

# Implication of EEG theta/alpha and theta/beta ratio in Alzheimer's and Lewy body disease

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## Purpose

- Alzheimer's disease (AD) and Lewy body disease (LBD) account for the majority of degenerative dementia.
- Alzheimer's disease (AD) is a cognitive impairment associated with amyloid plaque and neural fiber tangles, and LBD is a cognitive impairment associated with alpha-synuclein, including Parkinson's disease (PD) and dementia with Lewy body (DLB).
- Diagnosis of AD and LBD with Positron Emission Tomography (PET) and DAT (Dopamine Transporter) is possible, but it is expensive and difficult to access, and is not optimal for people mixed with AD in LBD and without visual hallucinations and cognitive impairment.
- Therefore, non-invasive and inexpensive EEG testing is a promising biomarker for dementia diagnosis.

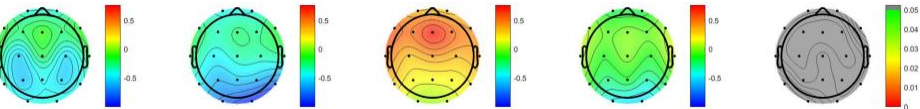
## Subjects / Methods

Subjects : 91 people(Control group: 17 people, AD: 16 people, Mixed disease: 20 people, LBD: 38 people)

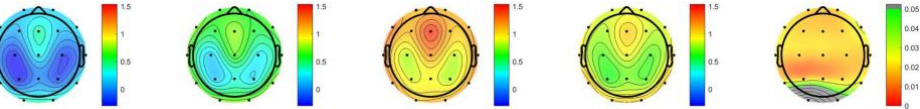
- Used the Theta/Alpha ratio as biomarker to distinguish AD patients from Control groups in previous studies.
- Checked theta/alpha ratio by borrowing that theta/alpha ratio is higher in patients with LBD.
- In MCI due to LBD, an increase in beta and theta was observed compared to MCI due to AD, confirming theta/beta ratio

### [Topomap]

#### Theta Alpha Ratio(TAR)



#### Theta Beta Ratio(TBR)



Control      AD      Mixed disease      LBD      p-value

### [LBD]

- Related to an increase in TBR in all brain regions.
- Not related to TAR in all brain regions.
- Theta in all brain areas.
- Alpha 1 in the frontal, central, temporal, and occipital lobes
- Significant in beta3 of parietal lobe.

### [AD]

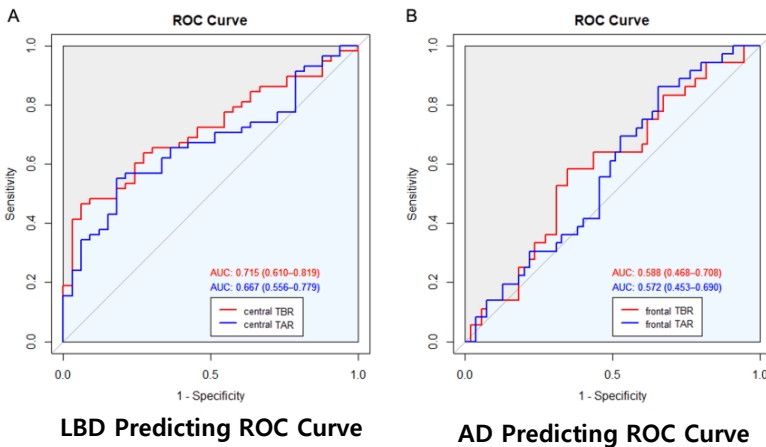
- Not related to increasing TBR.
- There is a slight correlation with the TAR of the frontal, central, and temporal lobes.
- Significance in the frontal lobe, central lobe theta.

### [Mixed disease]

- Showed high TAR in all brain regions.
- High TBR observed in the frontal, central, and parietal lobes.

### [Artificial Intelligence]

- TBR was associated with low memory and visuospatial domain scores, and high TARs in the temporal and occipital lobe TAR were associated with low language region scores. The increased TBR of the temporal lobe and parietal lobe was associated with the lower memory domain score, and the increased TBR of the parietal lobe was associated with the lower frontal/executive score.



## Discussion

- Non-AD LBD is associated with TBR, especially TBR of central and parietal lobes has the highest accuracy in predicting LBD.
- TAR is related to AD (or amyloid-positive), significantly increasing TAR mainly in the mixed disease group.
- Patients with cognitive impairment were associated with increased TBR and TAR in the temporal lobe in all brain regions, while not with the severity of cognitive impairment and Parkinson's disease.
- Therefore, increased TBR in the central and parietal lobes is associated with LBD, and brain waves with simultaneous increases in TAR and TBR can be predicted as mixed disorder.