



MORPHOFUNCTIONAL CHARACTERISTICS OF NERVOUS TISSUE AND ITS SIGNIFICANCE IN THE FUNCTIONING OF THE ORGANISM

Ochilova Xosiyat Xayitqulovna

*Shahrisabz Abu Ali Ibn Sino nomidagi Jamoat salomatligi
texnikumi*

ARTICLE INFO:

Received:23.10.2026

Revised: 24.10.2026

Accepted:25.10.2026

KEY WORDS:

*nervous tissue,
neuron, neuroglia,
dendrite, axon, myelin
sheath, synapse, nerve
impulse,
morphofunctional
characteristics.*

ABSTRACT

This article discusses the morphofunctional characteristics of nervous tissue and the structure and functions of its main components—neurons and neuroglial cells. It analyses the roles of the neuronal cell body, dendrites, axon, myelin sheath, and synapses in receiving, processing, and transmitting nerve impulses. It also summarises the supportive, protective, trophic, and insulating functions of neuroglia in the central and peripheral nervous systems, as well as the importance of nervous tissue in coordinating the functioning of the organism.

Introduction

Nervous tissue is a highly specialised tissue that enables the organism to receive stimuli from the external and internal environments, process information, and generate appropriate responses. It is found in the brain, spinal cord, nerves, and ganglia, and plays an important role in coordinating the activities of organs and systems. Movement, sensation, memory, learning, speech, emotional states, and the neural regulation of internal organs are closely associated with the structure and functional properties of nervous tissue [1; 2].

The principal properties of nervous tissue are excitability and conductivity. Excitability is the ability of a cell to change its electrical activity in response to a stimulus, while conductivity refers to the propagation of the resulting nerve impulse along the cell. These processes are supported by synaptic connections between neurons and by neuroglial activity. Therefore, nervous tissue should be studied not merely as a structure that transmits nerve impulses, but as a complex morphofunctional system responsible for information exchange and regulation within the organism.



Literature Review

Sources on histology, anatomy, and physiology describe nervous tissue as consisting of two principal cell groups: neurons and neuroglial cells. Neurons play the primary role in receiving, integrating, and transmitting information, whereas neuroglia help maintain the microenvironment required by neurons and participate in protection, nourishment, and myelin formation [1; 2].

The Uzbek-language textbook Histology, Cytology and Embryology discusses nervous tissue within the functional classification of tissues and emphasises its ability to respond to external and internal stimuli [3]. O. X. Saitmuratova's teaching manual Nervous Tissue covers the structure of nerve cells, nerve fibres, neuroglia, nerve endings, and synapses [4]. Contemporary open educational resources also describe neuroglia's role in supporting neuronal activity, maintaining ion balance, regulating neurotransmitters, and contributing to the protective mechanisms of the central nervous system [1; 5].

The literature review indicates that the normal functioning of nervous tissue depends on interactions between neurons and neuroglia. The microscopic structure of cells, the characteristics of their processes, the presence of a myelin sheath, and the organisation of synapses determine the nervous system's ability to perform a range of functions.

Research Methodology

This article is theoretical and analytical in nature. Textbooks on histology, anatomy, and physiology, together with open scientific and educational sources, were reviewed. Comparative analysis, content synthesis, and interpretation of structure–function relationships were used. Particular attention was paid to linking the principal morphological features of neurons and neuroglia with their physiological roles. The article does not present new clinical experiments or original statistical findings; its conclusions are based on the theoretical content of the sources consulted.

Results and Discussion

1. General Structure of Nervous Tissue

The principal cells of nervous tissue are neurons and neuroglia. Neurons are specialised to generate and transmit electrical and chemical signals, while neuroglial cells provide conditions that support the survival and functioning of nerve cells. Intercellular communication in nervous tissue is extensive, and neuronal processes form complex networks. In the central nervous system, grey matter is rich in neuronal cell bodies, dendrites, and synapses, whereas white matter consists predominantly of myelinated nerve fibres [1; 2].

During embryonic development, nervous tissue arises mainly from the ectoderm, specifically the neural plate. The neural tube gives rise to the principal structures of the central nervous system, while neural crest cells contribute to the formation of certain components of the peripheral nervous system, including many sensory and autonomic ganglia and Schwann cells [2; 4].



2. Morphological Structure and Functions of the Neuron

The neuron is the principal functional cell of nervous tissue and usually consists of a cell body, dendrites, and an axon. The cell body contains the nucleus, cytoplasm, and organelles involved in protein synthesis, energy production, and intracellular transport. The neuronal cell body may contain Nissl substance, formed by rough endoplasmic reticulum and ribosomes involved in protein synthesis. These structures are associated with the neuron's high metabolic activity [2; 4].

Dendrites are generally short, branched processes that receive signals from other neurons or receptors. The axon is usually a single process that carries nerve impulses away from the cell body towards another neuron, a muscle cell, or a gland cell. Synaptic terminals at the ends of axons transmit signals to the next cell. Based on their shape and number of processes, neurons are classified as multipolar, bipolar, or pseudounipolar; these morphological differences are related to their functions [1; 2].

Functionally, neurons are classified as sensory (afferent), motor (efferent), and interneurons. Sensory neurons carry information from receptors to the central nervous system, while motor neurons transmit commands from the central nervous system to muscles and certain glands. Interneurons process information within the central nervous system and connect different neural pathways.

3. Myelin Sheath, Nerve Fibres, and Synapses

Some axons are surrounded by a myelin sheath, which provides electrical insulation and helps nerve impulses travel more rapidly. In the central nervous system, myelin is produced by oligodendrocytes; in the peripheral nervous system, it is produced by Schwann cells. The myelin sheath is discontinuous, with gaps called nodes of Ranvier between its segments. In myelinated fibres, the impulse effectively "jumps" from node to node, increasing conduction speed [1; 5].

A synapse is a specialised junction between a neuron and another neuron or an effector cell. At a chemical synapse, neurotransmitters are released from the presynaptic terminal and act on receptors in the postsynaptic membrane. This can increase or decrease the activity of the receiving cell. At electrical synapses, ionic currents pass directly between cells through specialised channels. Synaptic transmission is an important mechanism through which the nervous system selects and integrates information and generates an appropriate response [1; 2].

Table 1. Main Components of Nervous Tissue and Their Functions

Component	Main morphological characteristic	Main function
Neyron tanasi	Region containing the nucleus and major organelles	Maintaining cell viability and integrating signals
Dendritlar	Short, highly branched processes	Receiving incoming signals



Akson	Usually a single long process	Transmitting nerve impulses to other cells
Mielin qobig'i	Lipid-rich insulating layer surrounding the axon	Speeding impulse conduction and insulating the axon
Astrotsitlar	Glial cells with star-shaped processes	Supporting the neuronal microenvironment and ionic balance
Oligodendrotsitlar / Shvann hujayralari	Cells that produce myelin in the central/peripheral nervous system	Forming myelin sheaths around axons
Mikroglia	Small, motile immune cells	Protection and phagocytosis of damaged structures

The table summarises the main components of nervous tissue, their characteristic microscopic features, and their functional roles. The functions of some glial cells overlap and collectively support neuronal activity as an integrated system.

4. Morphofunctional Characteristics of Neuroglia

Neuroglia comprise a group of supporting cells in nervous tissue, but it is insufficient to regard them merely as cells providing mechanical support. Astrocytes help regulate ion concentrations in the extracellular environment, take up certain neurotransmitters, support the function of the blood–brain barrier, and respond to injury. Oligodendrocytes form the myelin sheath in the central nervous system, while Schwann cells do so in the peripheral nervous system [5].

Microglia participate in immune surveillance in the central nervous system and can remove damaged cellular material and certain foreign particles through phagocytosis. Ependymal cells line the brain ventricles and the central canal of the spinal cord and participate in processes involving cerebrospinal fluid. Satellite glial cells in peripheral ganglia surround neuronal cell bodies and help regulate their local microenvironment [1; 5].

Thus, neuroglia are important for nourishing and protecting neurons, maintaining an environment suitable for their electrical activity, and supporting efficient impulse conduction along nerve fibres. Interactions between neurons and glial cells are essential for the normal functioning of nervous tissue.

5. Significance of Nervous Tissue in the Functioning of the Organism

Nervous tissue is one of the principal regulatory systems involved in adapting the organism to the external environment and maintaining internal stability. Sensory receptors convert external or internal stimuli into neural signals. The central nervous system compares incoming



information with previous experience and other signals to generate a response. This may result in movement of skeletal muscles, secretion by glands, or changes in the activity of internal organs [2].

Nervous tissue provides the cellular basis for reflexes, balance, coordination of movement, attention, memory, and learning. Through the autonomic nervous system, numerous processes—including heart rate, vascular tone, breathing, and digestion—are regulated. These functions depend not only on individual cells but also on the coordinated activity of neuronal networks, synapses, and glial cells.

Damage to nervous tissue can disrupt impulse conduction, impair sensory or motor function, and cause cognitive changes. Therefore, studying the normal structure of neurons, myelin sheaths, synapses, and neuroglia provides an important theoretical foundation not only for histology but also for understanding the mechanisms of neurological disorders and interpreting clinical signs.

Conclusion

Nervous tissue is a highly specialised morphofunctional system composed of neurons and neuroglial cells. The distinctive structures of the neuronal cell body, dendrites, and axon enable information to be received, processed, and transmitted. The myelin sheath helps nerve impulses travel rapidly, while synapses facilitate information exchange between neurons and other cells.

Neuroglial cells perform functions such as maintaining the microenvironment required by neurons, providing protection and trophic support, and producing myelin. Cooperation between neurons and glial cells helps coordinate sensation, movement, the activity of internal organs, memory, and learning. Accordingly, studying the morphological structure and functional characteristics of nervous tissue together is essential to understanding the normal functioning of the human body.

REFERENCES

1. Betts J.G., Young K.A., Wise J.A. et al. Anatomy and Physiology 2e. Houston, TX: OpenStax, 2022. Section 12.2: Nervous Tissue. <https://openstax.org/books/anatomy-and-physiology/pages/12-2-nervous-tissue>.
2. Betts J.G., Young K.A., Wise J.A. et al. Anatomy and Physiology 2e. Houston, TX: OpenStax, 2022. Section 4.5: Nervous Tissue Mediates Perception and Response. <https://openstax.org/books/anatomy-and-physiology/pages/4-5-nervous-tissue-mediates-perception-and-response>.
3. To‘xtayev Q.R., Azizova F.X., Abdurahmonov M.A. va boshq. Gistologiya, sitologiya va embriologiya. Darslik. – Toshkent: Innovatsiya-Ziyo, 2024. – 444 b.
4. Saitmuratova O.X. Nerv to‘qimasi. O‘quv qo‘llanma. – Toshkent: Tafakkur-Bo‘stoni, 2012. – 112 b. ISBN 978-9943-362-62-8.



5. Ludwig P.E., Das J.M. Histology, Glial Cells. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; updated 2023 May 1.
<https://www.ncbi.nlm.nih.gov/books/NBK441945/>.