



# Tissue Repair

**Lecture: 7**

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# **Lecture Outline:**

- Introduction
- Repair, Regeneration and Healing.
- Cell Cycle and Types of cells.
- Healing by First Intention.
- Healing by Second Intention.
- Factors that influence wound healing
- Complications of wound healing

## **Introduction**

**Repairing injured or dead tissues is important for survival.**

**Once injury occurs, the host responds to eliminate the injurious agent, contain the damage, and prepare surviving cells for replication.**

# Repair:

Means the restoration of tissue architecture and function after an injury.

It occurs by two processes:

1. Some tissues are able to replace the damaged cells and it return to a normal state; this process is called **regeneration**.
2. If the injured tissues are unable to regenerate, or if the tissue severely damaged, repair occurs by deposition of connective (fibrous) tissue, a process termed **healing** that results in scar formation.

**Repair involves the proliferation of various cells, and close interactions between cells and the extra cellular matrix (ECM).**

**several cell types proliferate during tissue repair, these include:**

- \* The remnants of the injured tissue (which attempt to restore normal structure).**
- \* vascular endothelial cells (to create new vessels that provide the nutrients needed for the repair process).**

\* The fibroblasts (the source of the fibrous tissue that forms the scar to fill defects that cannot be corrected by regeneration).

The proliferation of these cell types is done by proteins that are collectively called **growth factors**.

Cell proliferation can be either:

- Physiologic (e.g. hormonal).
- Pathologic (e.g. injury, mechanical forces).

The main two processes in the proliferation of cells are **DNA replication** and **mitosis**.

The sequence of events that control these two processes is known as the **cell cycle**.

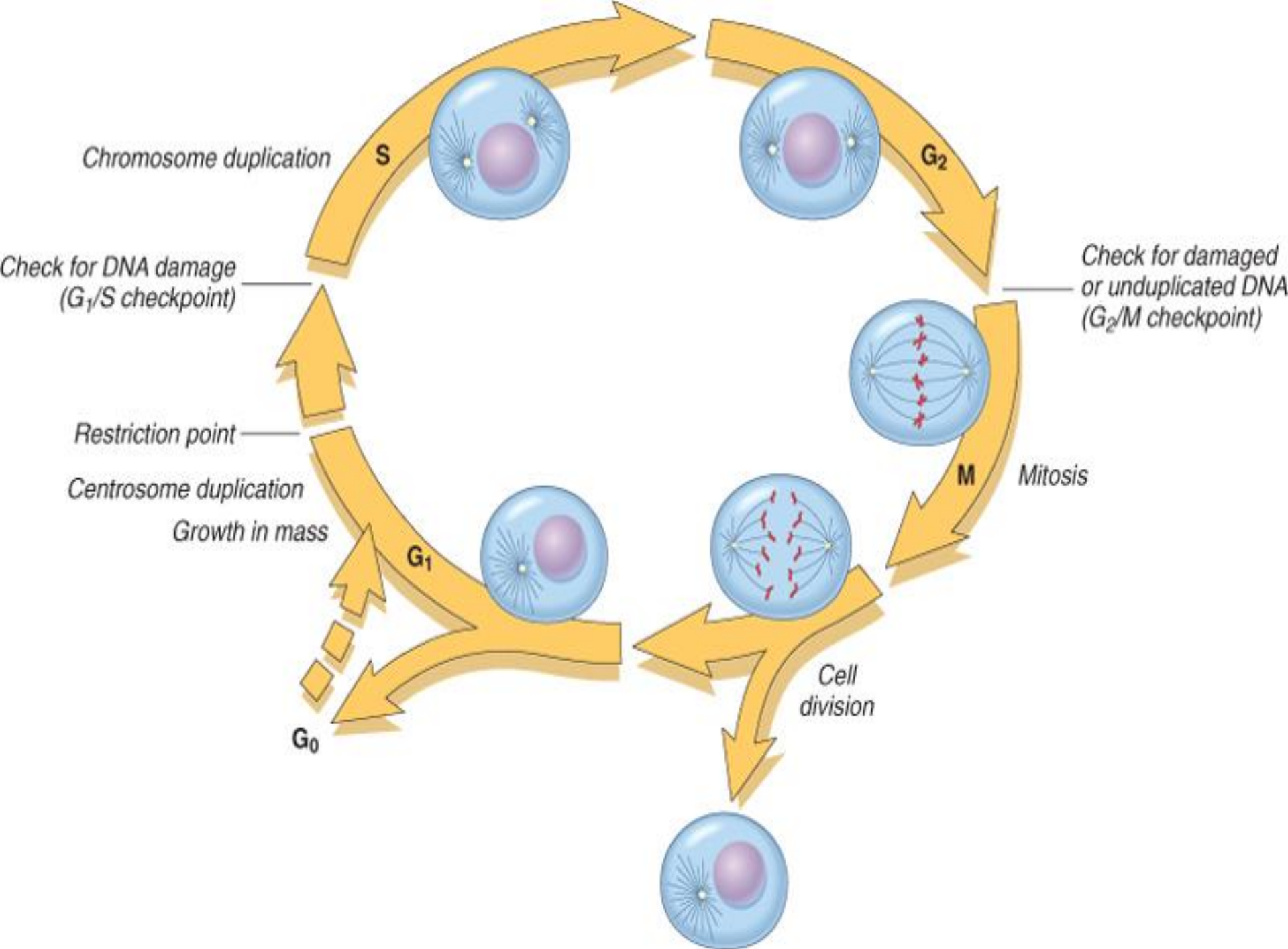
The cell cycle consists of:

- the presynthetic growth phase 1 (**G1**).
- the DNA synthesis phase (**S**).
- the premitotic growth phase 2 (**G2**).
- the mitotic phase (**M**).

Non-dividing cells are either in cell cycle arrest in G1 or they exit the cycle to enter a phase called G0.



**Any stimulus that initiates cell proliferation, such as exposure to growth factors, needs to promote the G<sub>0</sub>/G<sub>1</sub> transition and the entry of cells into the G<sub>1</sub> phase of the cycle.**



**Tissues are divided into three groups according to their proliferative capacity into:**

**I. Continuously Dividing Tissues (**labile tissues**) :**

Cells of these tissues are continuously being lost and replaced by new cells. **Labile cells** include:

1. Hematopoietic cells in the bone marrow
2. The majority of surface epithelia, such as the:
  - A. stratified squamous surfaces of the skin, oral cavity,
  - B. The columnar epithelium of the gastrointestinal tract.
  - C. The transitional epithelium of the urinary tract.

These tissues can readily regenerate after injury.

## **II. Stable Tissues:**

**Cells of these tissues are quiescent (in the G0 stage of the cell cycle) and have only minimal replicative activity in their normal state.**

**However, these cells are capable of proliferating in response to injury or loss of tissue mass.**

- 1. Stable cells include most solid tissues, such as liver, kidney, and pancreas.**
- 2. They also include endothelial cells, fibroblasts, and smooth muscle cells; the proliferation of these cells is particularly important in wound healing.**

### **III. Permanent Tissues:**

The cells of these tissues are non proliferative in postnatal life.

Skeletal muscle, neurons and cardiac muscle cells belong to this group.

Thus, injury to brain or heart is irreversible and results in a scar, because neurons and cardiac myocytes do not divide.

In permanent tissues, repair is typically dominated by scar formation.

# WOUND HEALING

Cutaneous wound healing has three main phases:

- (1) inflammation,
- (2) formation of granulation tissue, and
- (3) ECM deposition and remodeling.

Based on the nature of the wound, the healing of cutaneous wounds can occur by first or second intention.

## Healing by First Intention

One of the simplest examples of wound repair is the healing of a clean, uninfected surgical incision approximated by surgical sutures.

This is referred to as **primary union**, or **healing by first intention**

## Healing by Second Intention

When cell or tissue loss is more extensive, such as in: large wounds, abscess formation, and ulceration, the repair process is more complex.

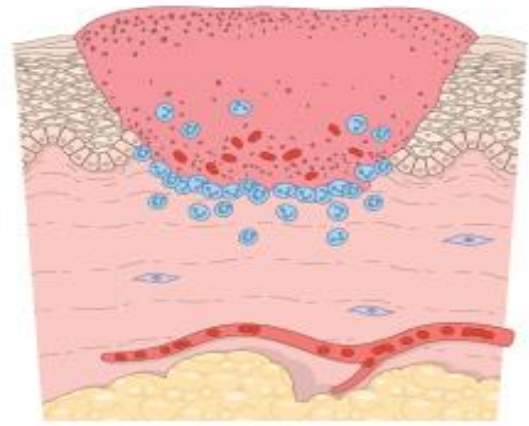
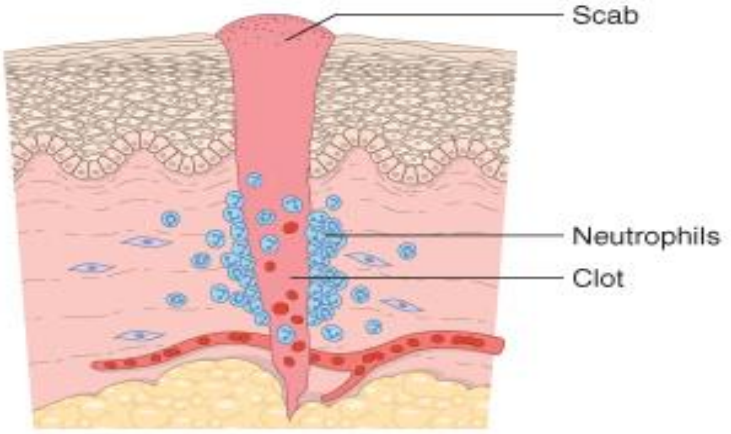
**Second-intention healing**, also known as **healing by secondary union**



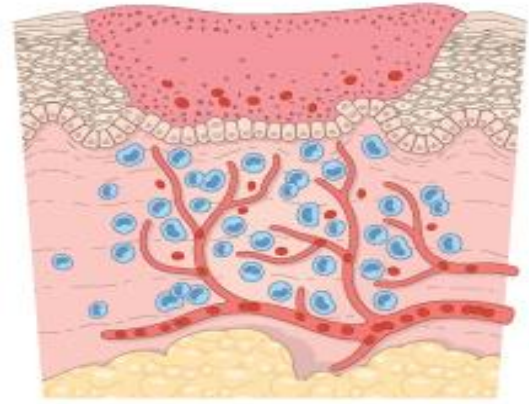
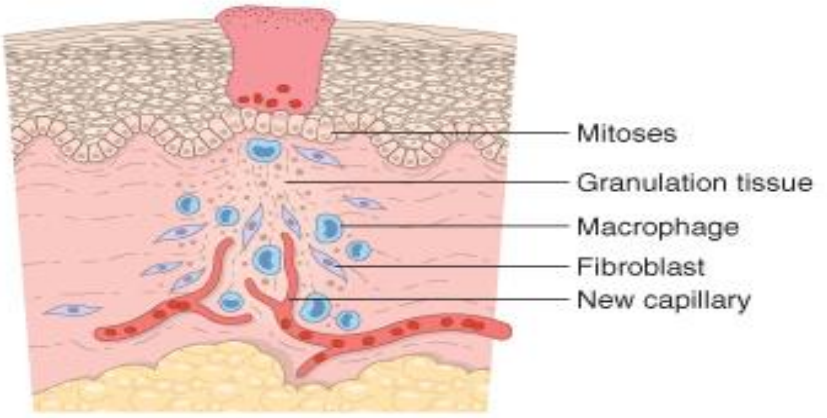
# HEALING BY FIRST INTENTION

# HEALING BY SECOND INTENTION

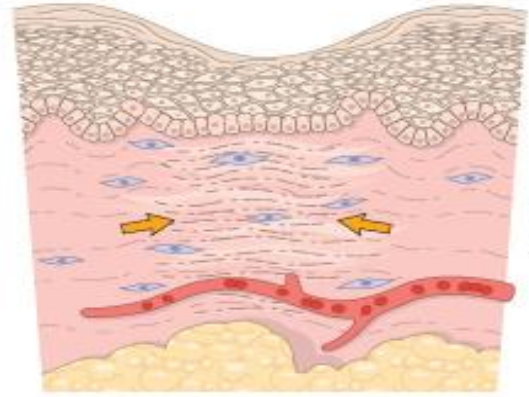
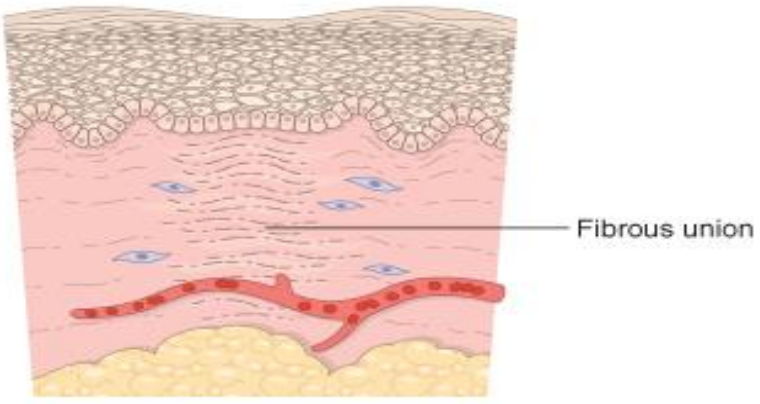
24 hours



3 to 7 days



Weeks



# Factors that influence wound healing

## 1. Local Factors:

- Infection (single most important reason for delayed wound healing)
- Foreign bodies
  - ▶ suture material, bone ...
- Mechanical factors
  - ▶ Early movement
  - ▶ Pressure

## 2. Systemic factors:

- **Malnutrition**
  - **Protein deficiency**
  - **Vitamin C deficiency (inhibition of collagen synthesis)**
- **Metabolic status**
  - **Diabetes mellitus**
  - **Cortison treatment inhibits inflammation and collagen synthesis**
- **Circulatory status**
  - **Inadequate blood supply due to arteriosclerosis**
  - **Varicose veins (retarded venous drainage)**

# Complications of wound healing

## 1. Deficient scar formation

- Wound dehiscence
- Ulceration

## 2. Excessive formation of scar tissue

- Keloid (excessive collagen deposition)
- Exuberant granulation (proliferation of fibroblasts that inhibits re-epithelialization)

## 3. Contraction



Wound dehiscence



**Secondary wound with infection**



**Wound ulceration**



**Keloid**





**Contracture**

Thank You

The background features abstract, overlapping geometric shapes in various shades of green, ranging from light lime to dark forest green. These shapes are primarily located on the right side and bottom of the frame, creating a modern, layered effect against the white background.