Embryological Basis of Twinning

Twinning is the development of two offspring from a single pregnancy. It is broadly classified into:

1. **Dizygotic (DZ) twins** — two separate ova fertilized by two separate spermatozoa.
2. **Monozygotic (MZ) twins** — one fertilized ovum divides into two embryonic units.

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1. Dizygotic Twins

Mechanism

- During the same menstrual cycle, **two ova are released**.
- Each ovum is fertilized by a **different spermatozoon**.
- Two separate zygotes are therefore formed.
- Each zygote develops independently.

2 ova + 2 sperm → 2 zygotes → 2 embryos

Placental arrangement

Because the embryos develop from separate zygotes, they usually have:

- **Two amnions**
- **Two chorions**
- **Two placentas**

Thus, they are generally:

Dichorionic–diamniotic (DCDA)

The two placentas may become closely apposed and appear fused, but their circulations remain separate.

Genetic relationship

Dizygotic twins are genetically similar to ordinary siblings:

- Approximately **50% of segregating genes shared**
- May be of the **same or different sex**
- May have different blood groups and physical characteristics.

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2. Monozygotic Twins

Monozygotic twins arise when **one zygote gives rise to two embryonic individuals**.

1 ovum + 1 sperm → 1 zygote → division → 2 embryos

They are therefore usually **genetically very similar** and are generally of the **same sex**.

The important embryological feature is that the **timing of separation of the embryonic mass determines the type of placenta and membranes**.

A. Separation during the first 3 days

The zygote separates at the **morula/early blastocyst stage**, before differentiation of the trophoblast.

Each embryo develops its own:

- Chorion
- Amnion
- Placenta

Therefore:

Dichorionic–diamniotic twins

This is the same membrane arrangement as most dizygotic twins.

B. Separation during days 4–8

The division occurs after formation of the **blastocyst**, when the trophoblast has differentiated, but before formation of the amnion.

Both embryos share the same chorion but develop separate amniotic cavities.

Therefore:

Monochorionic–diamniotic twins

- One chorion
- Two amnions
- Usually one placenta

This is the **commonest form of monozygotic twinning**.

C. Separation during days 8–13

Division occurs after formation of the **amnion**.

The two embryos therefore share:

- One chorion
- One amniotic cavity
- One placenta

Therefore:

Monochorionic–monoamniotic twins

They are at increased risk of **umbilical cord entanglement** because both fetuses occupy the same amniotic cavity.

D. Incomplete separation after day 13

If separation occurs **very late and is incomplete**, the embryos remain partially joined.

This produces:

Conjoined twins

The site and degree of union depend on the region in which incomplete separation occurs.

Examples include:

- Thoracopagus — joined at thorax
- Omphalopagus — joined at abdomen
- Craniopagus — joined at skull
- Ischiopagus — joined at pelvis

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3. Summary Table

Time of separation	Chorion	Amnion	Type

0–3 days	2	2	Dichorionic–diamniotic
4–8 days	1	2	Monochorionic–diamniotic
8–13 days	1	1	Monochorionic–monoamniotic
After ~13 days	1	Usually 1	Incompletely separated → conjoined twins

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4. Key Difference

Dizygotic twins

Two ova + two sperm → two zygotes

→ Usually **DCDA**

Monozygotic twins

One ovum + one sperm → one zygote → separation

→ Membrane arrangement depends on **when separation occurs**.

Important embryological principle

> **The later the monozygotic embryo separates, the fewer separate fetal membranes it has.**

Early separation → DCDA → later separation → MCDA → still later → MCMA → very late/incomplete → conjoined twins.