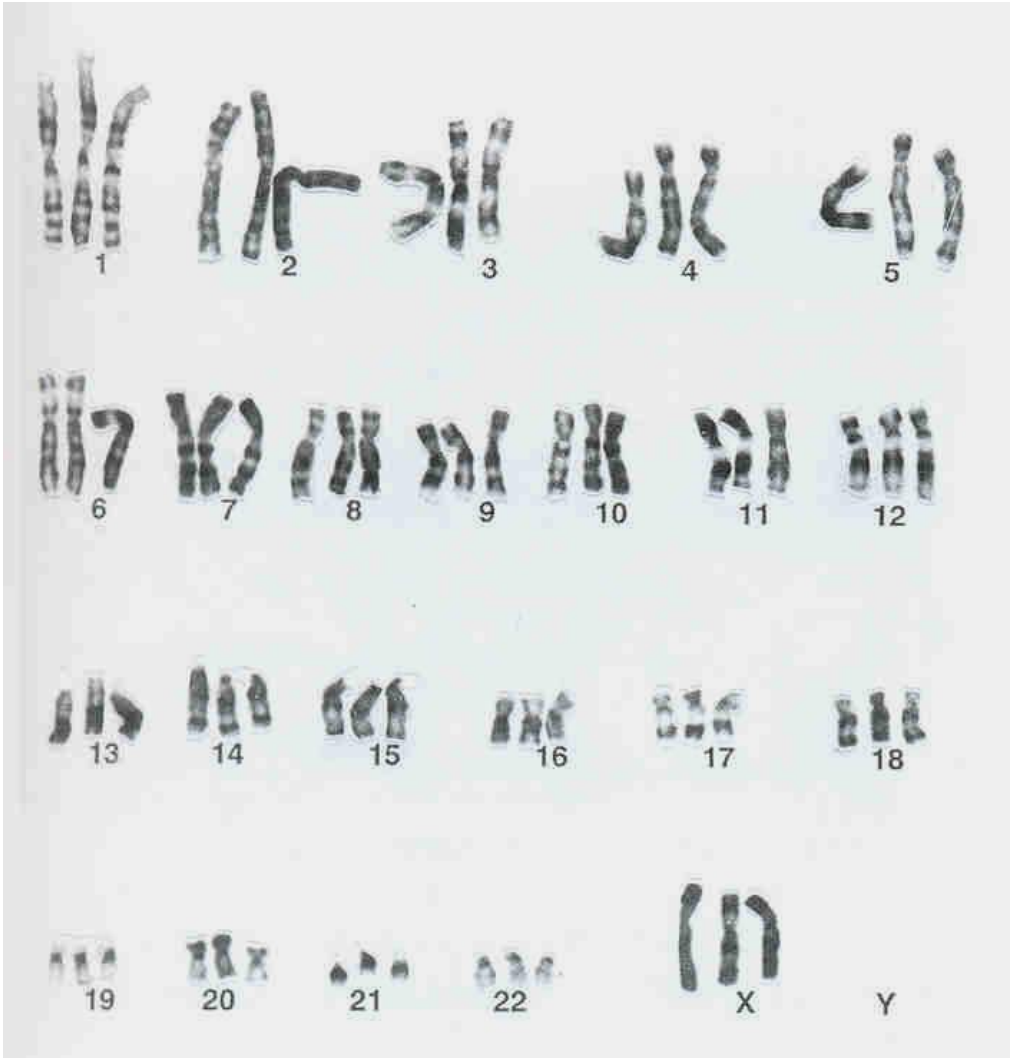
1) Triploidy (Dispermy) 3n- can be liveborn but nonviable

2) Tetraploidy 4n- nonviable

B) Aneuploidy –Extra or **Missing** chromosome

2n – 1 / 2n +1

TRIPLOIDY



ANEUPLOIDY

- Loss or gain of one or more chromosome
- In 3-4% of clinically diagnosed pregnancies

TRISOMY

- **Autosome**- 15,18,
  21-(commonest)

- **Sex chromosome-** **X** chromosome

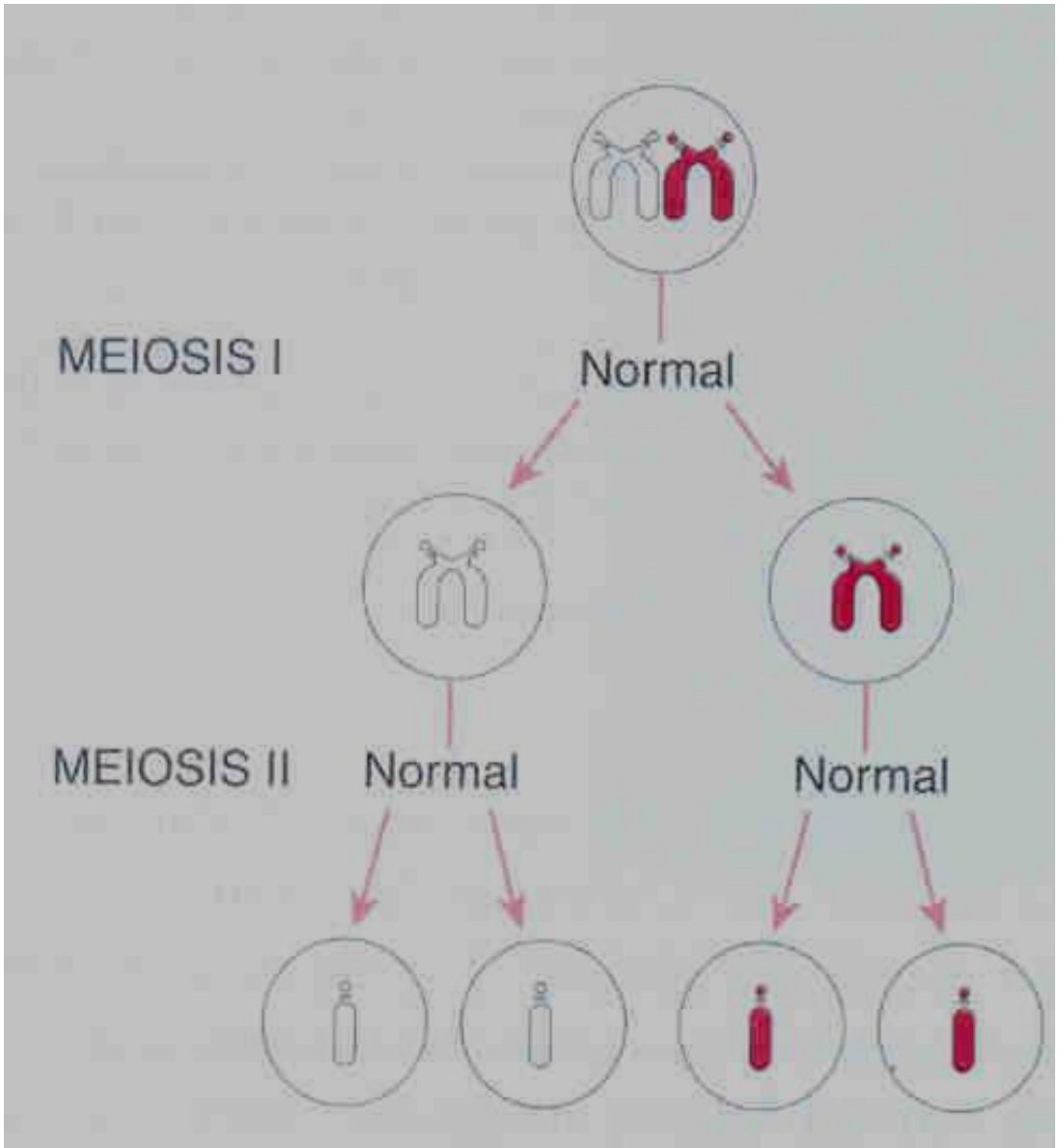
  Y chromosome

Aneuploidy

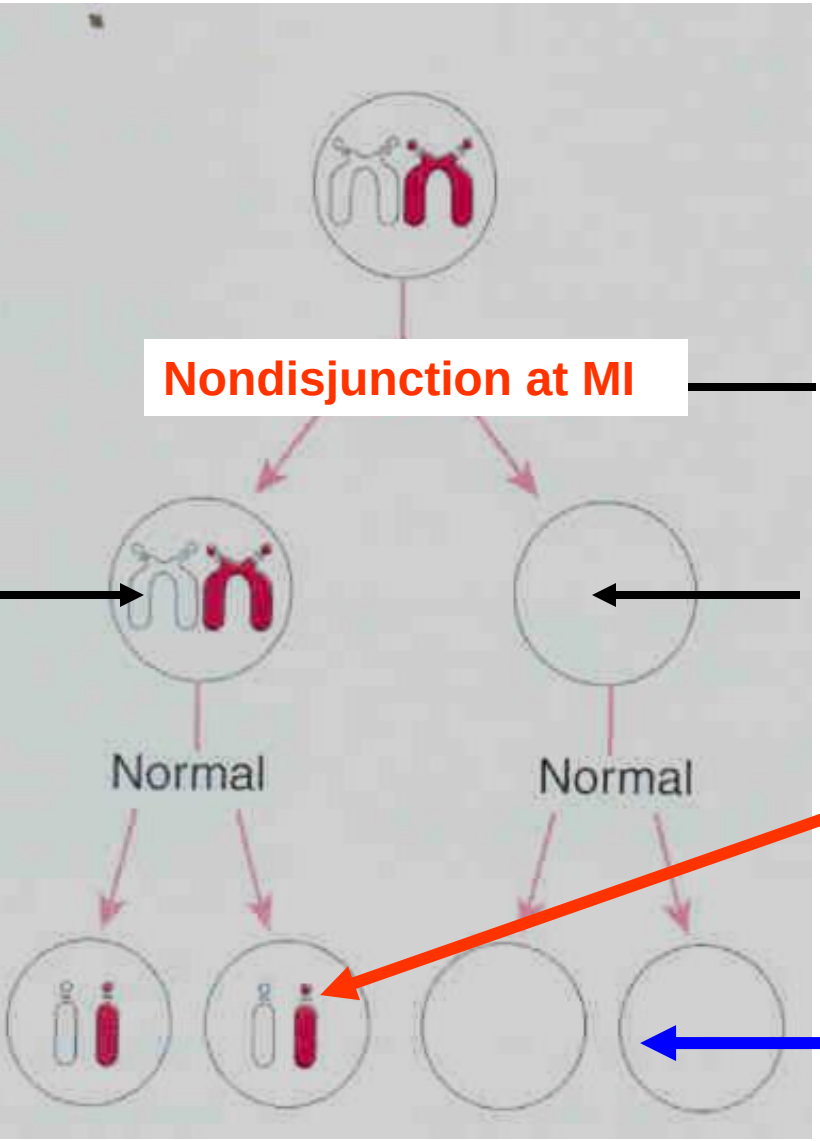
MONOSOMY

- **Autosome - Nonviable - Do not survive**
- **Sex chromosome - - -**
- **X chromosome - Turner syndrome XO**
- **Y Chromosome -** ??

NORMAL M-I and M-II



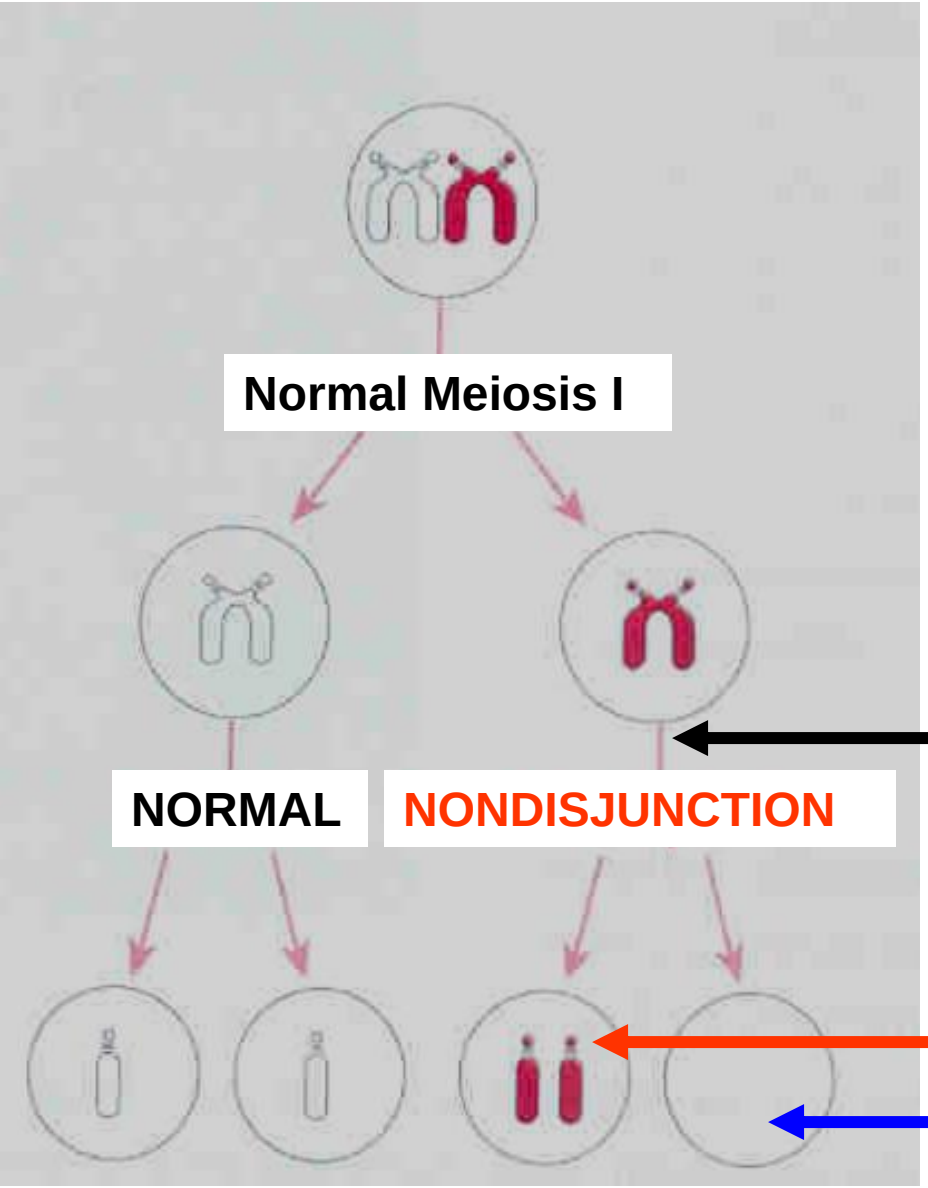
NONDIJUNCTION AT Meosis I



Consequences of Fertilization with normal gamete

- **50%--Trisomy**
- **50%--Monosomy**

NONDISJUNCTION at M-II



Consequences after fertilization with normal gamete

- **Mistake at M-II**
- **50%-Normal**

- **25%-Trisomy**
- **25%-Monosomy**

Causes Of Nondisjunction

- **Aging effect on Primary Oocyte** - as it remains in suspended inactivity upto 40 years or more
- **Delayed fertilization after ovulation**

- **Abnormality in Spindle Formation**

- **Absence of recombination-**

  Premature separation

  Segregate randomly

Causes of Aneuploidy

NONDISJUNCTION

At Meiosis - Failure to Pair

Failure to Disjoin

Anaphase Lag

At Post-zygotic - Mitosis- MOSAICISM

The patient is known as ‘Mosaic’

Effects of the Mosaicism

Depend on

- **Time** of the non disjunctional event
- **Nature** of the chromosomal abnormality
- **Proportions** of different chromosomes
- **Tissues** affected

Structural Aberration

- Structural Breakage with **subsequent reunion** in different configuration

- **Balanced** –Chromosomal complement is intact
  Carriers have risk of producing children with Unbalanced complement

- **Unbalanced-**
  Loss or gain of the segment of the gene

Structural Aberrations

- **Deletion**- Unbalanced -Terminal, Interstitial
- **Insertion**-Unbalanced
- **Ring Chromosome-** Unbalanced

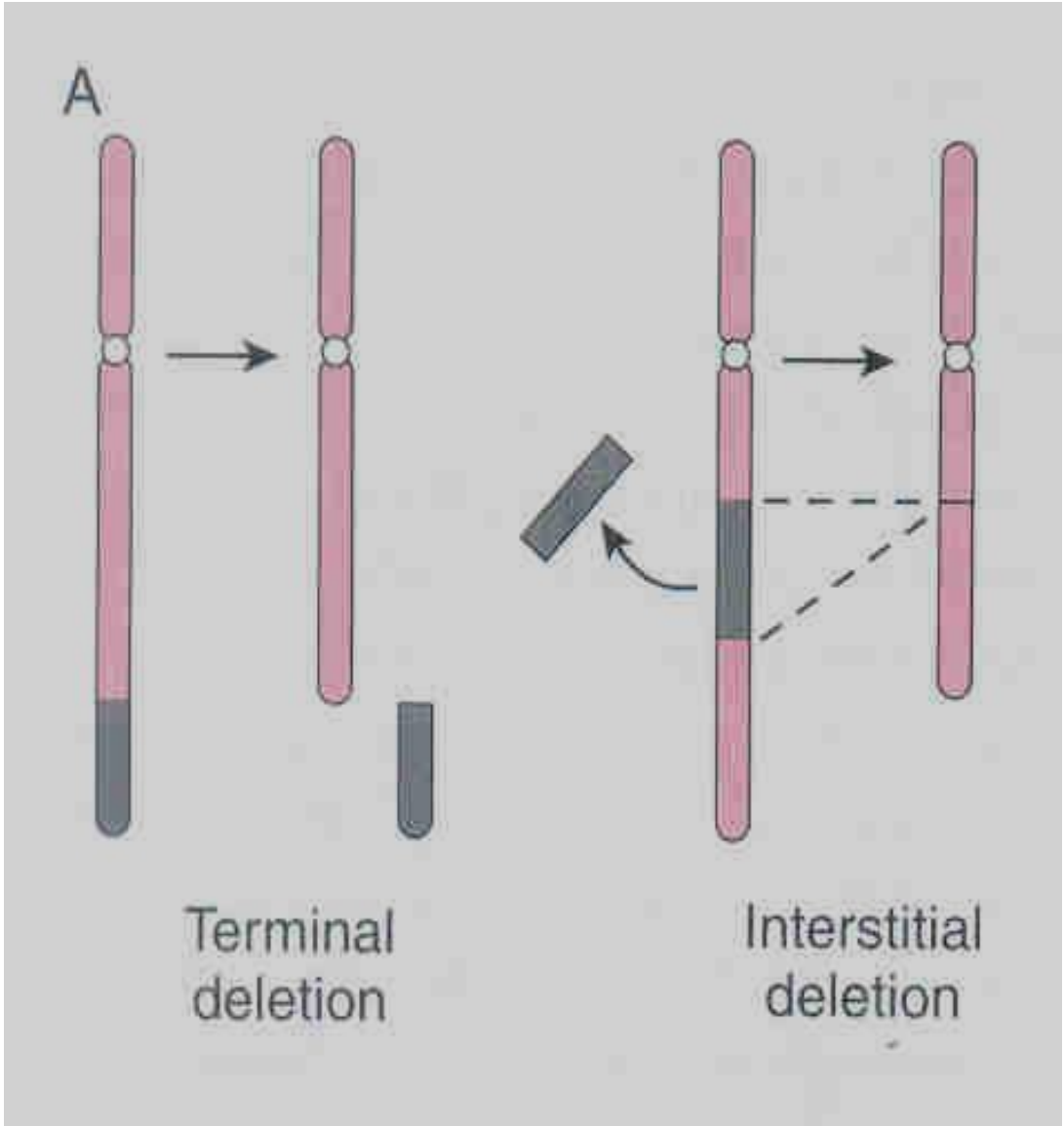
  Double deletion -- more severe
- **Duplication**-Though Unbalanced less harmful
- **Isochromosome**-Unbalanced

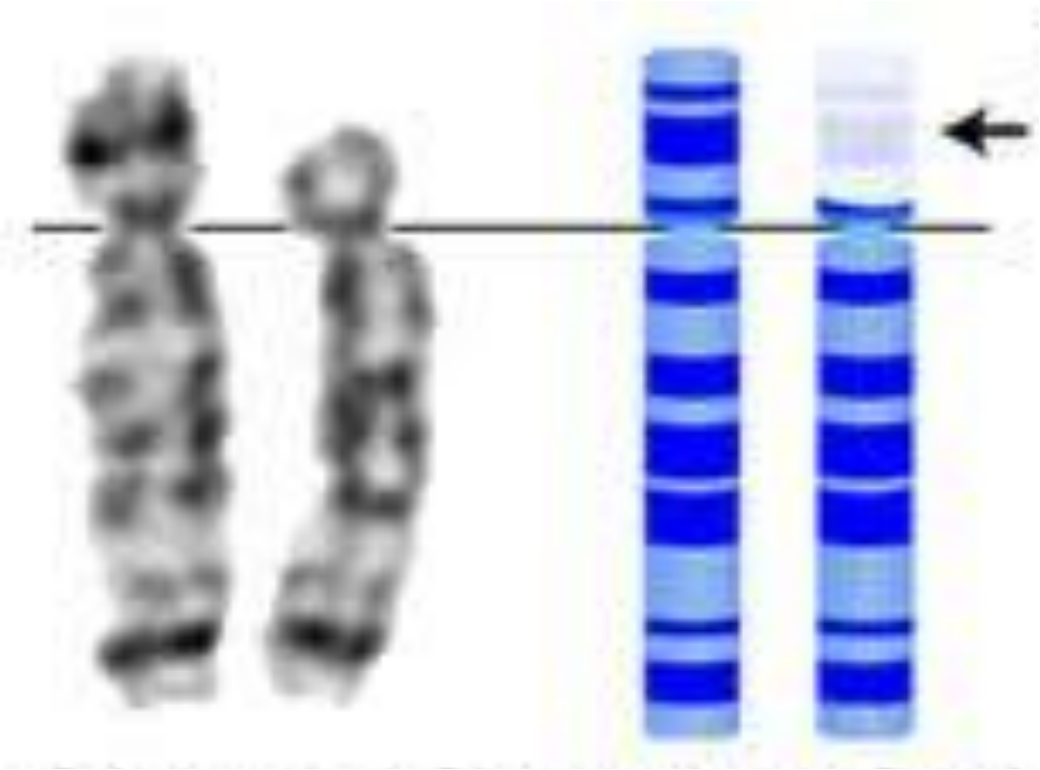
  More common in X chromosome
- **Inversion** -Balanced
- **Translocation-** Reciprocal - Balanced

  Robertsonian - Unbalanced

UNBALANCED- Deletion

Terminal, Interstitial

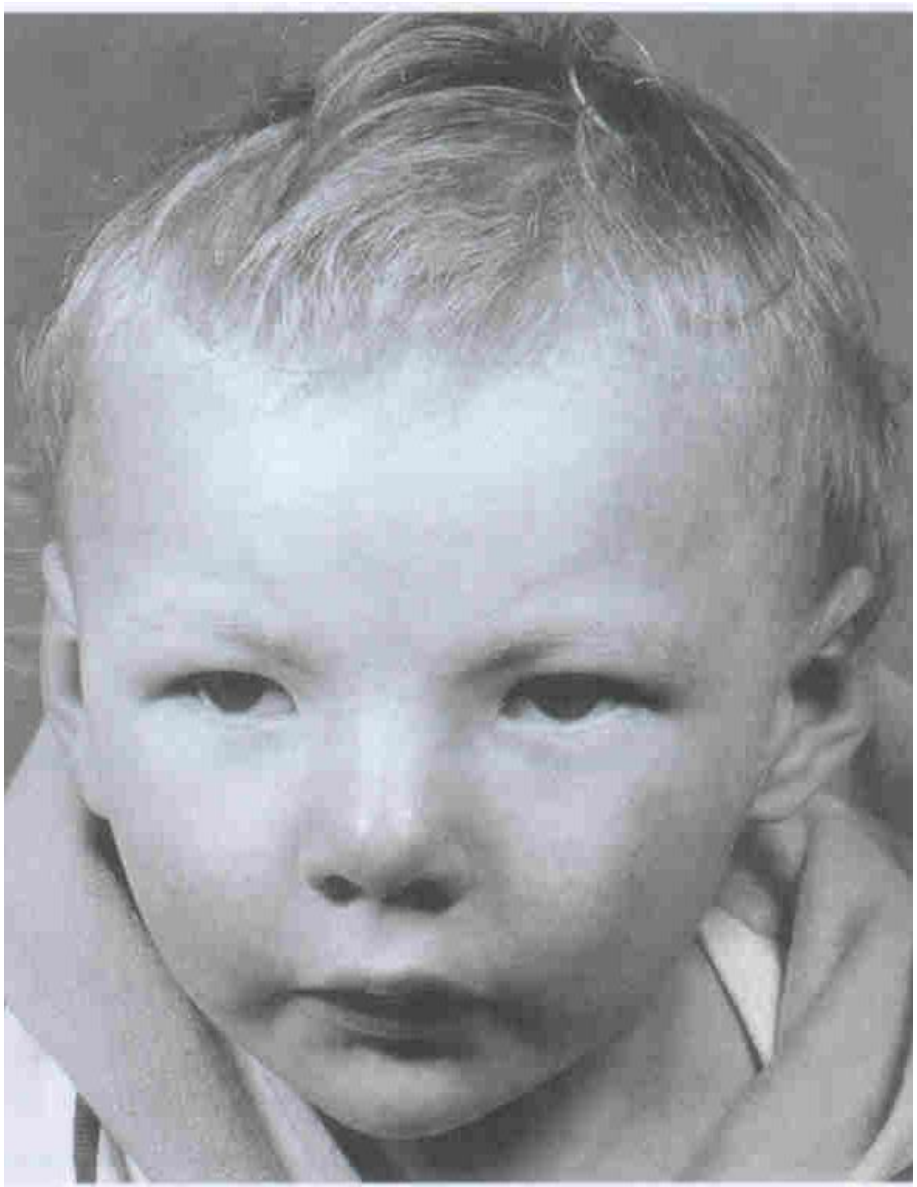




CRI-Du-CHAT-Deletion of Chromosome no. 5

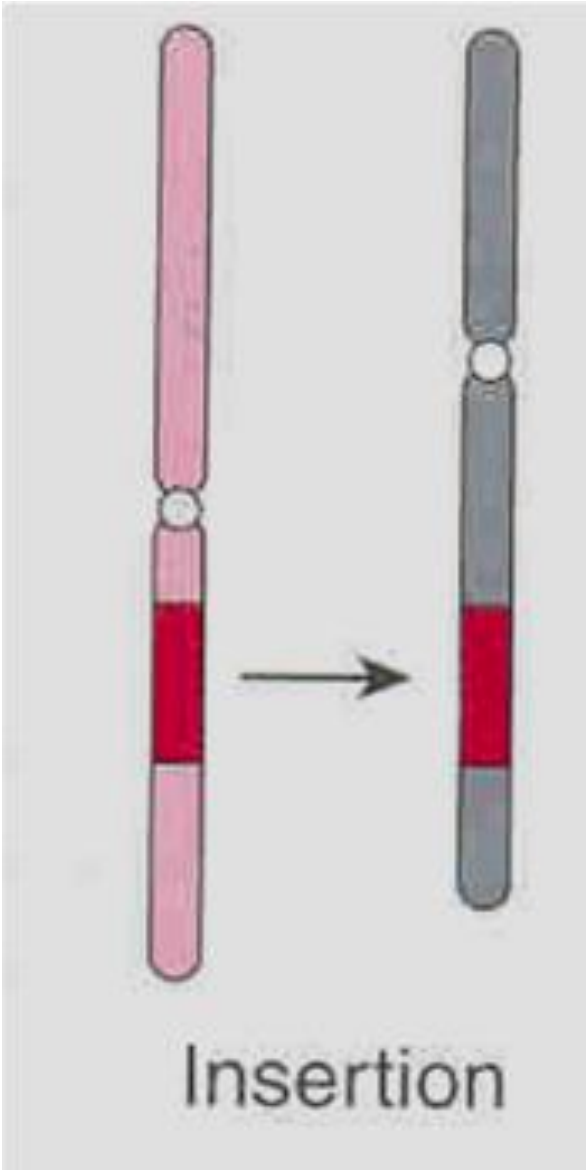
Cri-du chat

Cri-du-chat(5p-)

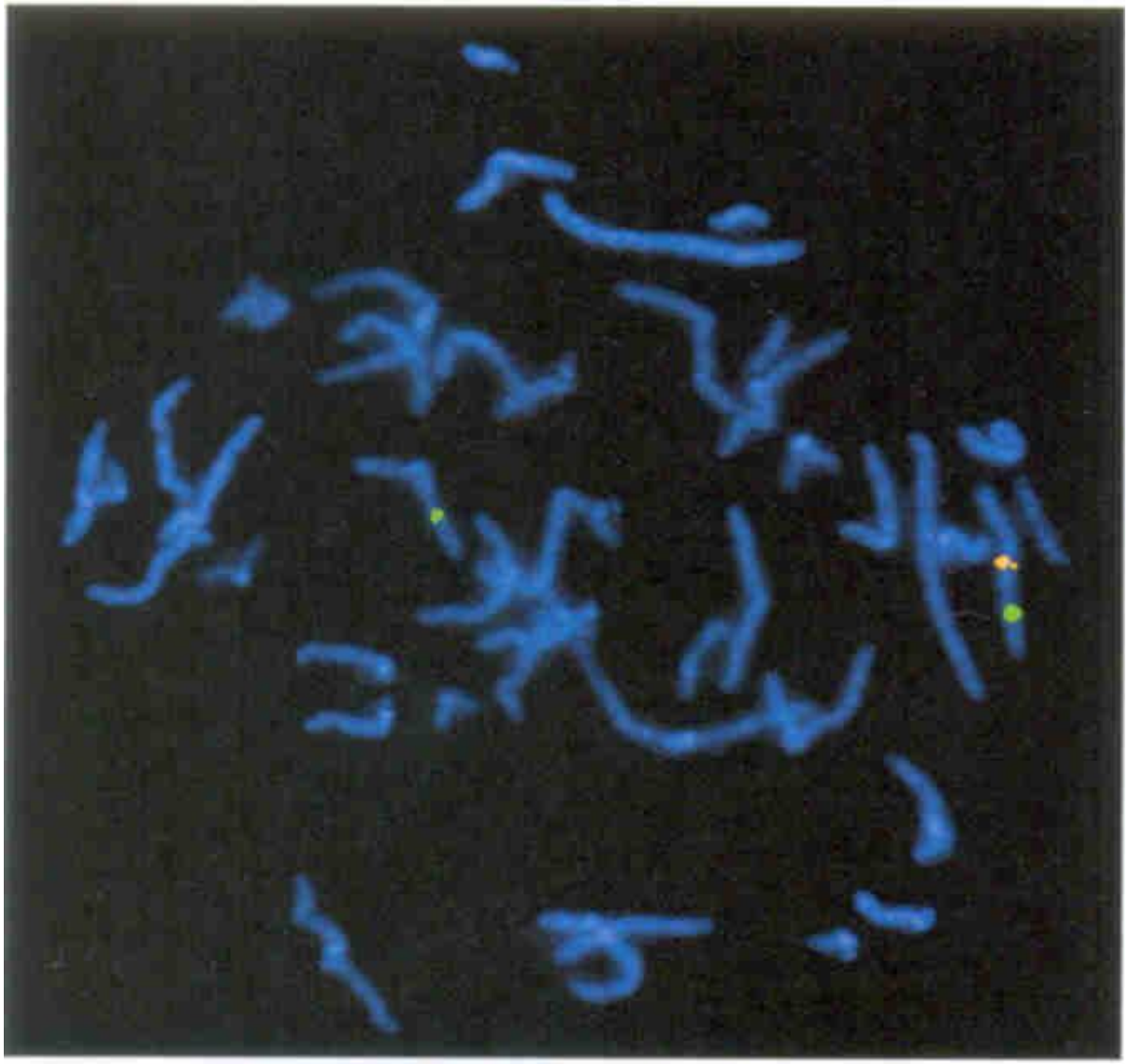


Deletion (5p-) Cri-du-chat
Mild to Moderate Mental retardation

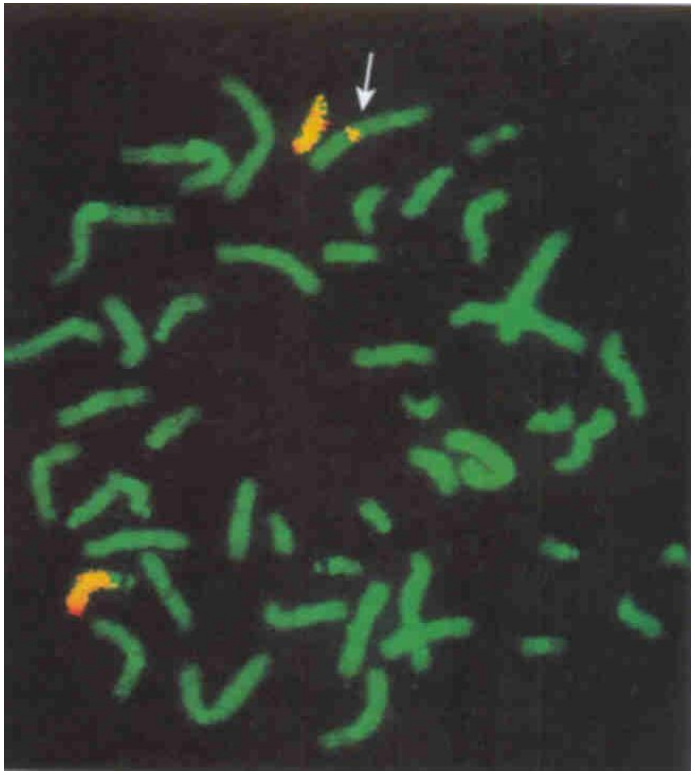
Unbalanced- Insertion



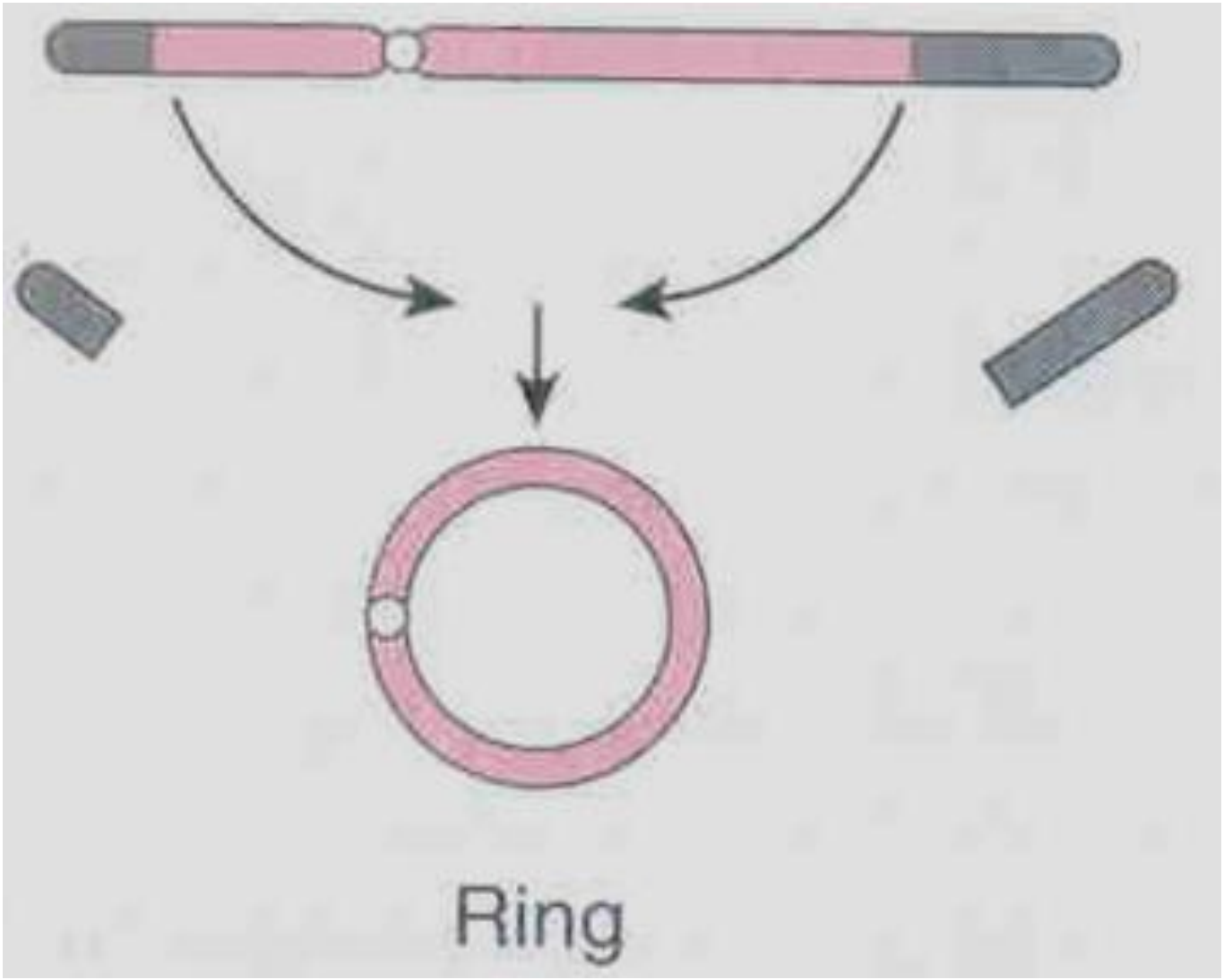
Insertion

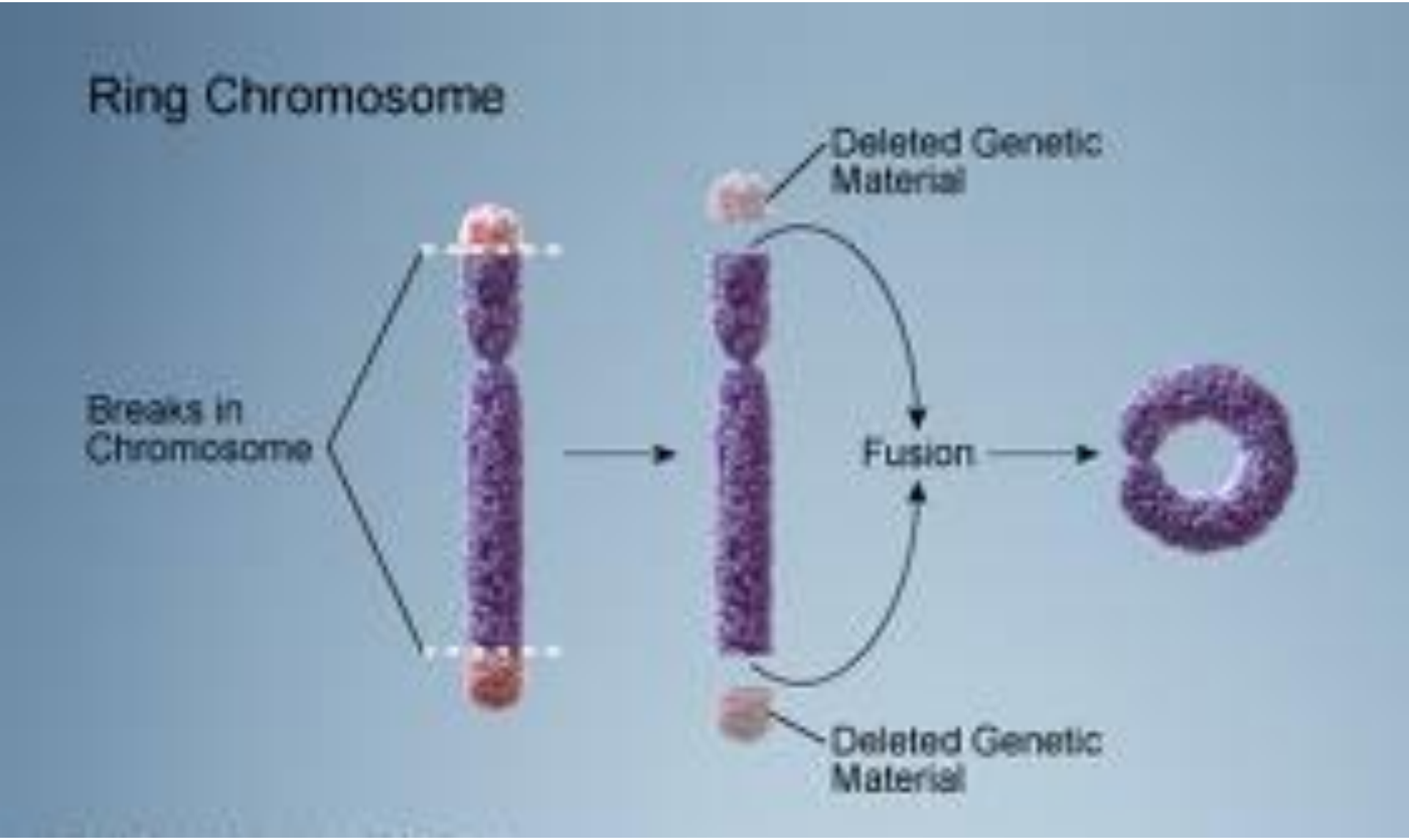


Insertion -Unbalanced FISH

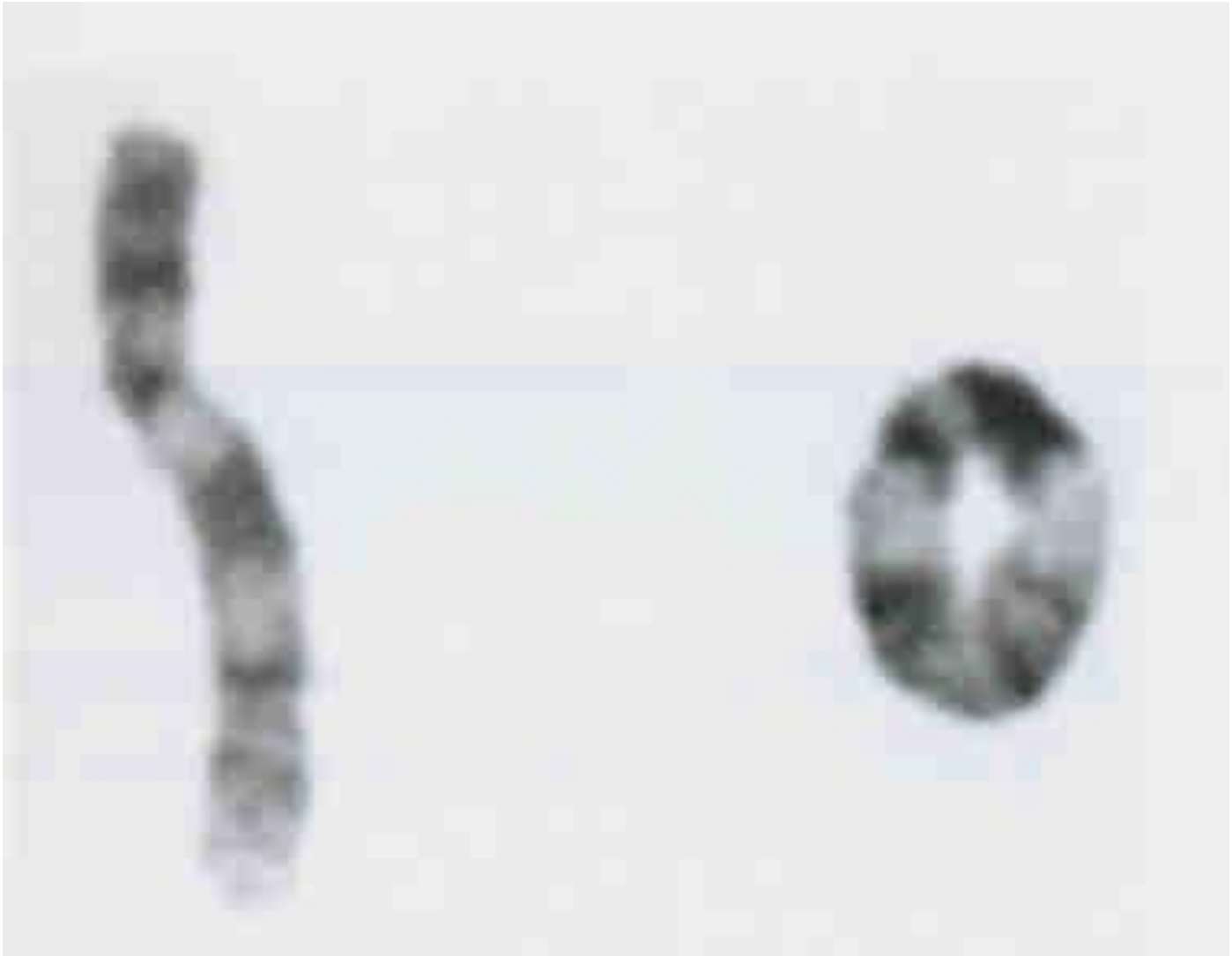


Unbalanced-Ring chromosome

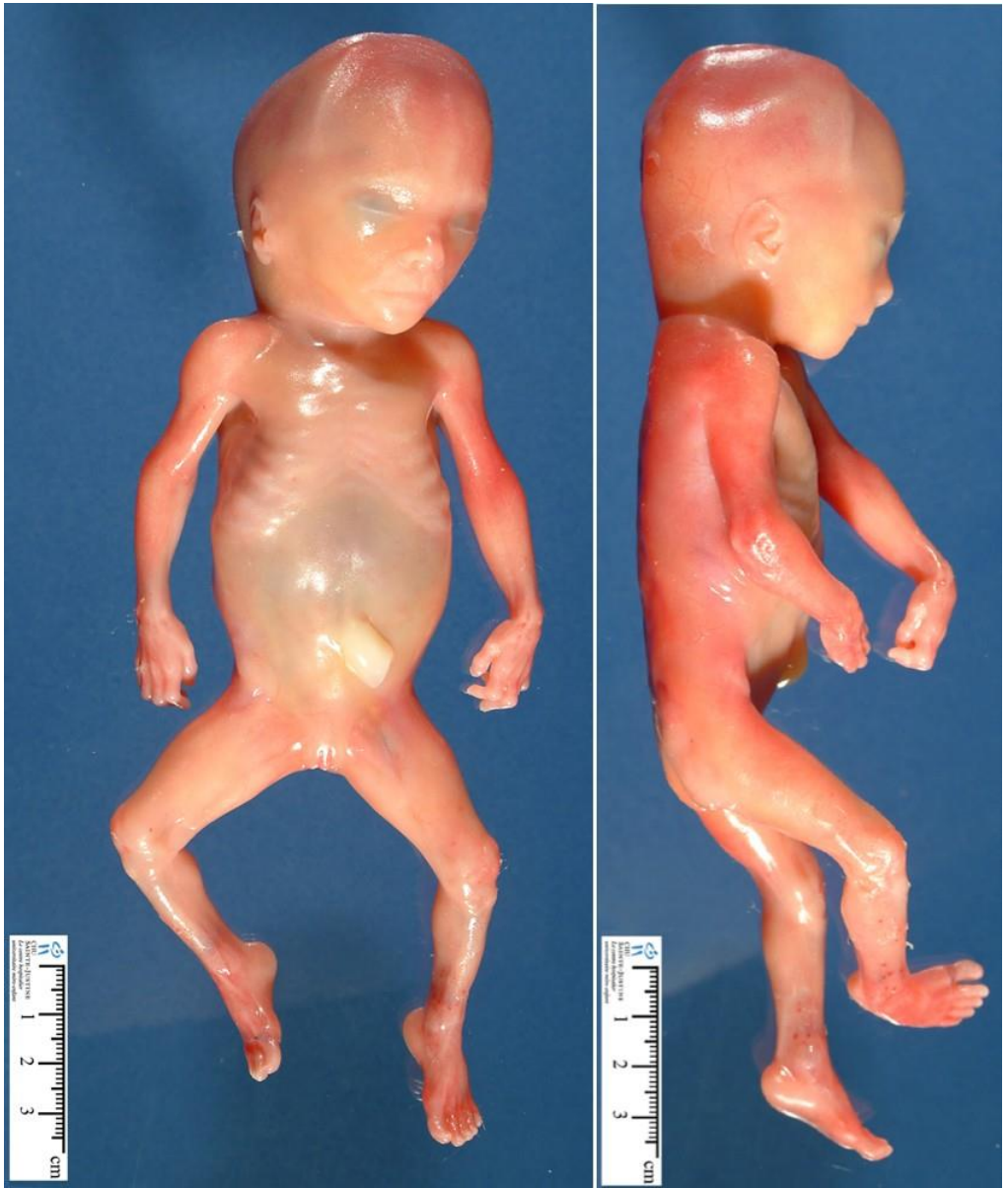



Ring Chromosome
Deleted Genetic Material
Breaks in Chromosome
Fusion
Deleted Genetic Material

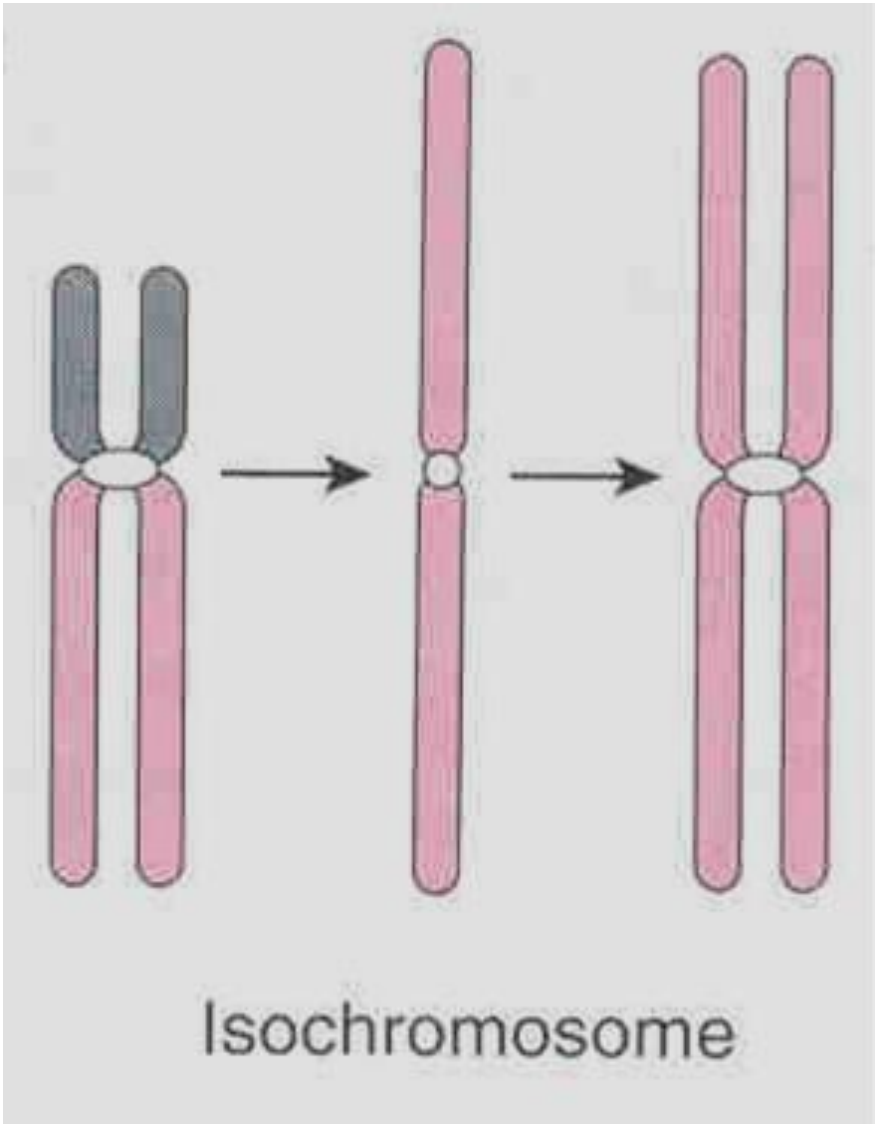
Ring chromosome



Ring Chromosome



Unbalanced-ISOCHROMOSOME



Common in

X chromosome

Results in

Partial-Monosomy

Partial-Trisomy

Unbalanced -Duplication

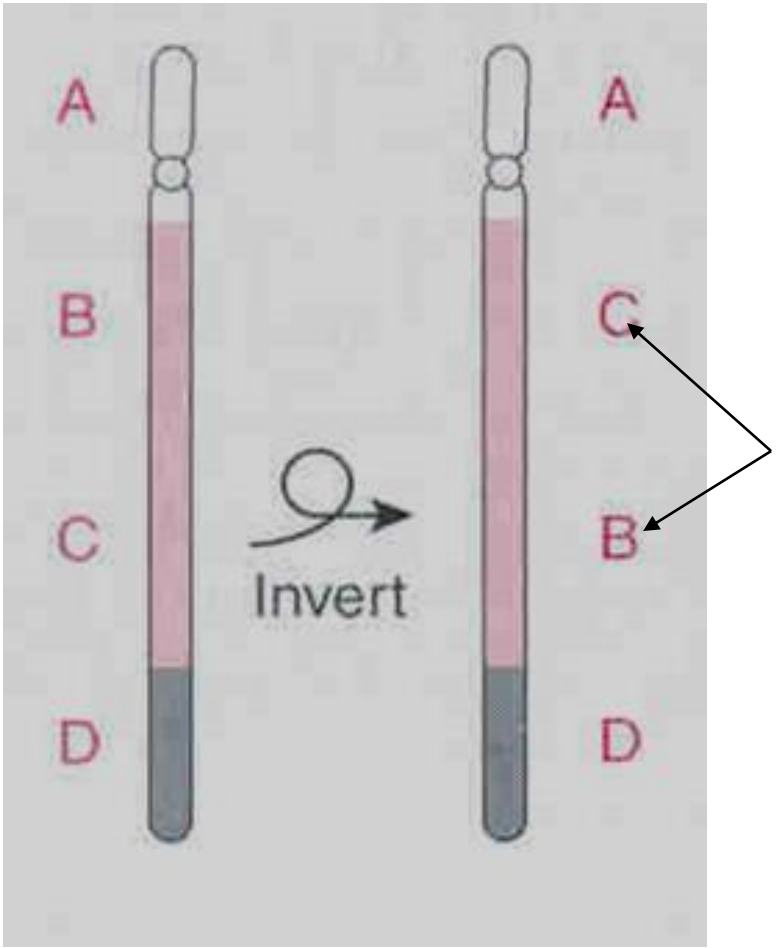
Uncommon

as

Many genes code for the same amino-acid

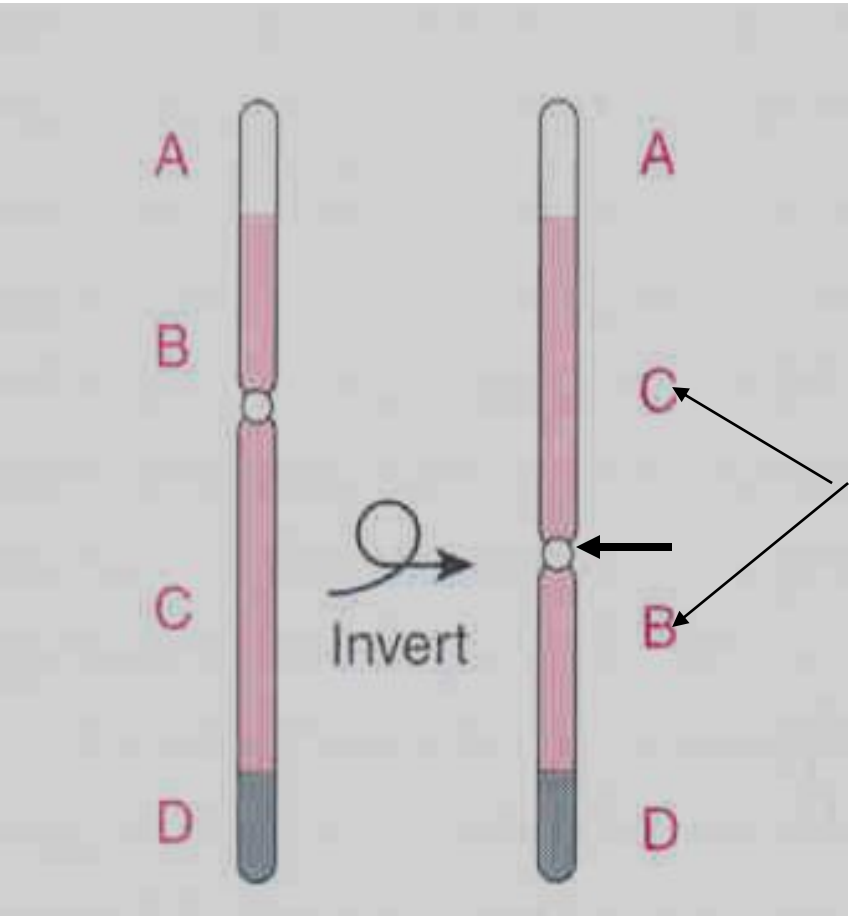
Therefore effect may not be abnormality

Balanced-Inversion



- **Paracentric** inversion

Balanced-Inversion



- **Pericentric** Inversion

Translocations

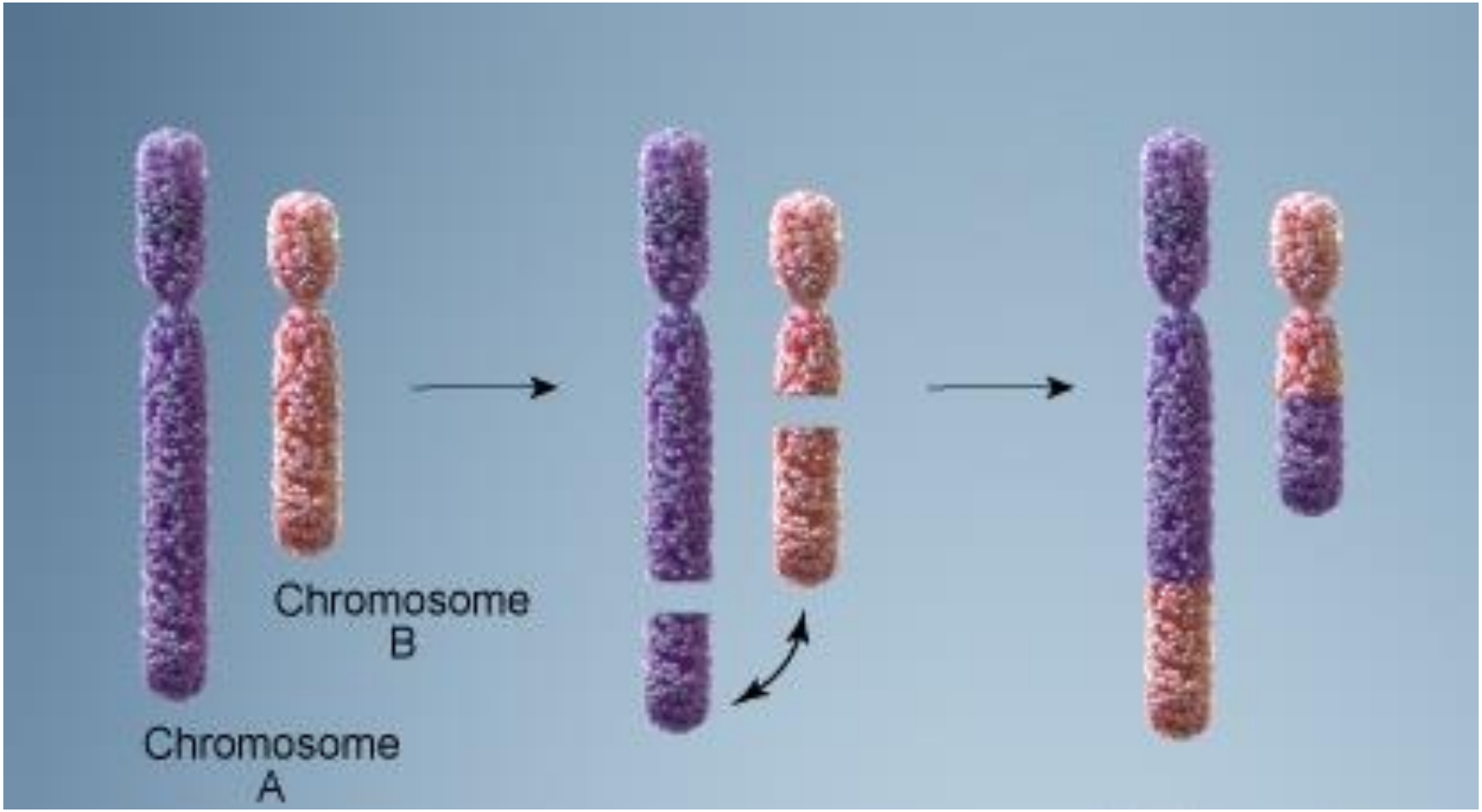
Reciprocal- Balanced

Breakage of

NONHOMOLOGOUS chromosomes and

Reciprocal exchange of broken of segments

Reciprocal Translocation Balanced



Robertsonian Translocation

TWO ACROCENTRIC Chromosomes

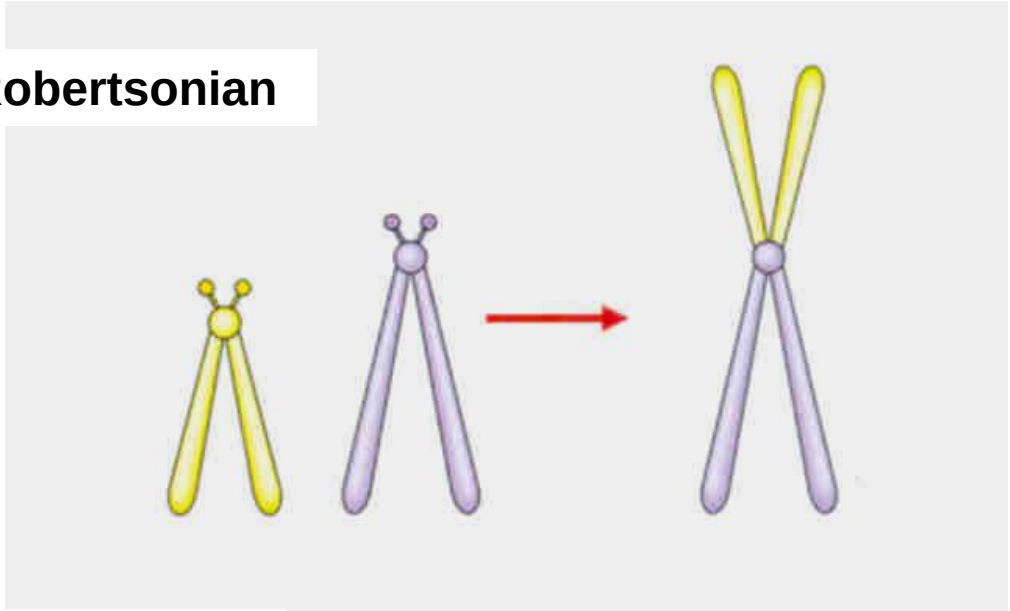
- Fusion of region near centromere
  with loss of short arms of both the chromosomes
- 45 chromosomes with translocation chromosome
- Chromosomal number –One less
- DNA Content-almost Normal

Examples- 14 and 21chromosome

Carrier may be normal, but risk for the Offsprings

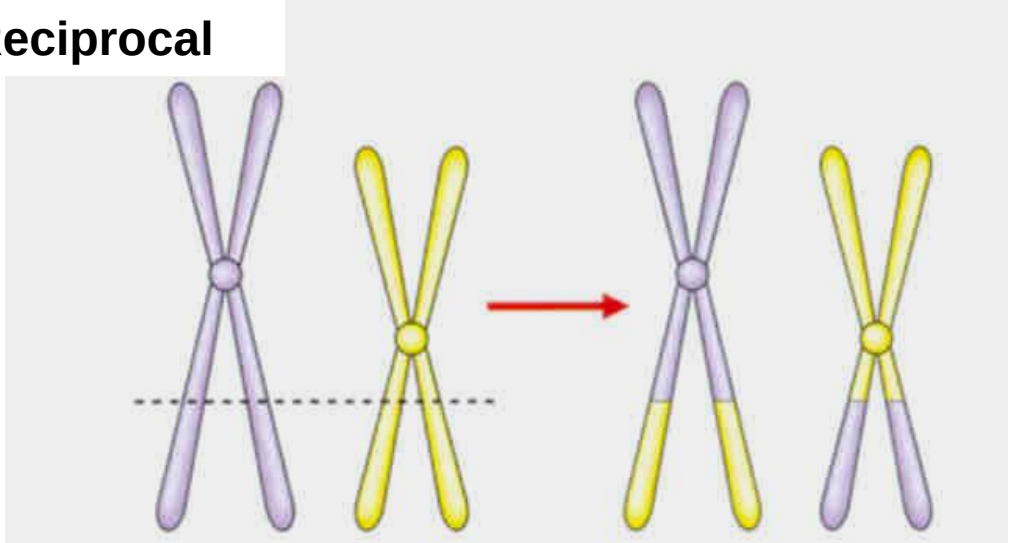
TRANSLOCATION

Robertsonian

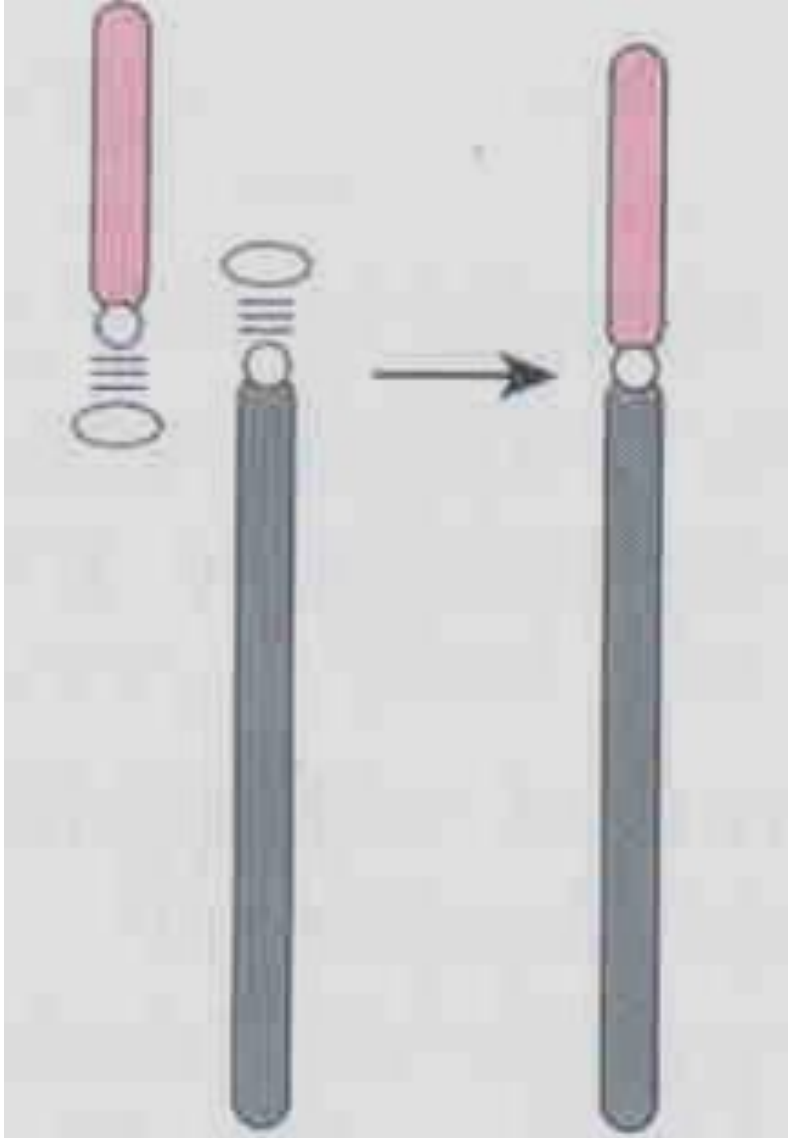


Unbalanced

Reciprocal



Balanced



Robertsonian
translocation

Chimera

- Two or more genetically distinct cell lines derived from more than one zygote

Characters from **Greek Mythology**

- **Female Monster** with
  Lion's Head, Goat's body and serpent's tail

- **Sphinx** - Egyptian stone figure
  Lion's body, and
  human or animal head

Chimera

Centaur

Egyptian Sphinx
Human Head with Lion's Body

CHIMERA

- In Humans……..
  Dispermic fertilization-

  Two zygotes fuse to form one Embryo
  If two Zygotes are of different sex –
  then

Chimera will be **TRUE HERMAPHRODITE**

Blood Group Chimera

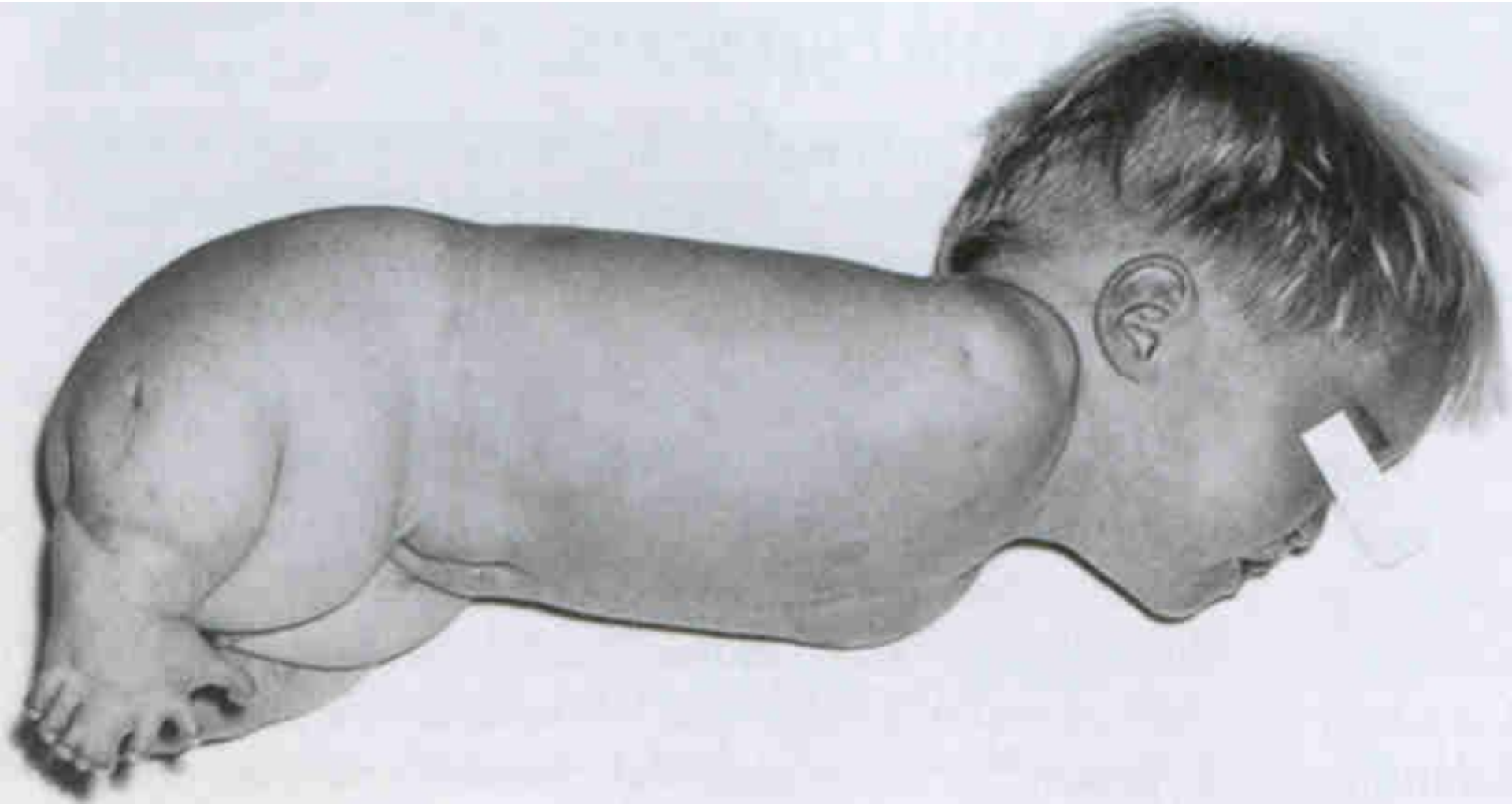
- Dizygotic twin with different blood groups

- One with Blood group **A**
- One with Blood group **B**

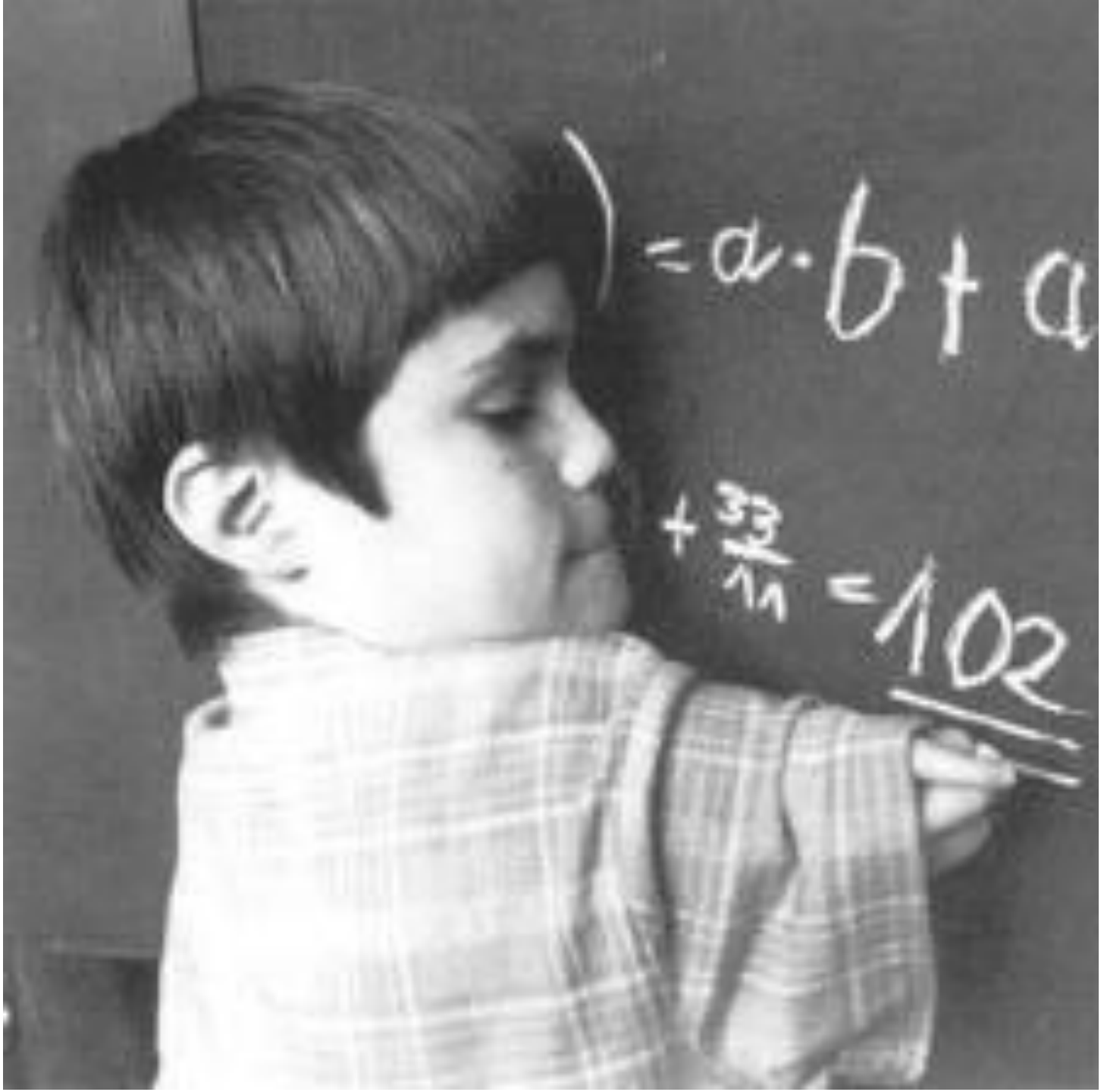
Both exchange blood through common placenta

Each baby will have blood group '**A'** **AND** **'B'**

Phocomelia-Thalidomide baby



THALIDOMIDE BABIES


= a · b + a
+ 33
11
= 102

M C Qs

1) Commonly used cells for Karyotyping are

a) Red blood cells

b) Neutrophils

c) Monocytes

d) Lymphocytes

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2. Mitogenic agent used in karyotyping is

a) Heparin

b) Phytohemagglutinin

c) Hypotonic Saline

d) Colchicin

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a) Mitogenic agent

b) It swells the cells

c) Arrests the cells division in Metaphase

d) Works as anticoagulant

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4. All of the following are unbalanced structural aberrations EXCEPT

a) Isochromosome

b) Deletion

c) Reciprocal translocation

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5. Numerical aberration could be due to

a) Failure to pair

b) Failure to disjoin

c) Anaphase lag

d) All of the above

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6.Mosaicism is due to non-disjunction in

a) Meiosis I

b) Meiosis II

c) Meiosis I and II

d) Post-zygotic-mitotic

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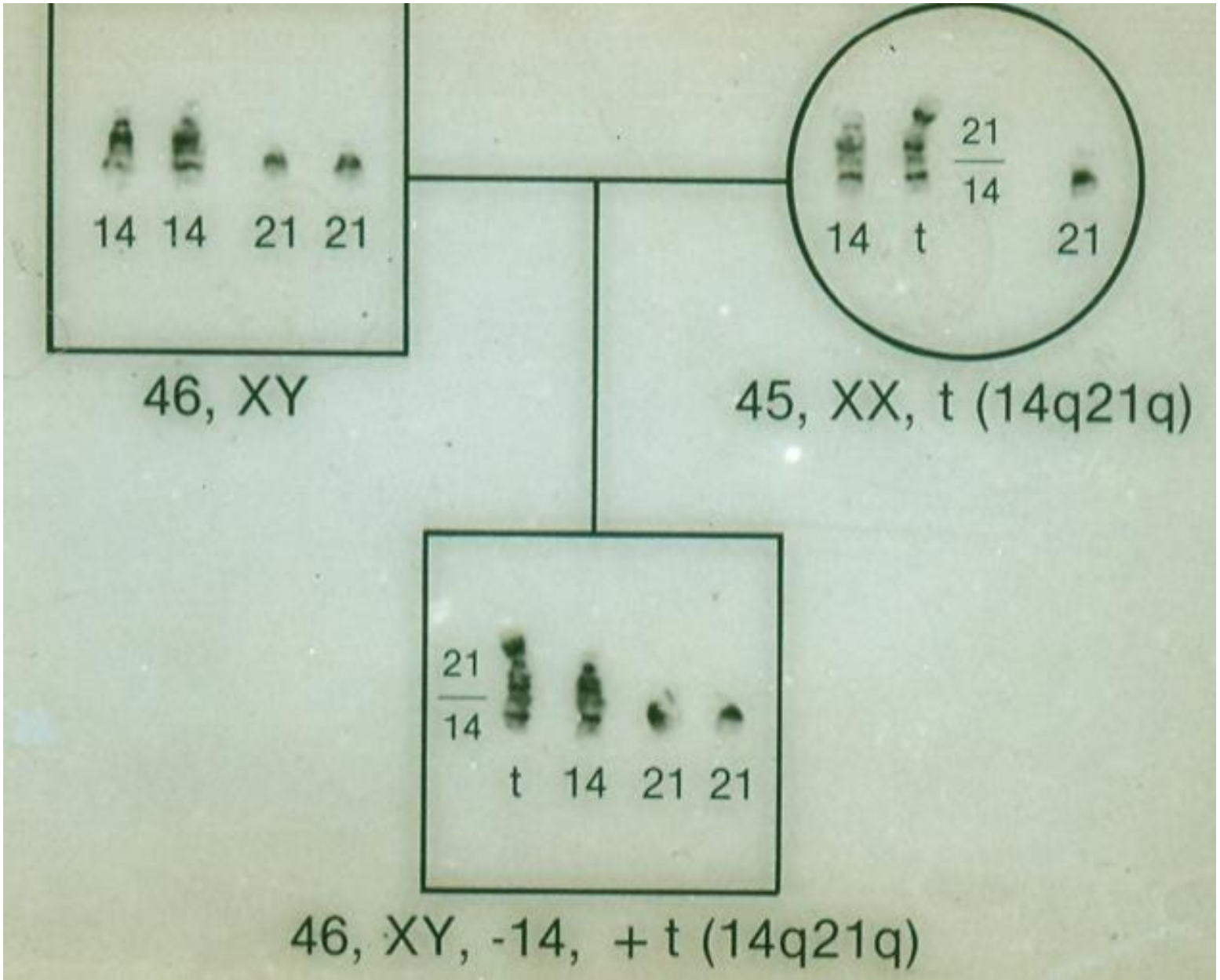
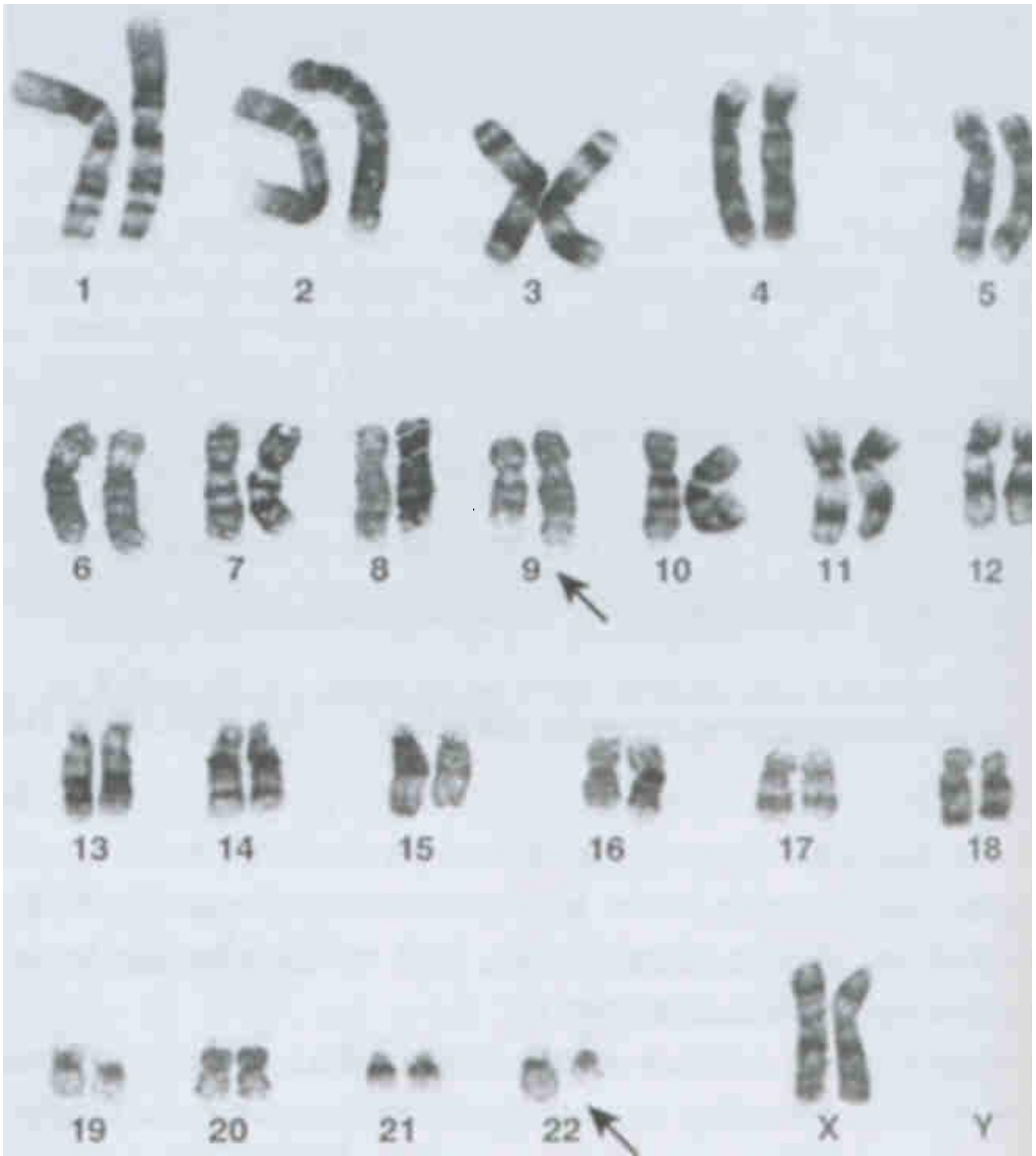
THANK YOU

Insertion F.I.S.H.

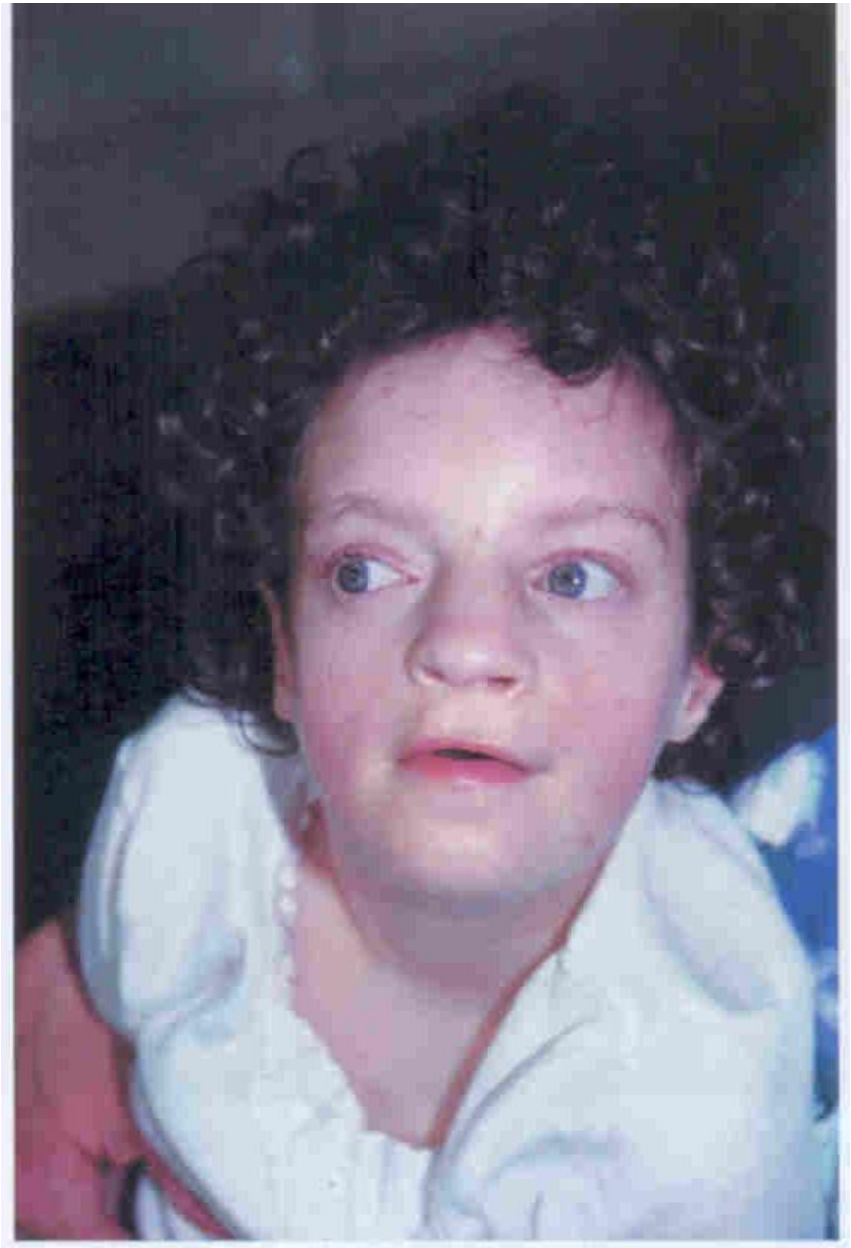
Robertsonian Translocation



Translocation-t9q22q



Deletion 4p-



- The patient could be **MOSAIC**
- The normal cells overtook the abnormal
- Patient can lead reasonably normal life