Redefining MRI:
From Image to Insight

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MD-PhD Cross Talks

SY17-1

From Structure to Diagnosis: AI-Powered CT Imaging in Neurodegenerative Disease

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1. The Core Engine: Essential Circuitry of Human Memory
Memory formation and consolidation are driven by highly coordinated neural networks rather than isolated cortical regions. This session reviews the Papez Circuit, the primary anatomical substrate for episodic memory.

2. Vulnerable Nodes: Topographic Progression in Alzheimer's Disease
Alzheimer's disease pathology systematically targets specific nodes within the memory circuit and the Default Mode Network (DMN). This session details the structural and metabolic relationships among three critical regions: the entorhinal cortex (the earliest gateway of tau pathology), the hippocampus (the central controller of memory retention), and the posterior cingulate cortex (PCC) (the primary cortical hub for network-wide distribution).

3. Quantitative Biomarkers: MR-Based Volumetry in Clinical Practice
Quantifying regional brain atrophy on high-resolution T1-weighted MRI is a validated approach for screening patients at the mild cognitive impairment (MCI) stage. This section addresses the technical methodologies of MR volumetry. Furthermore, we will discuss the clinical utility of multi-regional pattern recognition systems, such as the Structural Anomaly Index (STAND) score, and automated cortical thickness pipelines that translate multi-dimensional atrophy into reliable diagnostic metrics.

4. Paradigm Shift: AI-Driven CT Volumetry and Image Synthesis
Despite its high soft-tissue contrast, MRI is constrained by high costs, long scan times, and limited availability, hindering its utility for mass screening. Computed Tomography (CT), conversely, remains the most ubiquitous and cost-effective neuroimaging modality globally. This session introduces a paradigm-shifting approach: AI-powered CT-based brain volumetry. This allows for the precise, automated quantification of hippocampal volume and cortical thickness without requiring an actual MR scan, drastically reducing screening barriers and democratizing early dementia detection.

Keywords: *CT, Volumetry, AI, Alzheimer's disease, Anatomy, Segmentation*