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EEG Biomarkers for Alzheimer's Disease

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Introduction

A growing body of evidence suggests that EEG analyses; including both resting state and event-related stimulation protocols, may be useful in early detection of neural signatures of dementia.

Moreover, an EEG-based analysis shows potential for discriminating across dementia sub-types, including Alzheimer's (AD), Mild Cognitive Impairment (MCI), Vascular dementias, and the Lewy Body Dementias (LBD) – including Parkinson's Disease with Dementia (PDD). Although these approaches have been largely confined to university research investigations; if proven accurate, reliable, and scalable, the widespread use of EEG as a neuroimaging modality could provide an inexpensive and easy to implement method for early diagnosis and treatment outcome studies of the dementias.

EEG Biomarkers for Alzheimer's

Promising EEG biomarkers include:

1) Increased power in the low-frequency bands (i.e., theta, delta) with reductions in higher frequency bands (i.e., beta, gamma).
2) Changes in the amplitude and latency of evoked potentials for both cognitive (i.e., attention, memory, learning) and sensory stimuli (i.e., visual, auditory, somatosensory).
3) Reduction in the complexity of the EEG dynamics assessed with non-linear analyses (e.g., entropy, Grainger causality).
4) Abnormal functional connectivity as assessed by coherence, phase, and source localization (e.g., LORETA) analyses.

In addition to the potential for developing a sensitive, quantitative early diagnostic index; a variety of EEG-based metrics of variability have been successfully applied to characterize the Cognitive Fluctuations and discriminate across sub-types of dementia associated with LBD and PDD but not present in the AD.

In an analysis of resting state EEG data acquired by Orasi Medical (Minneapolis, MN) from a cohort of 31 subjects previously diagnosed with AD and 44 healthy controls, statistically-significant differences were seen between groups in frequency bandwidth averages, frequency ratios, and wavelets. The patterns observed support the utility of EEG-based biomarkers of Alzheimer's disease.

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Conclusion

EEG-based biomarkers show promise for utility in early detection of Alzheimer's Disease, notably:

- Frequency Bandwidths – significant decreases in parietal/temporal alpha, and global sigma, beta.
- Frequency Bandwidth Ratios – excessive slowing in parietal and temporal regions.
- Wavelet Analysis – significant increases in slow wave activity over the sensorimotor region.

These findings support the use of EEG as an inexpensive, easily-implementable biomarker analysis method for AD.