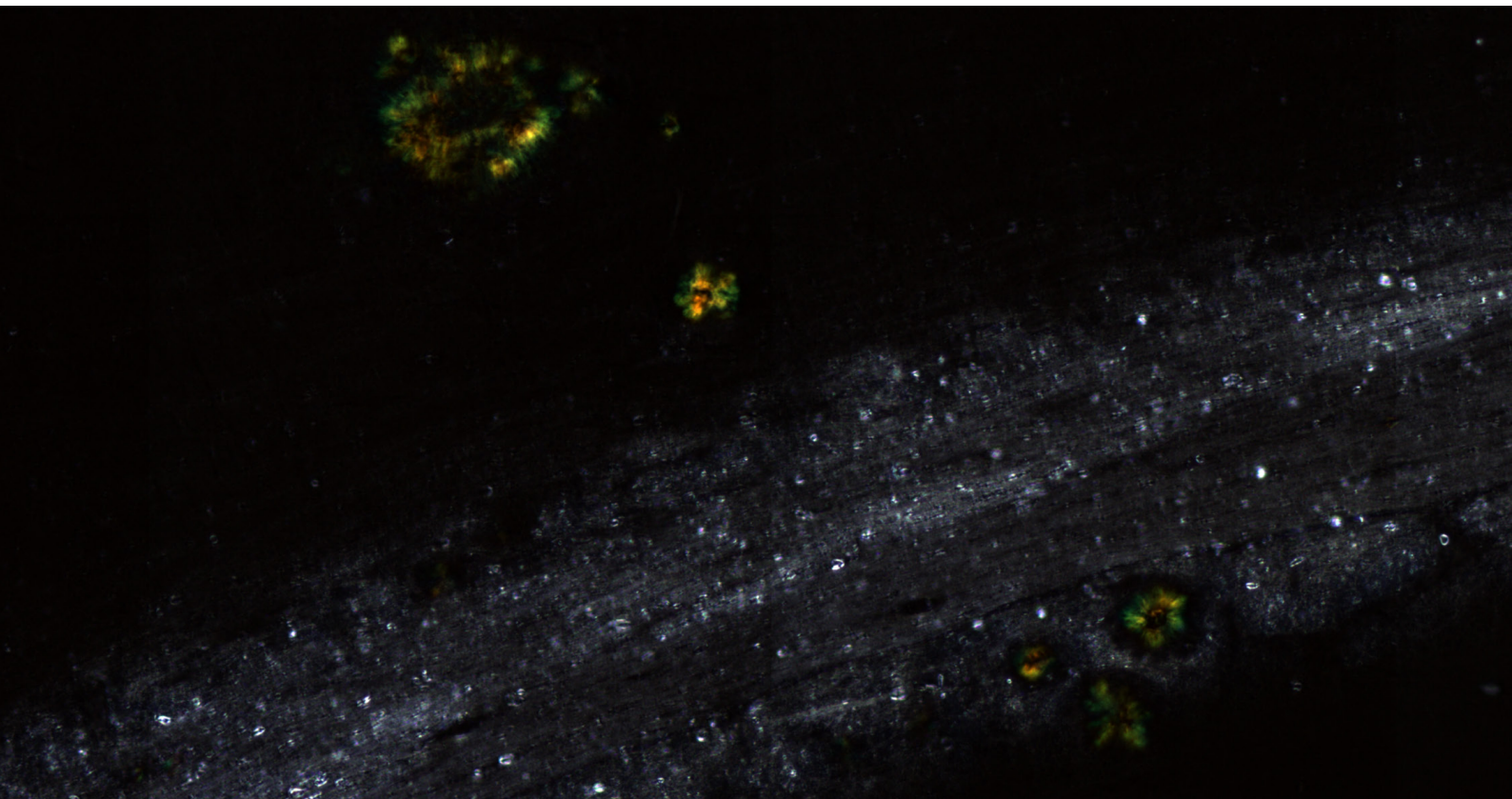


Studying Alzheimer's Disease Using Microscopy-Based Detection of Amyloid Fibrils

ZEISS Axioscan 7 clinical



Seeing beyond

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Alzheimer's Disease is linked to the buildup of beta-amyloid fibrils - misfolded protein aggregates that disrupt normal brain function. These fibrils accumulate into plaques that interfere with neuronal communication and contribute to neurodegeneration. Congo Red is a dye that specifically binds to amyloid structures, enabling their visualization in brain tissue. When viewed under polarized light, Congo Red-stained amyloid exhibits apple-green birefringence, confirming the presence and location of fibrils.

What is Alzheimer's Disease (AD)?

Alzheimer's Disease is a **progressive neurodegenerative disorder** that affects the brain, leading to memory loss, cognitive decline, and behavioral changes. It is the most common cause of dementia, especially in older adults.

At the biological level, Alzheimer's is associated with two main pathological features:

1. **Amyloid plaques** – formed by the buildup of beta-amyloid protein fragments between neurons.
2. **Neurofibrillary tangles** – twisted strands of tau protein found inside brain cells.

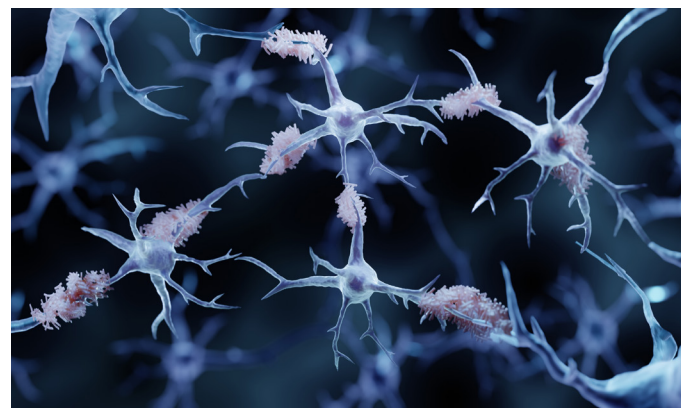
These abnormal protein accumulations disrupt communication between neurons, cause cell damage, and eventually lead to **neuronal death**. As the disease progresses, brain regions involved in memory, reasoning, and language shrink, resulting in a gradual loss of mental function and independence.

The Role of Amyloid plaques

A hallmark of Alzheimer's disease (AD) is the accumulation of **beta-amyloid plaques** in the brain. These are **abnormal clumps of misfolded protein fragments** that deposit between neurons, disrupting connectivity and contributing to neurodegeneration.

Beta-amyloid is normally produced as a **byproduct of protein metabolism**. In AD, it **misfolds and aggregates** into **insoluble fibrils**, which then form dense **extracellular plaques**.

These plaques disrupt neuronal communication, trigger inflammation, and lead to cell death. Their presence is **strongly associated with cognitive decline**, making them a central focus in research, diagnosis, and therapeutic development.

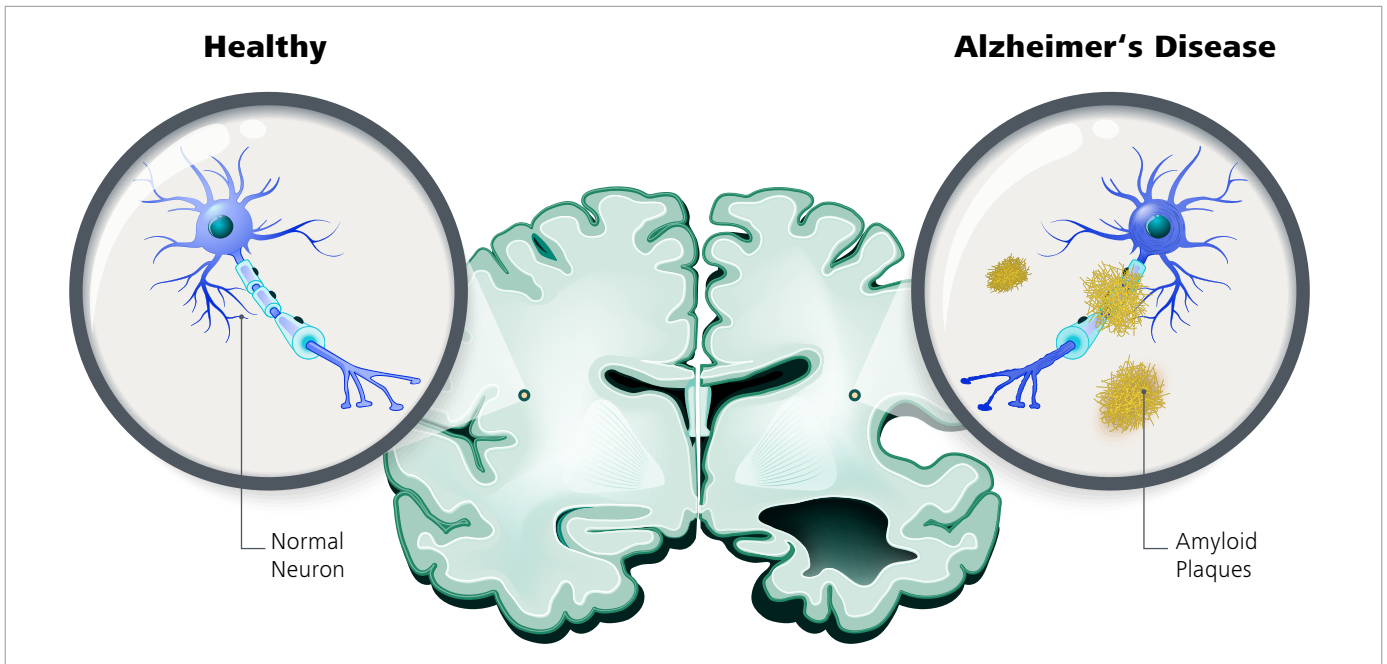


Amyloid plaques in Alzheimer's disease

How Researchers Study Amyloid Plaques

Researchers study amyloid plaques using a combination of **biological samples, special stains, and microscopy techniques** to understand their formation, distribution, and role in diseases like Alzheimer's. Biological samples may be large brain sections of animal models such as genetically modified mice that develop amyloid plaques or **brain organoids**, lab-grown 3D cell cultures mimicking human brain tissue.

In this workflow, large brain sections can be scanned with Whole Slide Scanners and analyzed to locate and quantify amyloid-positive areas.

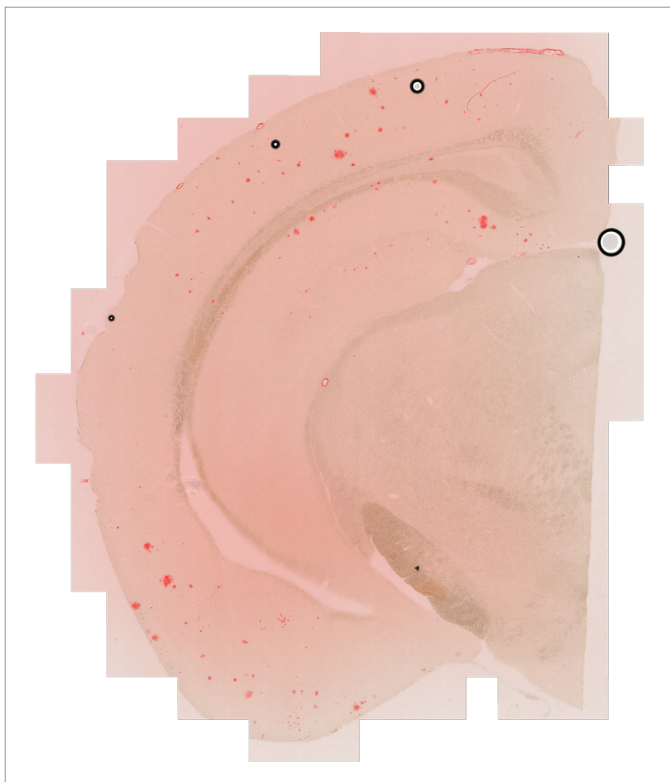


Alzheimer's disease. Neurons and brain

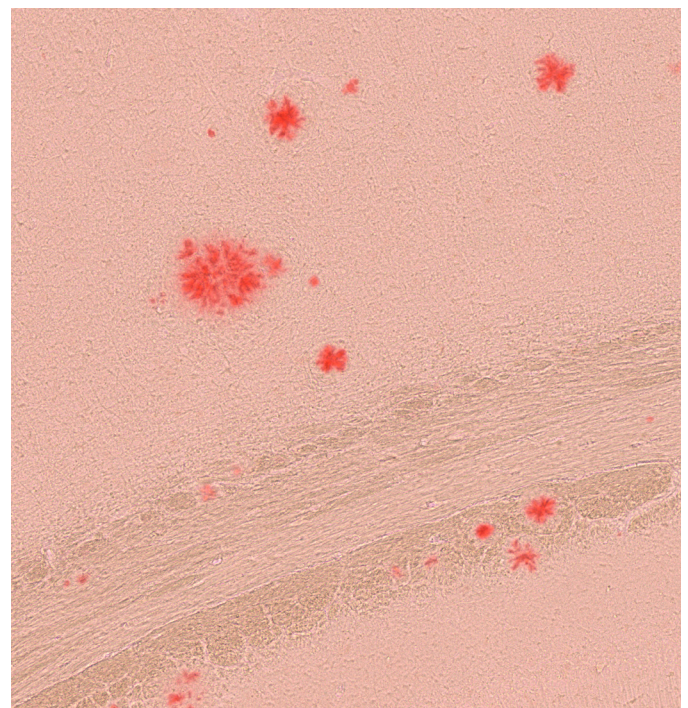
What is Congo Red Staining?

Congo Red staining is a histological technique used to detect **amyloid fibrils** in tissue samples. Congo Red is a synthetic dye that has a strong affinity for the **cross- β -sheet structure** typical of amyloid fibrils. When applied to brain tissue, the dye binds specifically to these fibrils and allows them to be visualized under a microscope.

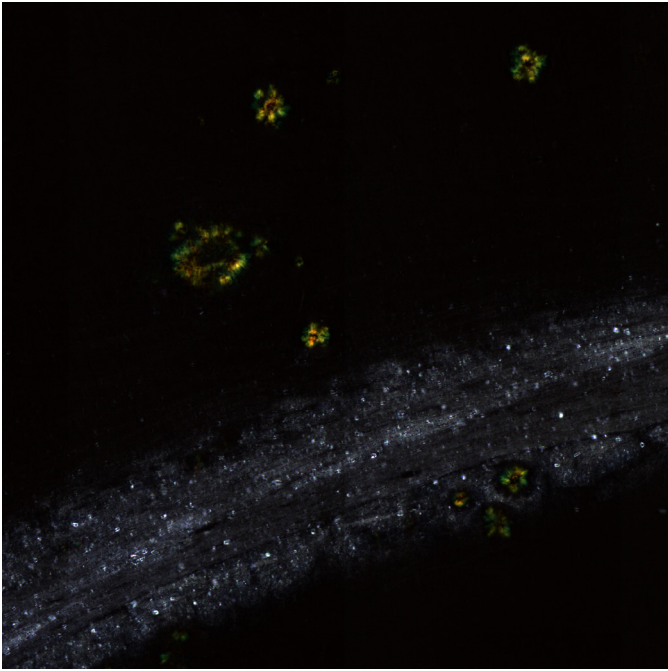
Under **brightfield microscopy**, stained regions appear red or pink indicating possible amyloid deposits. However, the most definitive feature of Congo Red staining is observed using **polarized light microscopy to confirm** that the red-stained areas are truly amyloid. Amyloid fibrils bound to Congo Red show a characteristic **apple-green birefringence**, a unique optical signature. This optical property confirms the presence of amyloid and helps distinguish it from other tissue components.



Mouse brain section from an Alzheimer's disease model stained with Congo Red, a dye that binds specifically to amyloid fibrils. Sample courtesy of Prof. Dr. M. Morawski, Paul-Flechsig-Institut, Zentrum für Neuropathologie und Hirnforschung, Leipzig



Under brightfield microscopy, stained regions appear red or pink indicating possible amyloid deposits. Sample courtesy of Prof. Dr. M. Morawski, Paul-Flechsig-Institut, Zentrum für Neuropathologie und Hirnforschung, Leipzig



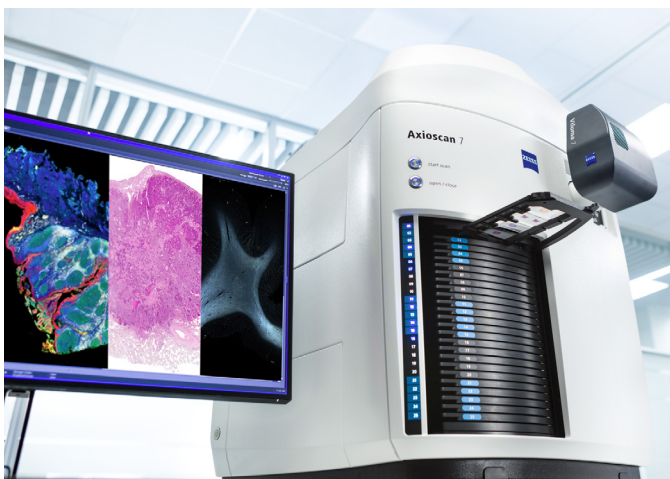
The Congo Red stain is easily visible and helps identifying the regions of interest; it's apple-green birefringence in polarization microscopy confirms amyloid. Sample courtesy of Prof. Dr. M. Morawski, Paul-Flechsig-Institut, Zentrum für Neuropathologie und Hirnforschung, Leipzig

Recommended Microscope

ZEISS Axioscan 7 clinical is a digital slide scanner for applications from clinical routine diagnostics to clinical research. With this IVD*-approved system (* acc. to IVDR) researchers can easily scan clinical samples in brightfield, fluorescence and even polarization contrast.

Researchers can map where plaques form, measure their size and density, and study their relationship to neuronal damage, helping to better understand and combat Alzheimer's Disease.

The use of Congo Red staining in combination with polarization microscopy enables researchers to map the spatial distribution of amyloid deposits with high contrast and specificity – advancing our ability to study pathological changes in the brain and develop targeted interventions.





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