OCT Angiography Multifractal Analysis of Alzheimer’s, Mild Cognitive Impairment, and Healthy Controls

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Multifractal fractal dimension may not distinguish among AD, MCI, and controls.

Multifractal fractal dimension correlates with FAZ area but not age or sex.
To compare macular OCT-A multifractal dimension in Alzheimer’s disease (AD)
Mild cognitive impairment (MCI)
Cognitively healthy controls

To understand macular OCT-A multifractal properties in a healthy control cohort
Monofractal Dimension
Monofractal Dimension
Monofractal Dimension
Monofractal Dimension
Monofractal Dimension
Monofractal Dimension

\[ \log (\text{# of boxes containing vessel segments}) \]

\[ \log (\text{box width}) \]

-Slope = fractal dimension
Multifractal Dimension

- Appropriate for asymmetric images
  (Stosic T & Stosic BD, IEEE Trans Med Imaging, 2006)

- Lower standard deviation
  (Jiang H et al., Microvasc Res, 2014)
Study Design

Prospective Cross-Sectional Study (07/17-Present)

- Alzheimer’s (AD)
- Mild cognitive impairment (MCI)
- Cognitively healthy controls
Study Design

Prospective Cross-Sectional Study (07/17-Present)

**Inclusion Criteria**
- Age > 50
- VA 20/40 or better

**Exclusion Criteria**
- Other neurodegeneration
- Diabetes
- Poorly controlled hypertension
- Refractive error <-6D or >6D
- Glaucoma or macular disease

Alzheimer’s (AD)

Mild cognitive impairment (MCI)

Cognitively healthy controls
Study Design

Raw Image

Binarized Image
Exclusion Criteria

Decentration  Desaturation  Motion
## Baseline Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Control (N=95)</th>
<th>MCI (N=48)</th>
<th>AD (N=31)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>67.2±7.5</td>
<td>70.7±6.8</td>
<td>71.0±8.0</td>
<td>0.0064*</td>
</tr>
<tr>
<td>Sex (% male)</td>
<td>23.2</td>
<td>37.5</td>
<td>22.6</td>
<td>0.157</td>
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</tbody>
</table>
Fractal Dimension in Controls

\[ \beta = -0.00005; \, 95\% \, CI, \, -0.0002857 \, \text{to} \, 0.0001856; \, P = 0.677 \]
Fractal Dimension in Controls

\[ \beta = 0.0003077; \text{ 95\% CI, } -0.0016048 \text{ to } 0.0022203; \text{ } P = 0.752 \]
Fractal Dimension in Controls

\[ \beta = -0.05495; \text{ 95\% CI, } -0.0672773 \text{ to } -0.0426319; \text{ } P<0.001^* \]
## Fractal Dimension across Groups

<table>
<thead>
<tr>
<th>Fractal Dimension</th>
<th>Control (129 eyes)</th>
<th>MCI (67 eyes)</th>
<th>AD (39 eyes)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1.851±0.008</td>
<td>1.853±0.010</td>
<td>1.853±0.007</td>
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</table>

**AD vs. controls:** $\beta=0.0003779$, 95% CI -0.000522 to 0.0012778; $P = 0.410$

**MCI vs. controls:** $\beta=0.000153$, 95% CI -0.0015571 to 0.0018631; $P = 0.861$

**AD vs. MCI:** $\beta=0.0003752$, 95% CI -0.0018513 to 0.0026018; $P = 0.741$
**Strengths**
- Sample size
- Multifractal analysis

**Limitations**
- Sample size
- Generalizability
On the Horizon

Repeatability
Technical modifications
Longitudinal change
Conclusions

Multifractal fractal dimension may not distinguish among AD, MCI, and controls

Multifractal fractal dimension correlates with FAZ area but not age or sex
<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Sharon Fekrat, MD</td>
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<td>Cason B. Robbins, BS</td>
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<td>Tom MacGillivray, PhD</td>
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<td>Charlene Hamid, BA</td>
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