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

Sophie Cai, MD
Mentors: Dilraj S. Grewal, MD & Sharon Fekrat, MD
Duke Vitreoretinal Service

Duke Eye Center

Financial Disclosures

- None

- Funding support:

  Heed Fellowship

  VitreoRetinal Surgery Foundation Research Award

  Alzheimer's Drug Discovery Foundation

Summary

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

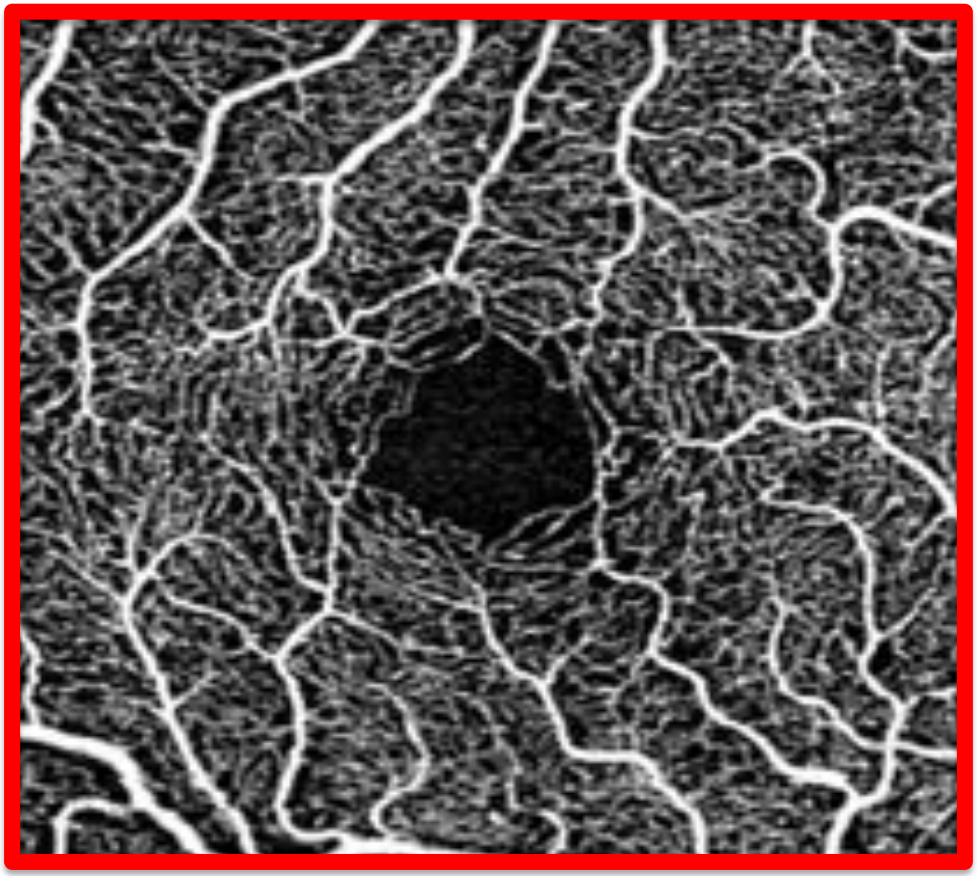
Multifractal fractal dimension correlates with FAZ area but not age or sex

Purpose

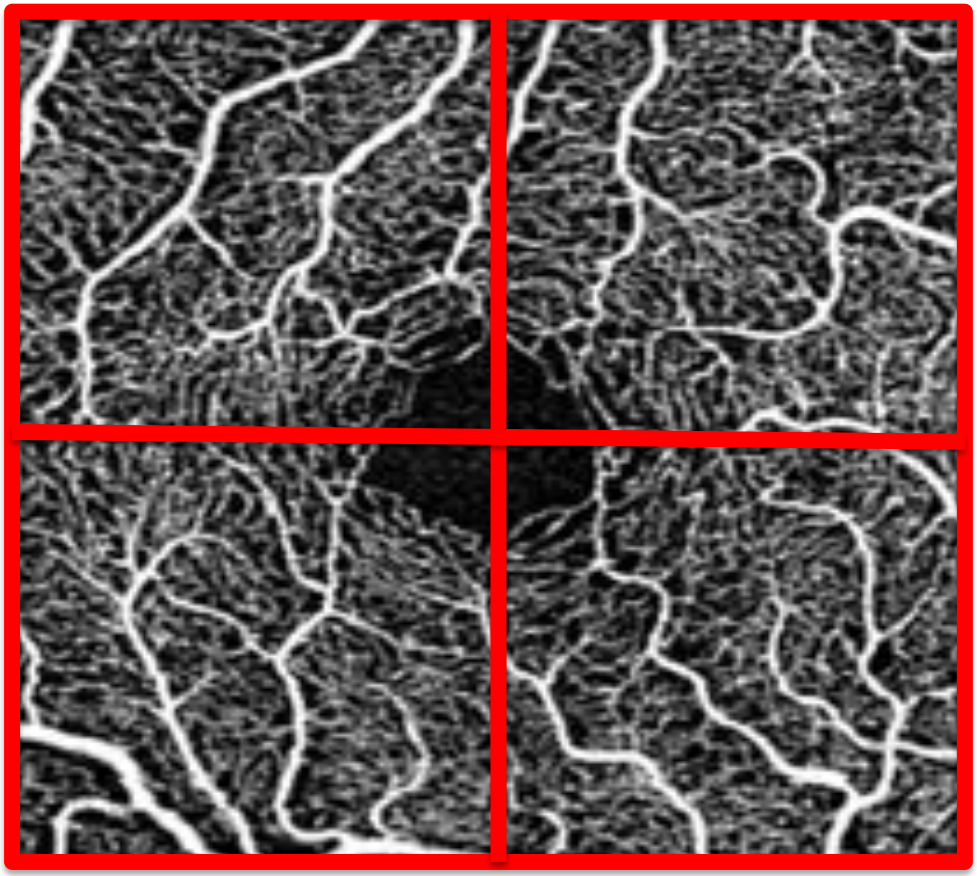
To compare macular OCT-A multifractal dimension in
- Alzheimer's disease (AD)
- Mild cognitive impairment (MCI)
- Cognitively healthy controls

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

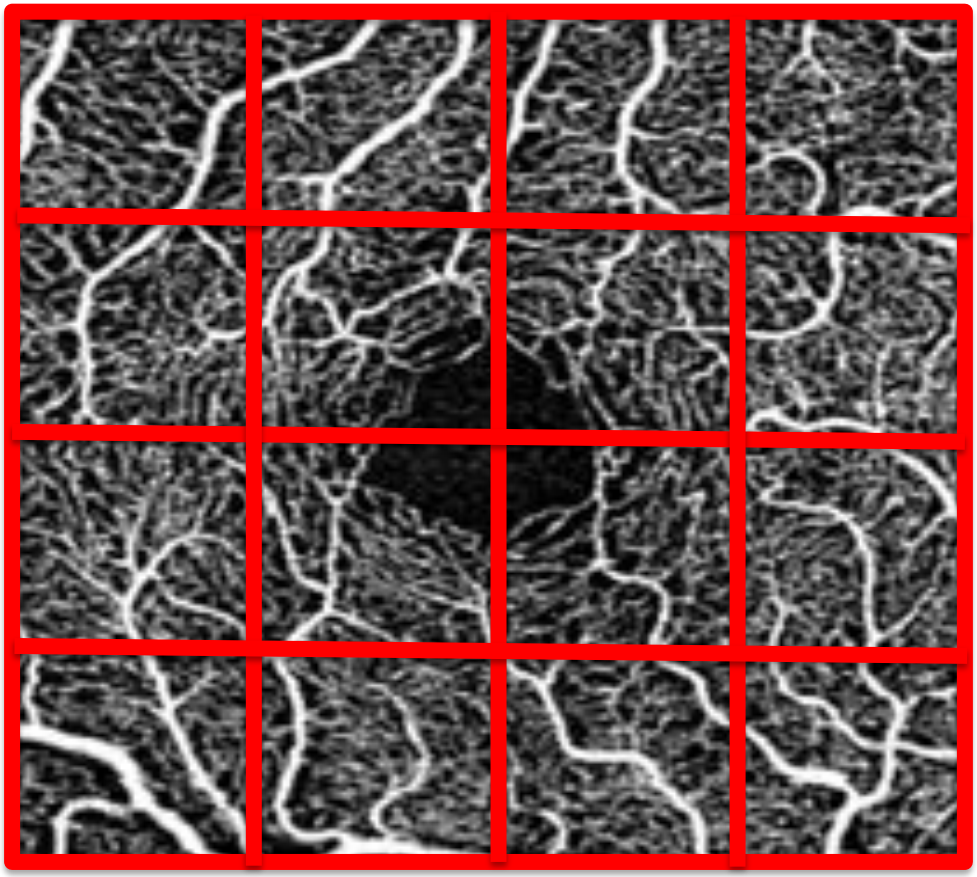
Monofractal Dimension



Monofractal Dimension

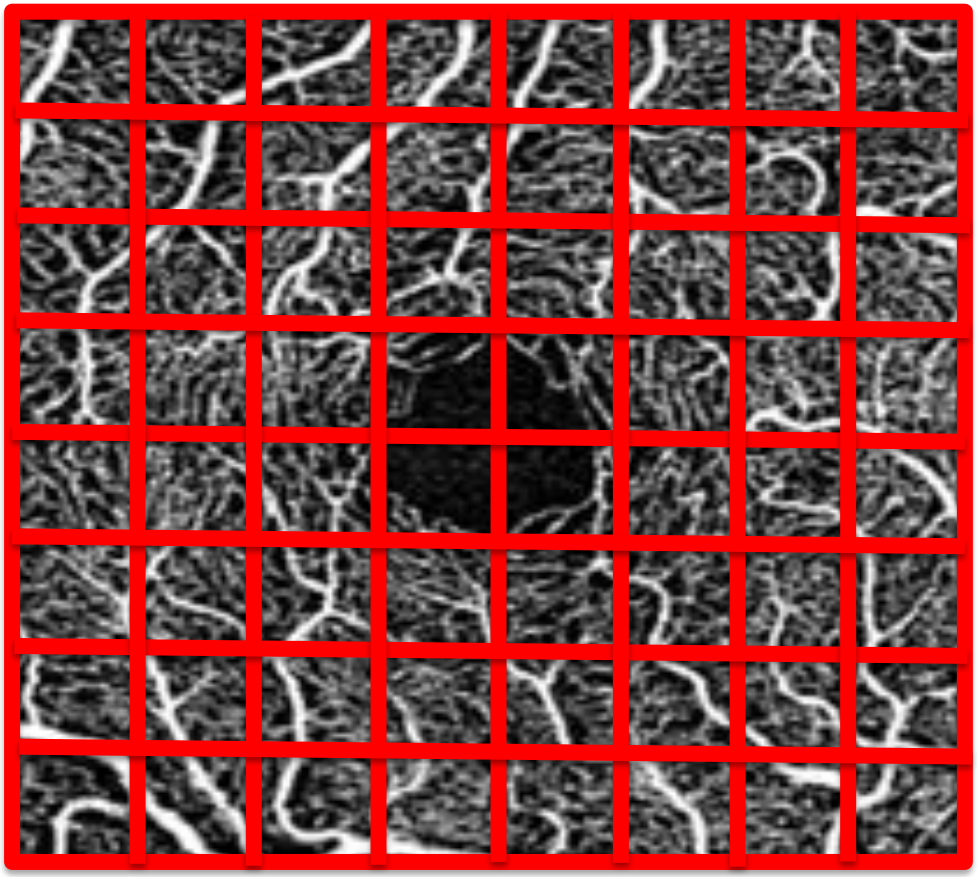


Monofractal Dimension

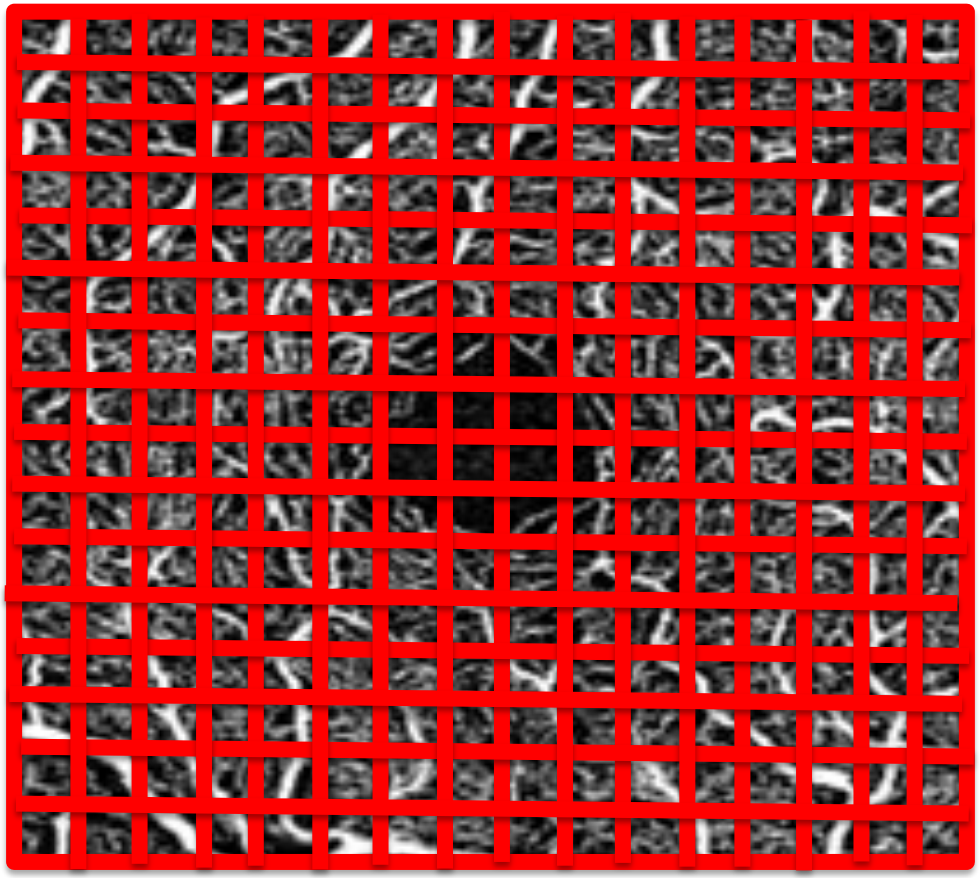


Duke Eye Center

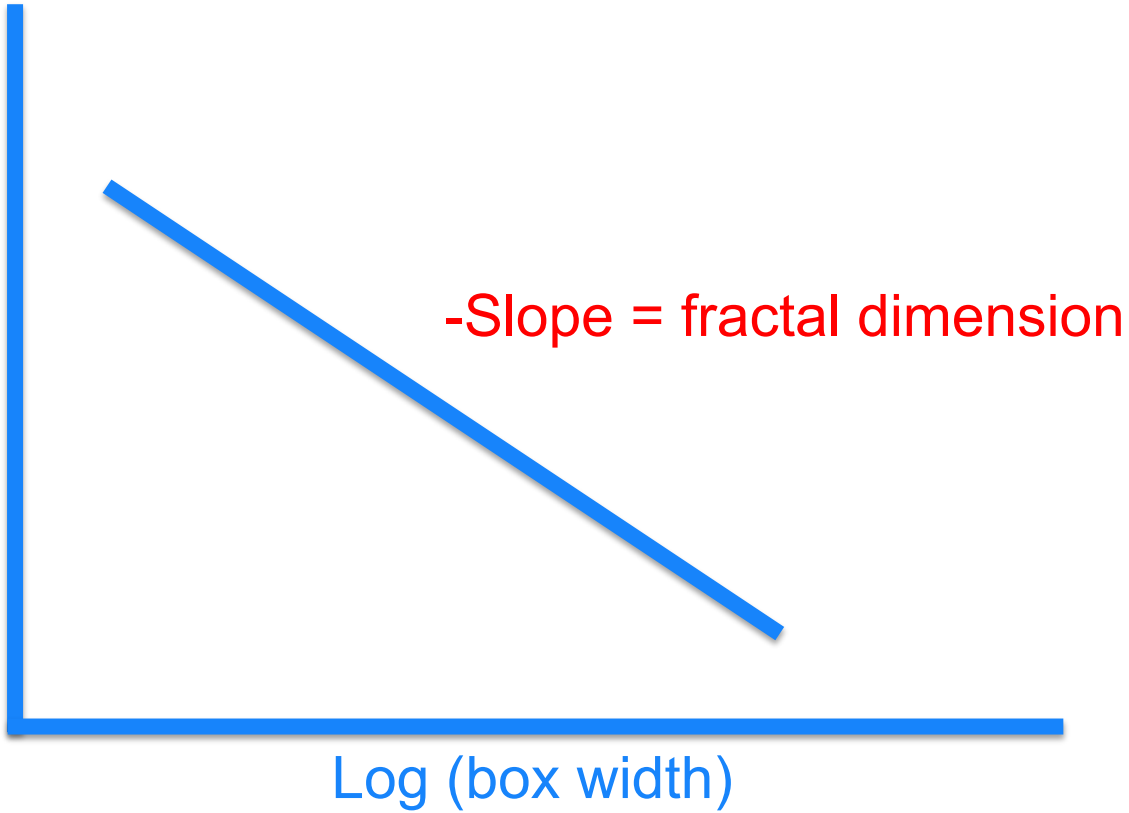
Monofractal Dimension



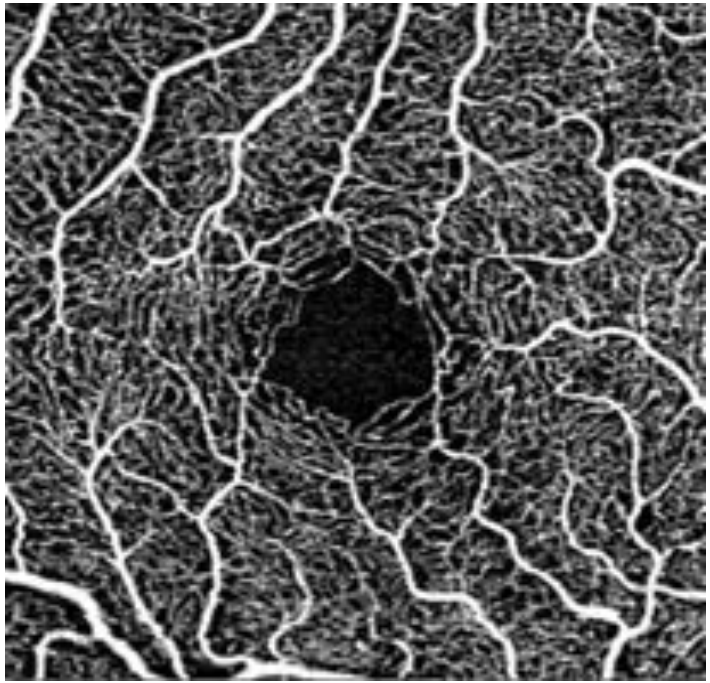
Monofractal Dimension



Monofractal 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)

- Alzheimer's (AD)
- Mild cognitive impairment (MCI)
- Cognitively healthy controls

Inclusion Criteria

Age > 50

VA 20/40 or better

Exclusion Criteria

Other neurodegeneration

Diabetes

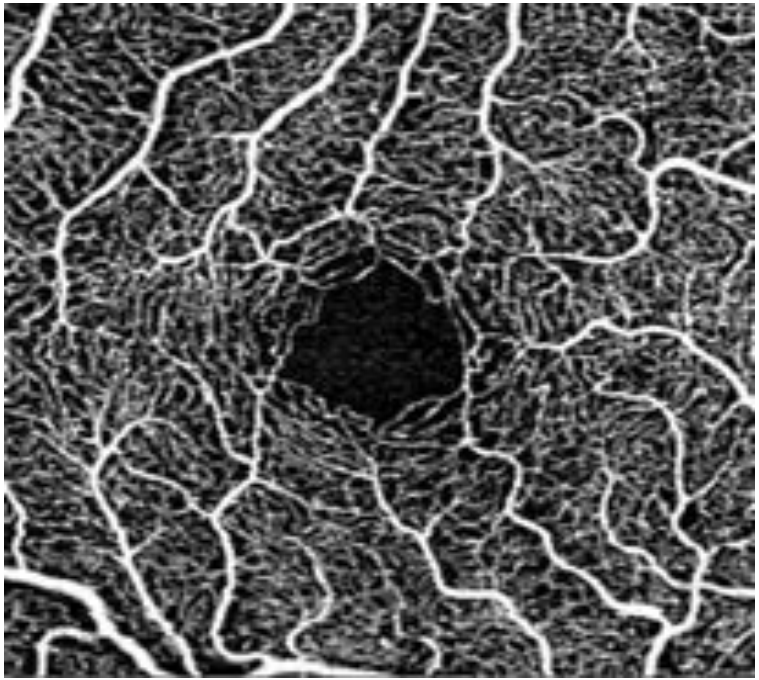
Poorly controlled hypertension

Refractive error <-6D or >6D

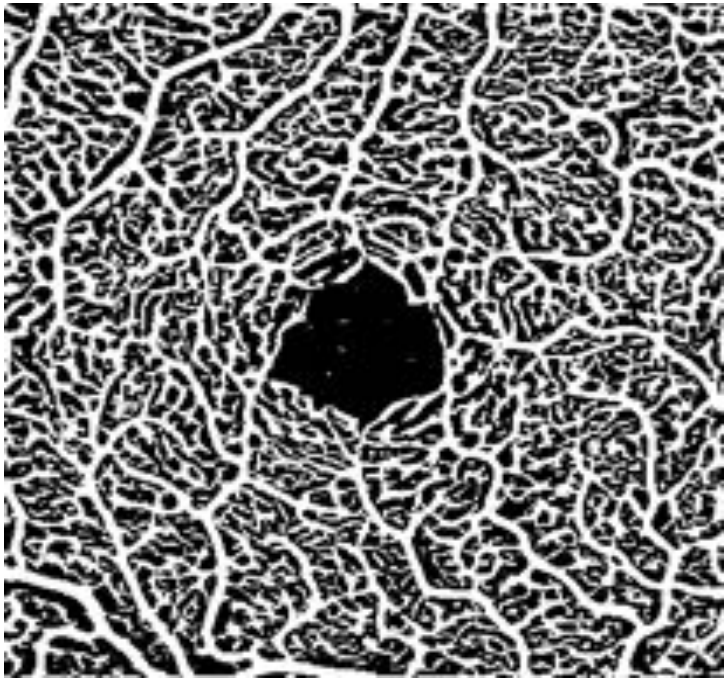
Glaucoma or macular disease

Study Design

Raw Image

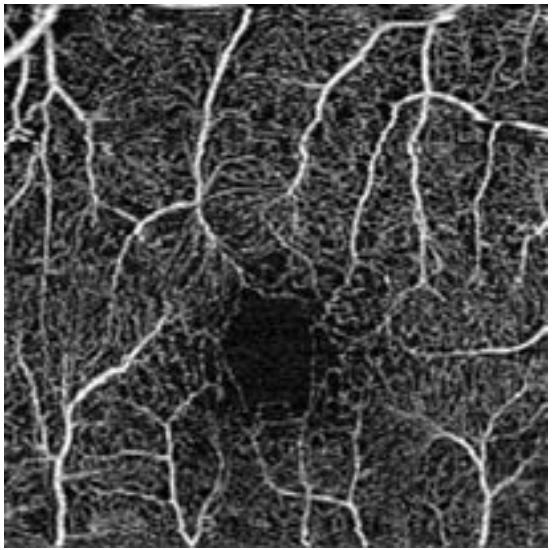


Binarized Image

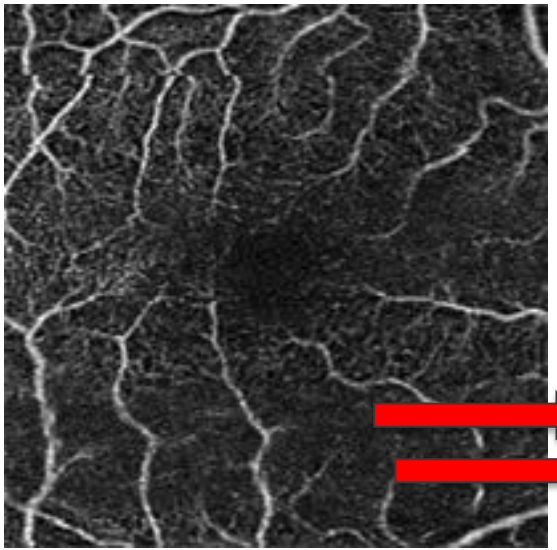


Exclusion Criteria

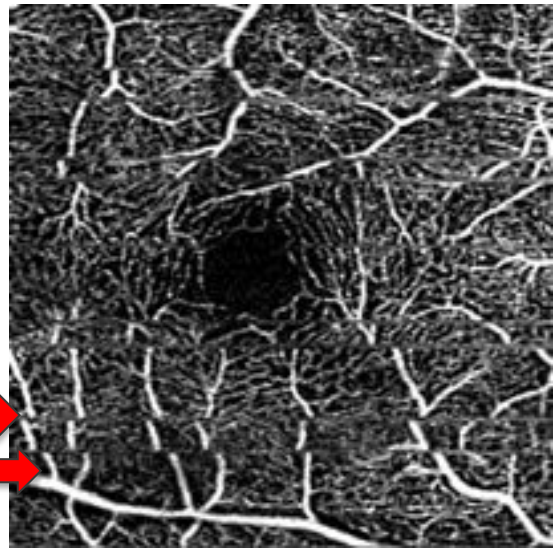
Decentration



Desaturation



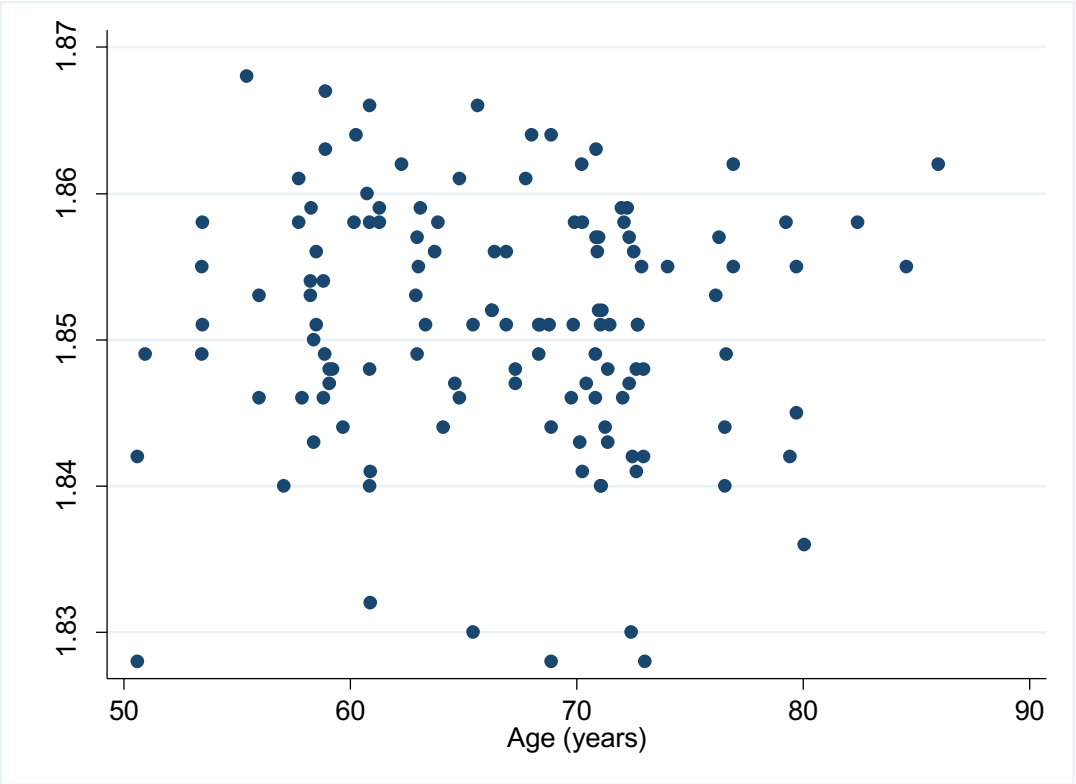
Motion



Baseline Characteristics

	Control (N=95)	MCI (N=48)	AD (N=31)	P
Age (years)	**67.2±7.5**	**70.7±6.8**	**71.0±8.0**	**0.0064***
Sex (% male)	23.2	37.5	22.6	0.157

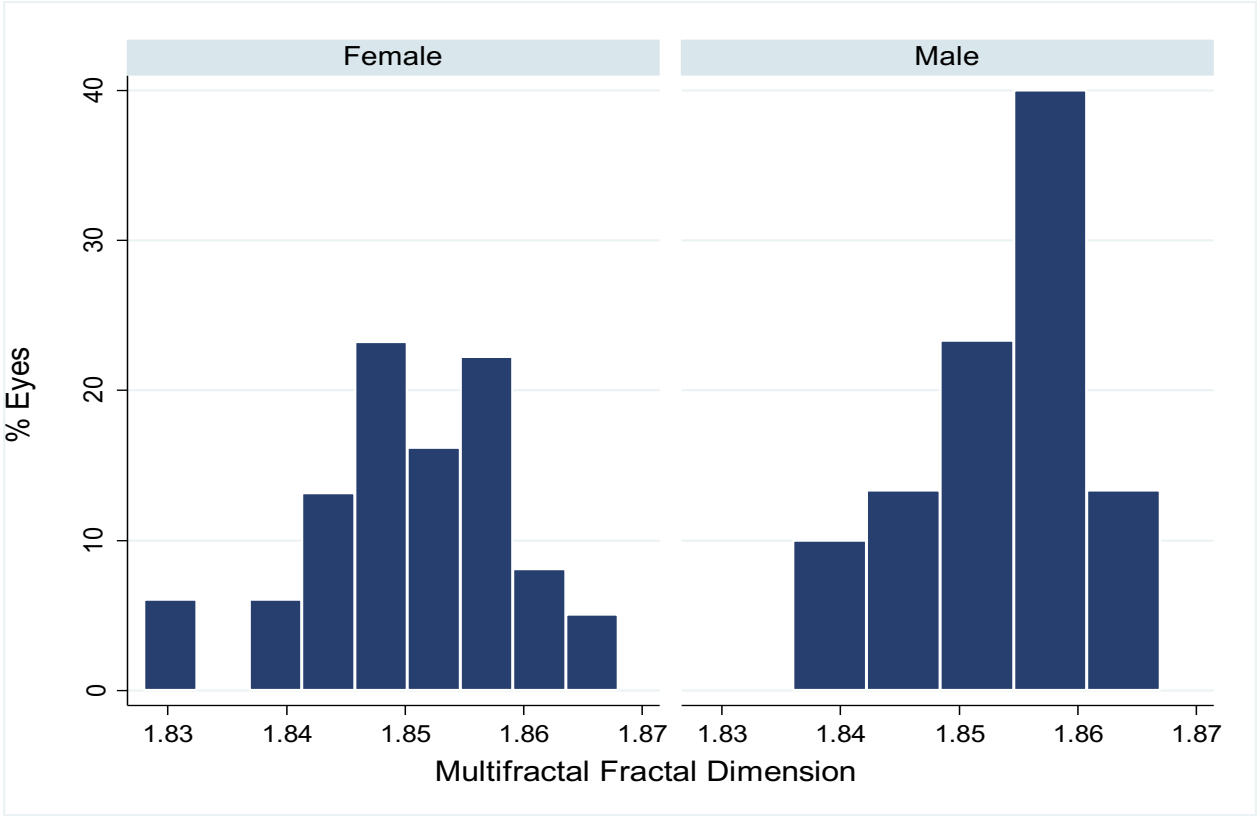
Fractal Dimension in Controls



Duke Eye Center

β=-0.00005; 95% CI, -0.0002857 to 0.0001856; **P=0.677**

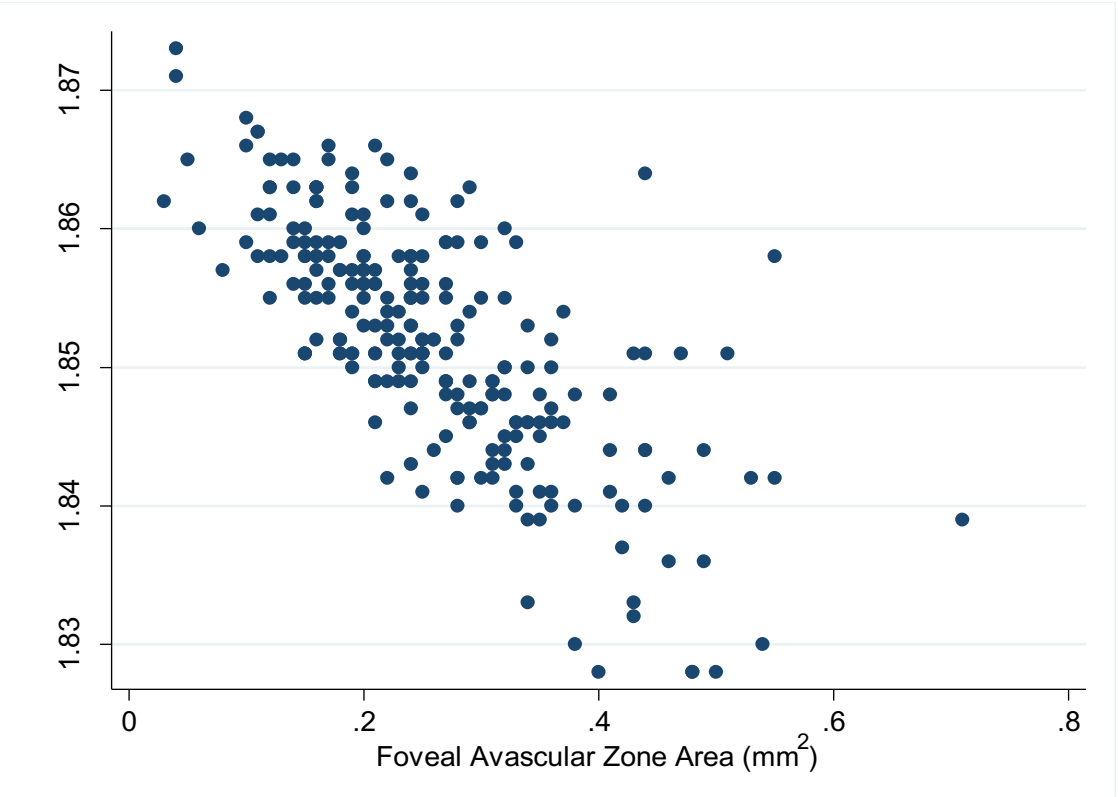
Fractal Dimension in Controls



Duke Eye Center

β=0.0003077; 95% CI, -0.0016048 to 0.0022203; **P=0.752**

Fractal Dimension in Controls



Duke Eye Center

β =-0.05495; 95% CI, -0.0672773 to -0.0426319; **P<0.001***

Fractal Dimension across Groups

	Control (129 eyes)	MCI (67 eyes)	AD (39 eyes)
Fractal Dimension	1.851±0.008	1.853±0.010	1.853±0.007

AD vs. controls: β=0.0003779, 95% CI -0.000522 to 0.0012778; **P = 0.410**
MCI vs. controls: β=0.000153, 95% CI -0.0015571 to 0.0018631; **P = 0.861**
AD vs. MCI: β=0.0003752, 95% CI -0.0018513 to 0.0026018; **P = 0.741**

Strengths & Limitations

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

Special Thanks

Sharon Fekrat, MD

Dilraj S. Grewal, MD

Cason B. Robbins, BS

Atalie C. Thompson, MD, MPH

Calum D. Gray, PhD

Charlene Hamid, BA

Tom MacGillivray, PhD

Stephen P. Yoon, BS

Andy Liu, MD, MS