HEALTH BASICS

White matter of the brain

White matter is brain tissue containing nerve fibres that carry signals between brain regions.

WHAT IT IS
Brain tissue made mainly of signal-carrying nerve fibres

WHERE IT COMES UP
Brain anatomy, MRI reports, stroke, and neurological conditions

WHY IT MATTERS
It connects brain regions needed for movement, sensation, and thinking

WHAT IT IS NOT
Not a disease or diagnosis

WHO TO ASK
Primary care clinician, neurologist, or radiologist

HOW IT IS CHECKED
Neurological examination and brain imaging, usually MRI

Overview

White matter is one of the main types of tissue in your brain. It contains bundles of nerve fibres that connect different brain areas and allow them to exchange information.

White matter is not a disease or a diagnosis . It is a normal part of the brain. The term may also appear in an MRI report when a scan shows a change within this tissue.

Most nerve fibres in white matter are axons. An axon is a long extension of a nerve cell that carries electrical signals. Many axons are covered by myelin , a fatty insulating layer that helps signals travel quickly and reliably.

Myelin gives white matter its pale appearance. However, white matter is not made of myelin alone. It also contains support cells, blood vessels and uncovered nerve fibres.

White matter lies beneath the brain's outer layer, known as the cerebral cortex. It also forms important pathways in the brainstem and cerebellum. Examples include the corpus callosum, which connects the brain's two halves, and the internal capsule, which carries movement and sensory signals.

The spinal cord contains white matter as well, but this article focuses on white matter in the brain.

How it works

Your brain's nerve cells communicate through networks. Gray matter contains many nerve-cell bodies and local connections. White matter contains many of the longer fibres that link one area with another.

The difference is not absolute. Gray matter contains some myelinated fibres, and white matter contains more than axons. The names describe which structures are most prominent in each tissue.

White matter pathways carry different kinds of information. Some connect nearby areas within the same side of the brain. Others connect the left and right sides or link the cerebral cortex with deeper structures, the brainstem, the cerebellum and the spinal cord.

These connections support functions such as:

Myelin is produced by cells called oligodendrocytes. One oligodendrocyte can help insulate parts of several axons. Small gaps in the myelin allow electrical signals to move along an axon in rapid steps.

White matter continues to develop from childhood into early adulthood. Its structure can also change with learning, ageing and health conditions. These changes do not all have the same meaning.

- Controlling and coordinating movement
- Carrying information about touch, pain and body position
- Linking areas involved in language, attention and memory
- Coordinating vision and hearing with other brain functions
- Helping different brain networks work together efficiently

Why it matters for your health

Healthy white matter allows information to move efficiently through the brain. Damage to a pathway can interrupt communication between the areas that pathway connects.

You may encounter the term in a brain MRI report. MRI, or magnetic resonance imaging, uses a strong magnetic field and radio waves to create detailed pictures. It shows white matter more clearly than a CT scan in many situations.

Reports may mention white matter lesions , white matter changes or white matter hyperintensities . A hyperintensity is an area that looks brighter than nearby tissue on certain

MRI images. It describes an appearance, not a cause.

Small white matter changes become more common with age. They may also be associated with conditions affecting the brain's small blood vessels. Their importance is influenced by factors such as your age, medical history, symptoms, the number and location of changes, and whether they are new or stable.

A scan finding must therefore be interpreted in context. The wording alone cannot show whether a change is harmless, related to a known condition or in need of further assessment.

White matter is also important when clinicians assess stroke, multiple sclerosis, inherited neurological conditions, head injuries and some infections. In each case, the pattern of affected tissue may help narrow down the possibilities, but imaging is only one part of the assessment.

What can go wrong

Several different conditions or situations can affect white matter. They do not all damage it in the same way.

Cerebral small vessel disease affects tiny blood vessels deep in the brain. On MRI, it can appear as white matter hyperintensities, small strokes or tiny areas of bleeding. Age, high blood pressure, diabetes and smoking can be relevant to blood-vessel health, but an individual scan cannot establish the cause by itself.

Stroke can damage white matter when blood flow to a pathway is blocked or when a blood vessel bleeds. The effects depend on the location and size of the stroke.

Multiple sclerosis is an immune-mediated disease that damages myelin and nerve fibres in the brain and spinal cord. MRI may show lesions in characteristic locations, but white matter spots alone do not diagnose multiple sclerosis.

Leukodystrophies are a group of uncommon, usually inherited disorders that affect white matter or myelin. The age at which they appear and their effects differ widely.

Traumatic axonal injury can follow a serious head injury. Rapid movement of the brain may stretch or damage axons, sometimes in several white matter areas.

Inflammation, infection, reduced oxygen supply and some toxic or metabolic problems can also affect white matter. Tumours may arise in it or spread through it, although white matter itself is not a type of tumour.

Changes that look similar on one MRI sequence may have different causes. A radiologist considers their shape, location and appearance across several types of images. Previous scans

can show whether findings are stable or changing.

What you can do

There is no routine reason to test the white matter of a person who feels well. Brain MRI is generally used when symptoms, examination findings or a medical history give a reason to look. It is not a general health screening test.

If an imaging report mentions white matter changes, useful questions include:

Keep copies of imaging reports and note where earlier scans were performed. The images themselves may be more useful for comparison than the written report alone.

Routine follow-up is appropriate when a clinician recommends discussing an incidental finding, reviewing vascular risk factors or arranging comparison imaging. Do not start aspirin or another medicine solely because a report mentions white matter changes; treatment depends on the underlying situation and your other health risks.

Seek emergency help for sudden facial drooping, one-sided weakness or numbness, difficulty speaking, sudden loss of vision, severe new loss of balance, or a sudden intense headache. These can be signs of stroke or another emergency. Do not wait for an appointment or try to interpret a previous MRI report first.

- What exact pattern did the scan show?
- Is the finding expected for my age and health history?
- Does it explain the reason the scan was ordered?
- Should this scan be compared with earlier imaging?
- Is follow-up imaging or a neurological assessment needed?
- Are blood pressure, blood sugar, cholesterol or smoking relevant here?

Common questions

Are white matter and gray matter opposites?

They are different but closely connected parts of the same nervous system. Gray matter handles much local processing, while white matter carries signals between areas. Both contain several kinds of cells and fibres.

Do white matter spots mean multiple sclerosis?

No. Many conditions and age-related changes can produce bright areas on MRI. Multiple

sclerosis is assessed using the lesion pattern, symptoms, examination findings and sometimes additional tests.

Are white matter changes normal with ageing?

Some changes are common in older adults, but "common" does not always mean unimportant. Their meaning depends on how extensive they are, where they occur and your health history.

Can damaged white matter repair itself?

Some myelin repair can occur, and the brain may adapt by using other pathways. The amount of recovery depends on what caused the damage, its location and its extent. There is no single treatment that repairs every type of white matter injury.

Can a CT scan show white matter?

CT can show major differences in brain tissue and may detect strokes, bleeding or extensive changes. MRI usually gives more detailed information about white matter.

Does an MRI finding explain problems with memory or concentration?

Not necessarily. Thinking problems can have many causes. A clinician must compare the scan with your symptoms, examination, medicines and other health information.

Sources

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