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المحاضرة الرابعة

Tissue: Structure, properties; classification and function(pat2)

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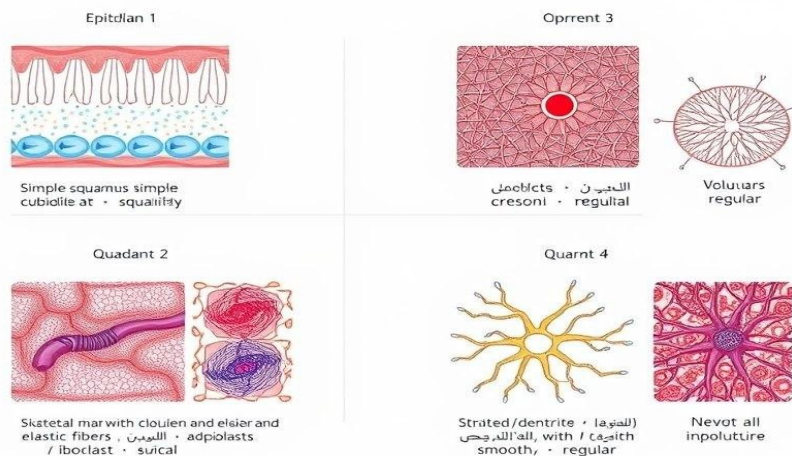
Tissue: Structure, properties; classification and function(patr2)

Introduction

Tissues are defined as organized groups of cells that share common structural features and perform specific biological functions. The study of tissues (histology) is fundamental in understanding how organs function and how pathological conditions develop.

In Part 1, epithelial and connective tissues were discussed. This section focuses on **muscle tissue, nervous tissue, and specialized tissues**, emphasizing their **microscopic structure, physiological roles, and functional integration** within organ systems.

Overview of the Four: Tissue Types



1. Muscle Tissue

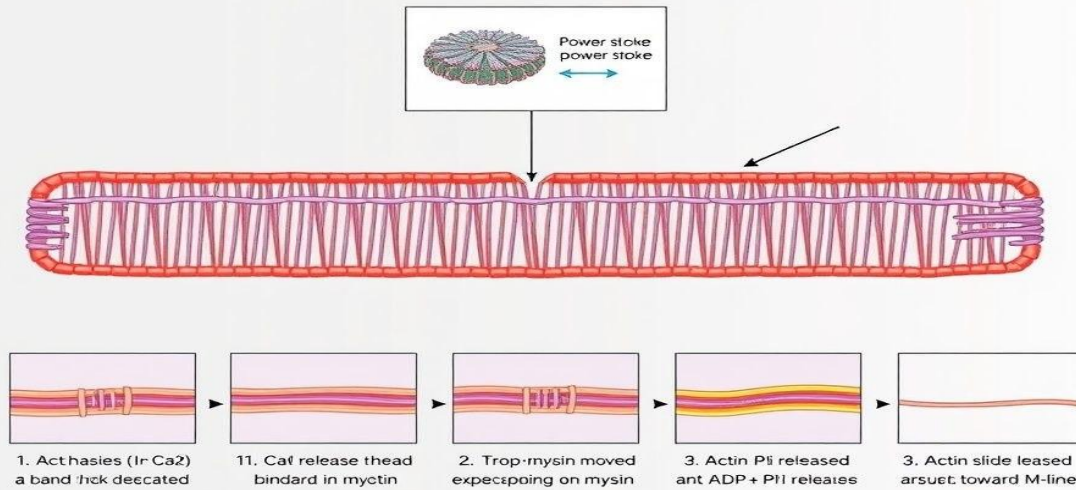
1.1 General Overview

Muscle tissue is responsible for generating force through contraction. This function is made possible by the interaction between **actin and myosin filaments**, which slide past each other in a mechanism known as the **sliding filament theory**.

Muscle tissue plays a crucial role in:

- Locomotion
- Circulation of blood
- Movement of internal organs

Sliding Filament Mechanism



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1.2 Skeletal Muscle

Structure

Skeletal muscle fibers are long, cylindrical, and multinucleated cells. The striations observed under the microscope are due to the organized arrangement of **sarcomeres**, the functional units of contraction.

Physiology

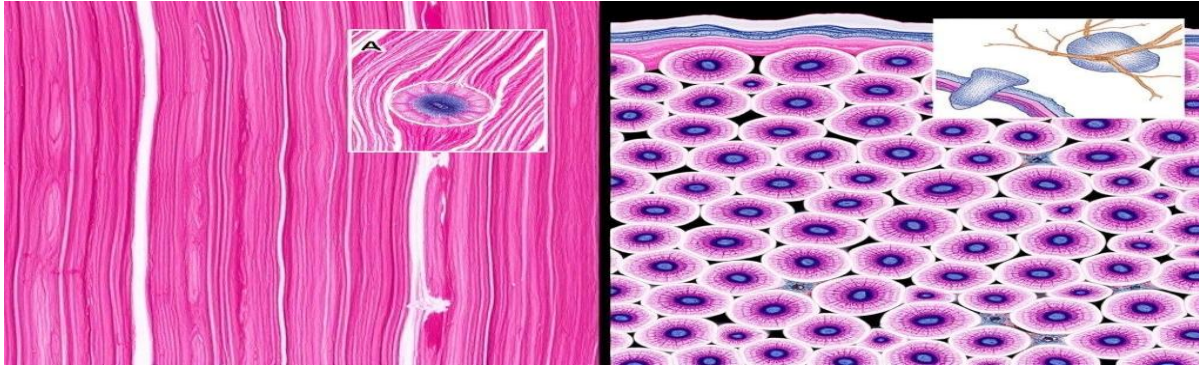
Skeletal muscle contraction is controlled by the **somatic nervous system**, making it voluntary.

Functions

- Body movement
- Maintenance of posture
- Heat production (thermogenesis)

Clinical Note

Disorders such as muscular dystrophy affect skeletal muscle function and lead to progressive weakness.



1.3 Cardiac Muscle

Structure

Cardiac muscle cells are short, branched, and interconnected via **intercalated discs**, which contain gap junctions and desmosomes.

Physiology

Cardiac muscle is **involuntary** and regulated by the autonomic nervous system and intrinsic pacemaker activity.

Functions

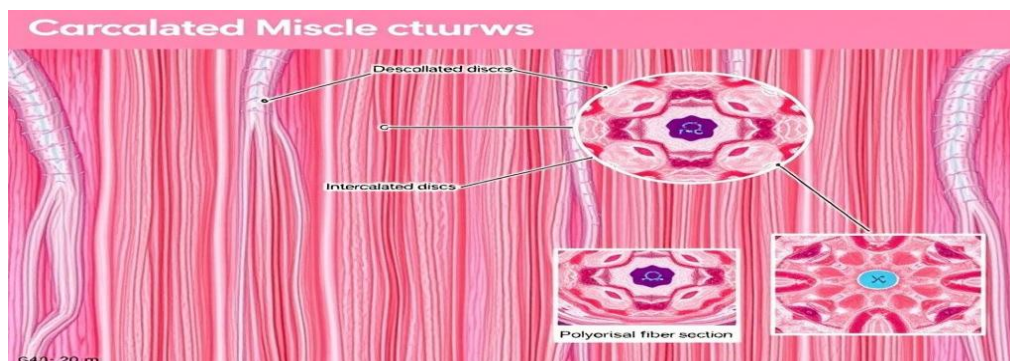
- Continuous pumping of blood
- Maintenance of blood pressure

Unique Feature

Presence of **autorhythmicity** (self-excitation).

Clinical Note

Damage to cardiac muscle (e.g., myocardial infarction) leads to permanent loss of function.



1.4 Smooth Muscle

Structure

Smooth muscle cells are spindle-shaped with a single central nucleus and lack striations.

Physiology

Controlled involuntarily by the autonomic nervous system and hormones.

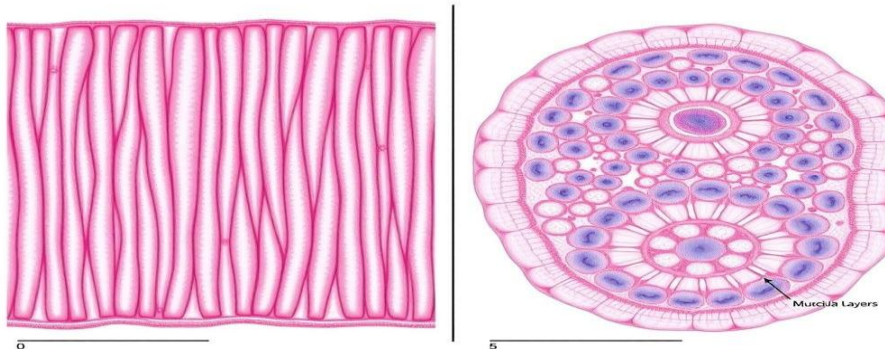
Functions

- Peristalsis in the digestive tract
- Regulation of blood vessel diameter
- Control of airflow in lungs

Special Feature

Capable of sustained contraction without fatigue.

Image Title: *Smooth muscle cells in intestinal wall*



2. Nervous Tissue

2.1 General Overview

Nervous tissue is specialized for communication through electrical impulses and chemical signals. It forms the basis of the **central nervous system (CNS)** and **peripheral nervous system (PNS)**.

2.2 Neurons

Structure

Neurons consist of:

- Cell body (soma)
- Dendrites (receive signals)
- Axon (transmits signals)

Types of Neurons

- Sensory neurons
- Motor neurons
- Interneurons

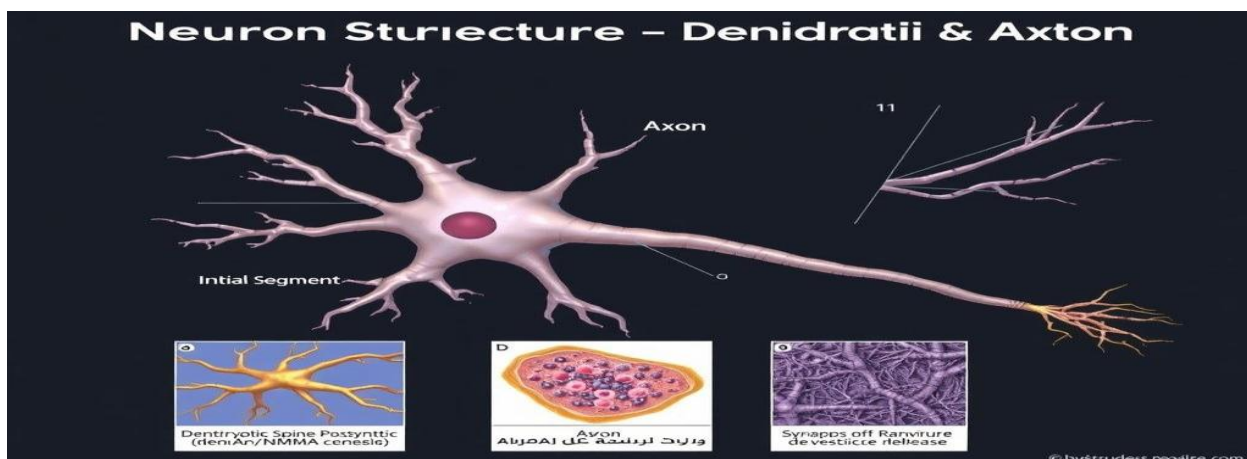
Function

Transmit electrical impulses rapidly across long distances.

Mechanism

Signal transmission occurs via **action potentials** and **synaptic transmission**.

Image Title: *Detailed neuron structure with labeled dendrites and axon*



2.3 Glial Cells

Overview

Glial cells provide structural and functional support to neurons.

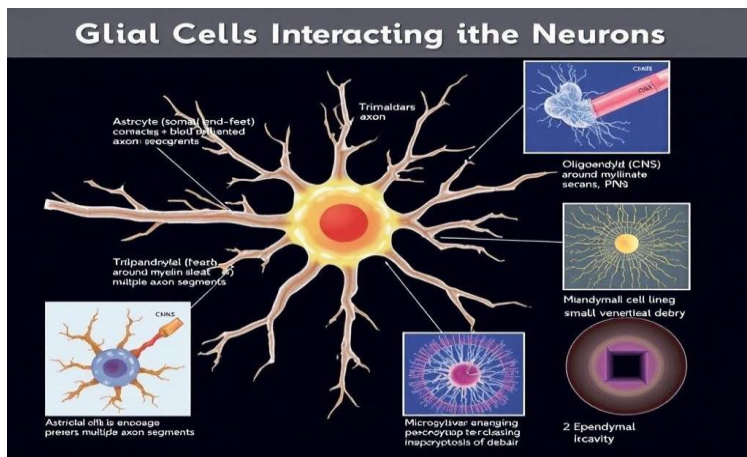
Types and Functions

- Astrocytes: maintain environment
- Oligodendrocytes: myelin formation (CNS)
- Schwann cells: myelin formation (PNS)
- Microglia: immune defense

Importance

Essential for neuron survival and signal efficiency.

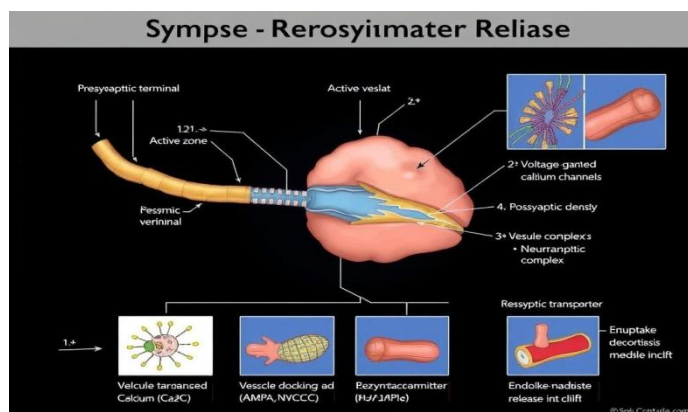
Image Title: *Glial cells interacting with neurons*



2.4 Functional Importance of Nervous Tissue

- Coordination of body activities
- Sensory perception
- Memory and cognition

Image Title: *Synapse showing neurotransmitter release*



3. Specialized Tissues

3.1 Blood Tissue

Composition

- Red blood cells (RBCs)
- White blood cells (WBCs)
- Platelets

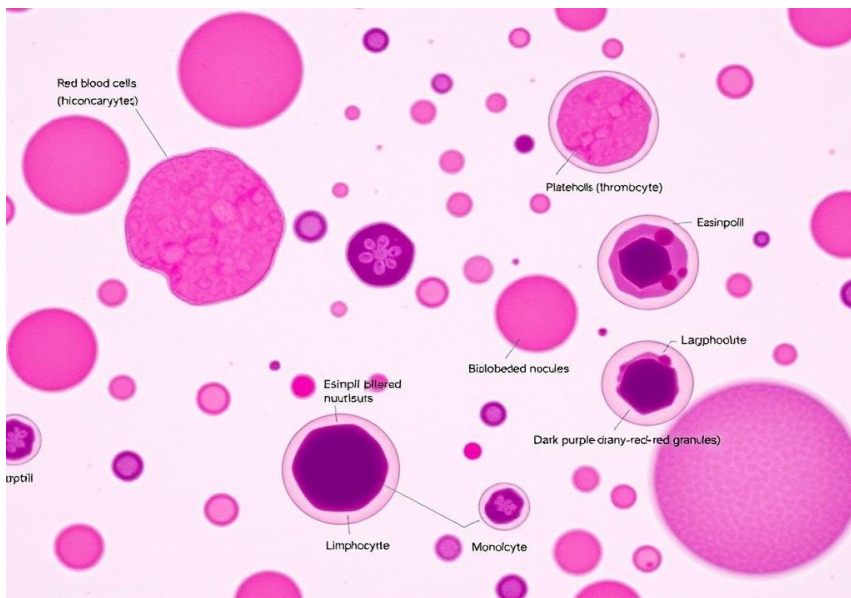
Functions

- Oxygen transport (hemoglobin)
- Immune response
- Blood clotting

Clinical Note

Diseases such as anemia and leukemia affect blood tissue.

Image Title: *Microscopic blood smear showing different blood cells*



3.2 Endocrine and Exocrine Glands

Endocrine Glands

Secrete hormones directly into bloodstream.



Exocrine Glands

Secrete substances via ducts.

Functions

- Regulation of metabolism
- Growth and development
- Homeostasis

3.3 Cartilage Tissue

Structure

Contains chondrocytes embedded in extracellular matrix.

Types

- Hyaline cartilage
- Elastic cartilage
- Fibrocartilage

Functions

- Support
- Shock absorption
- Flexibility

3.4 Bone Tissue

Structure

Organized into osteons (Haversian systems).

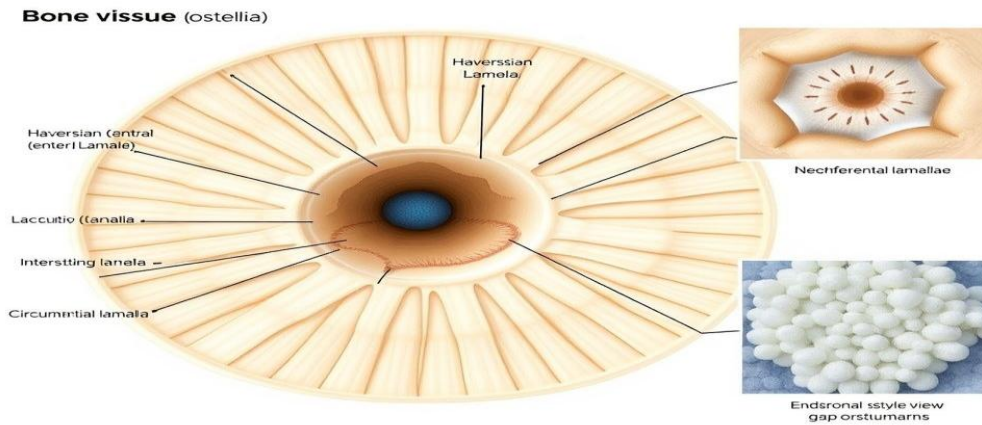
Cells

- Osteocytes
- Osteoblasts
- Osteoclasts

Functions

- Structural support
- Protection
- Mineral storage

Image Title: *Bone tissue showing Haversian system*



4. General Properties of Tissues

1. Specialization

Each tissue is adapted for a specific function.

2. Integration

Tissues cooperate within organs.

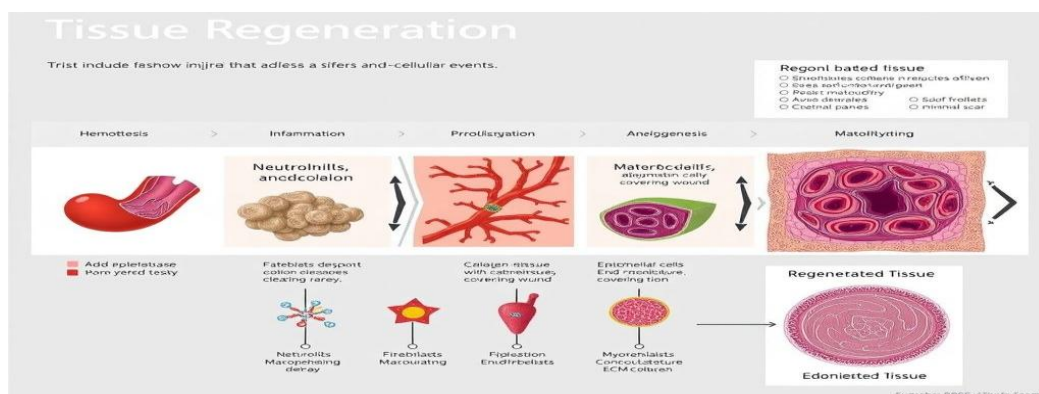
3. Regeneration

Varies between tissues.

4. Responsiveness

Ability to respond to stimuli.

Image Title: *Tissue regeneration process diagram*





5. Tissue Classification Summary

- Epithelial Tissue
- Connective Tissue
- Muscle Tissue
- Nervous Tissue
- Specialized Tissues

6. Functional Integration in the Body

Tissues do not function independently; instead, they interact within organ systems:

- Muscles + nerves → movement
- Blood + connective tissue → transport
- Nervous + endocrine → regulation