Retinal thickness and microvascular pattern in early Parkinson's disease

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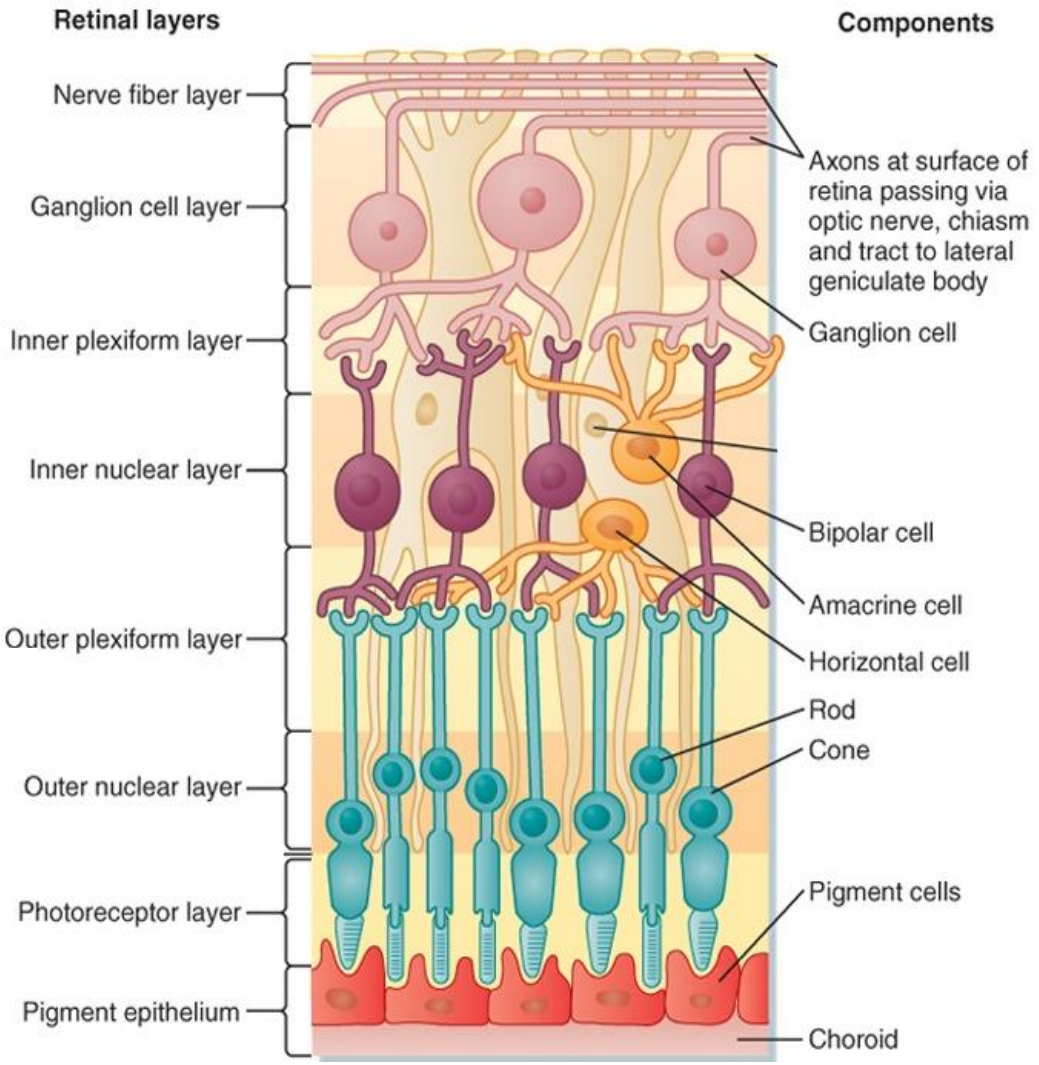
BACKGROUND

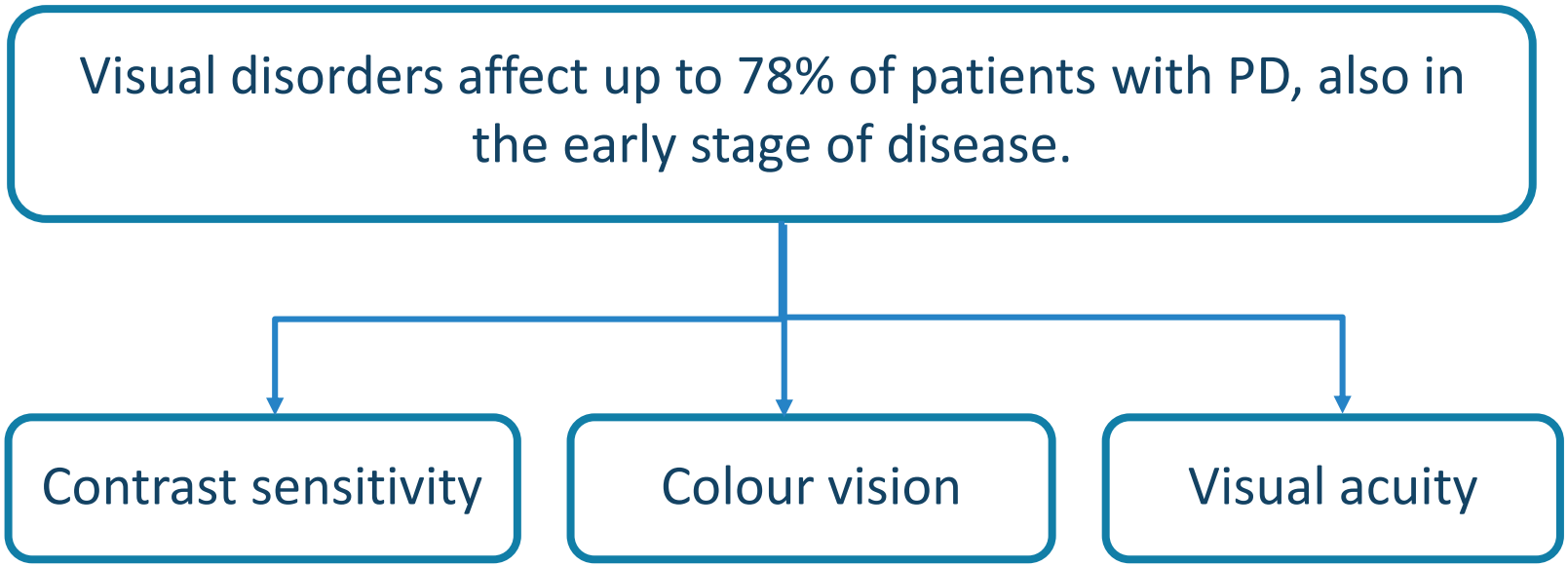
In the human retina **dopamine is** physiologically **released by amacrine cells** (ACs), sited in the inner nuclear layer (INL) *[Ivan Bodis-Wollner, 2013].*

Dopamine modulated ganglionic cells (GCs) visual signaling *[Ivan Bodis-Wollner, 2013].*

Dopamine is **decreased in** the retina of **PD** patients *[Nguyen-Legros et al, 1988; Ghilardi et al, 1988; Harnois et al, 1990]*



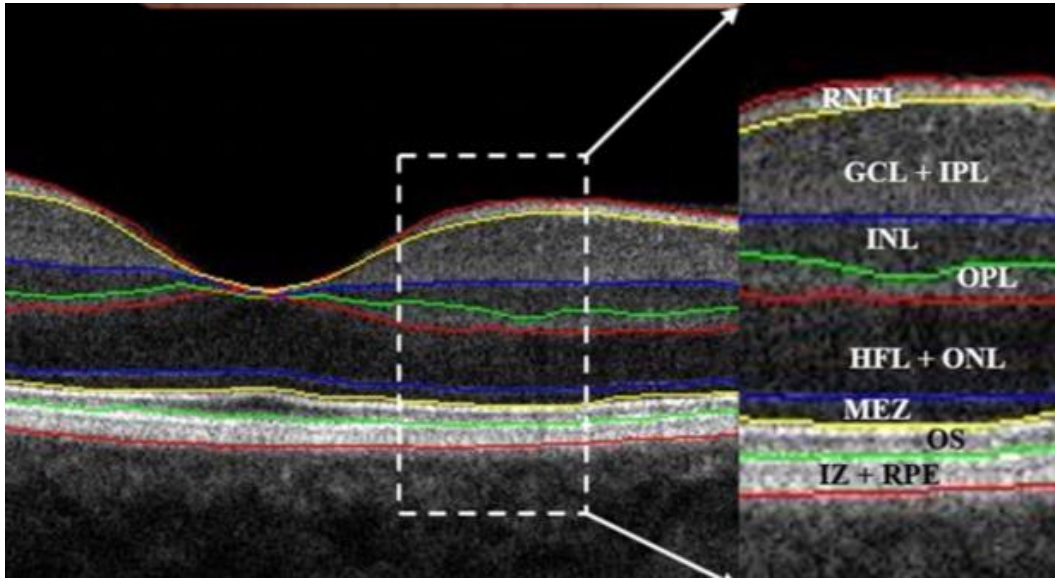
BACKGROUND



Ming et al, 2016; Weil et al 2016; Guo et al, 2018; Turcano et al 2018.

BACKGROUND

Several spectral-domain optical coherence tomography (SD-OCT) studies reported a **thinning of intraretinal layers** in PD patients compared to healthy controls (HC), especially in retinal nerve fiber layer (RNFL), ganglionic cells layer (GCL) and inner plexiform layer (IPL)



Inzelberg et al, 2004; Hajee et al 2009; Sari et al, 2015; Satue et al, 2016; Ahn et al 2018; Chrysou et al 2019.

BACKGROUND

PLOS ONE

RESEARCH ARTICLE

Evaluation of Retinal Vessel Morphology in Patients with Parkinson's Disease Using Optical Coherence Tomography

Robert Kromer[1☯‡*], Carsten Buhmann[2☯‡], Ute Hidding[2], Matthias Keserü[1], Diana Keserü[1], Andrea Hassenstein[1], Birthe Stemplewitz[1]

Impairment of retinal vasculature in PD patients compared to controls mainly due to changes of retinal veins.

- Retinal microvascular density decreased in PD patients.
- Correlation between microvascular impairment in the superficial retinal capillary layer and GCIP thinning.

Eye Movements, Strabismus, Amblyopia and Neuro-Ophthalmology

Retinal Microvascular Impairment in the Early Stages of Parkinson's Disease

William Robert Kwapong,[1] Hua Ye,[2] Chenlei Peng,[1] Xiran Zhuang,[1] Jianhua Wang,[3] Meixiao Shen,[1] and Fan Lu[1]

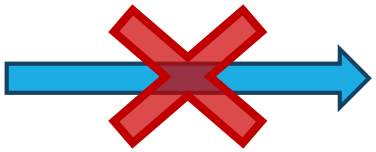
OBJECTIVE

To detect changes in retinal thickness and their possible correlates with microvascular pathway in early PD patients as compared to healthy controls

STUDY POPULATION

- Early PD patients*
  (n=21)

- Healthy controls
  (n=17)



EXCLUSION CRITERIA

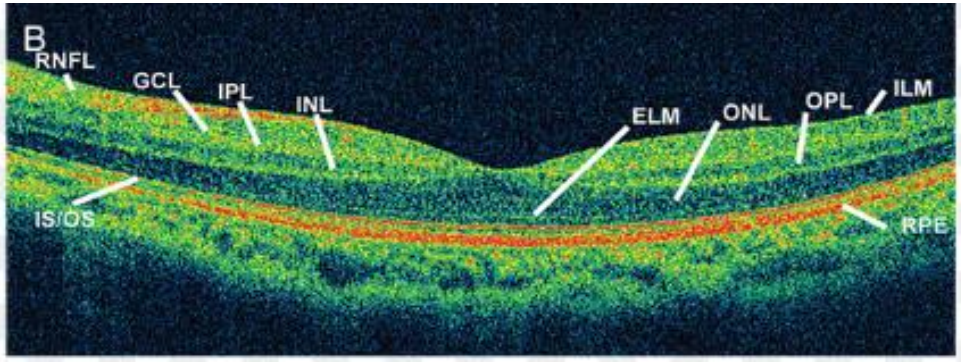
- Concurrent retinal diseases
- Concurrent ocular disease
- Intraocular pression > 21 mmHg
- Neurological diseases
- Systemic diseases impairing visual system:
  - Mellitus diabetes,
  - Uncontrolled hypertension/hypotension,
  - Cardiovascular diseases.

* According to UK-Brain-Bank criteria

MATERIALS AND METHODS

✓ Segmentation analysis of retinal layers

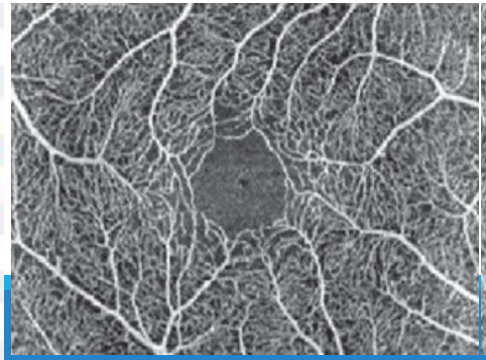
Spectral-Domain Optical Coherence Tomography (SD-OCT)

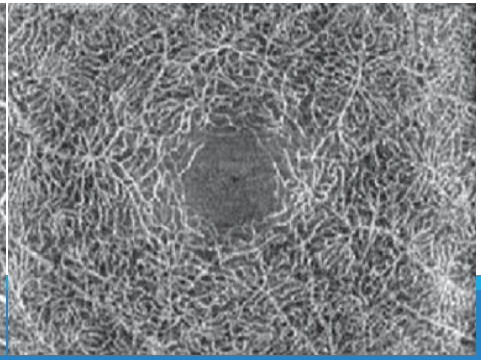


✓ Retinal microvascular pattern

Optical Coherence Tomography Angiography (OCT-A)

- Superficial capillary plexus (SCP)
- Deep capillary plexus (DCP)





RESULTS

A. Descriptive analysis

	PD	HC	p-value
Sex			0.69
Men	12 (57.1%)	17 (51.5%)	
Women	9 (42.9%)	16 (48.5%)	
Age	61.52±6.46	64.55±10.25	0.24
Age onset	59.33±7.02	/	
Disease duration (m)	27.43±14.27	/	
HY	1.88±0.38	/	
UPDRS-ME	25.05±6.87	3±2.32	**<0.001**
MMSE	27±2.67	27.08±2.31	0.92
Hypertension			**0.007**
Yes	12 (57.1%)	7 (21.2%)	
Not	9 (42.9%)	26 (78.8%)	
LD			
Yes	11 (52.4%)	/	
Not	10 (47.6%)		

RESULTS

B. Retinal segmentation analysis using SD-OCT in PD patients and healthy controls. Univariate and multivariate analysis

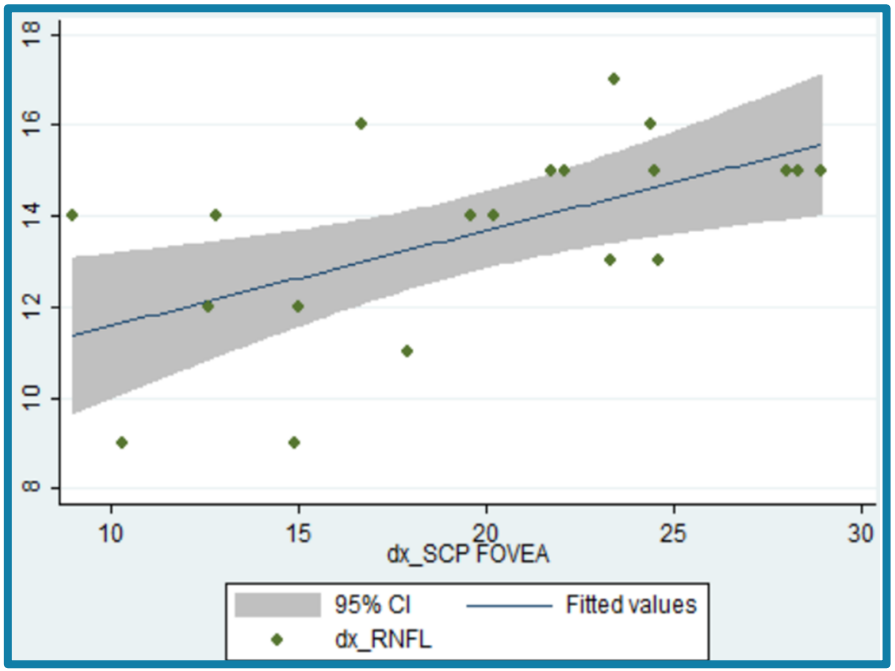
	MULTIVARIATE ANALYSIS		
	OR	**p-value**	**CI 95%**
Retina	-	-	-
RNFL	0.41	**0.001***	0.25-0.70
GCL	0.53	**<0.001***	0.37-0.75
IPL	0.64	**0.008***	0.46-0.89
INL	0.73	**0.004**	0.59-0.90
OPL	0.86	0.06	0.74-1.01
ONL	0.89	**0.003**	0.83-0.96
EPR	-	-	-
NOG	0.88	**0.003***	0.81-0.96
NOG Sup	0.93	**0.01**	0.87-0.98
NOG Temp	0.91	**0.02**	0.83-0.99
NOG Inf	-	-	-
NOG Nas	0.93	0.05	0.86-1.00

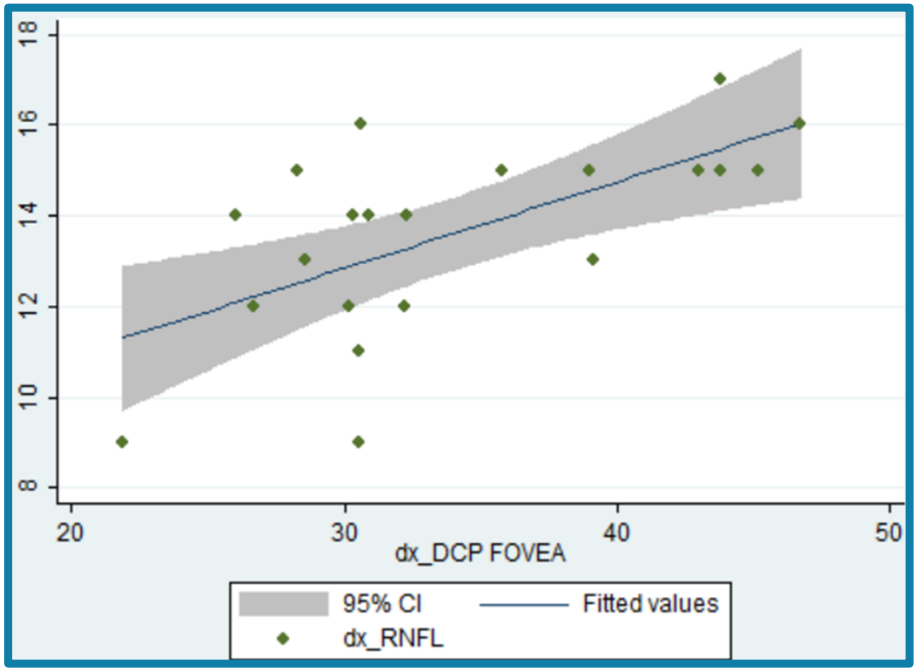
Legend: multivariate analysis, logistic regression, adjusted for age, sex and hypertension.
Note: * p-value < 0.05 adjusting for age, sex, hypertension and treatment with levodopa

RESULTS

Correlation between retinal layers thickness and SCP and DCP

A. Correlation between RNFL and foveal SCP and DCP.





r: 0.58 (0.18),
p-value: 0.005 (0.05)

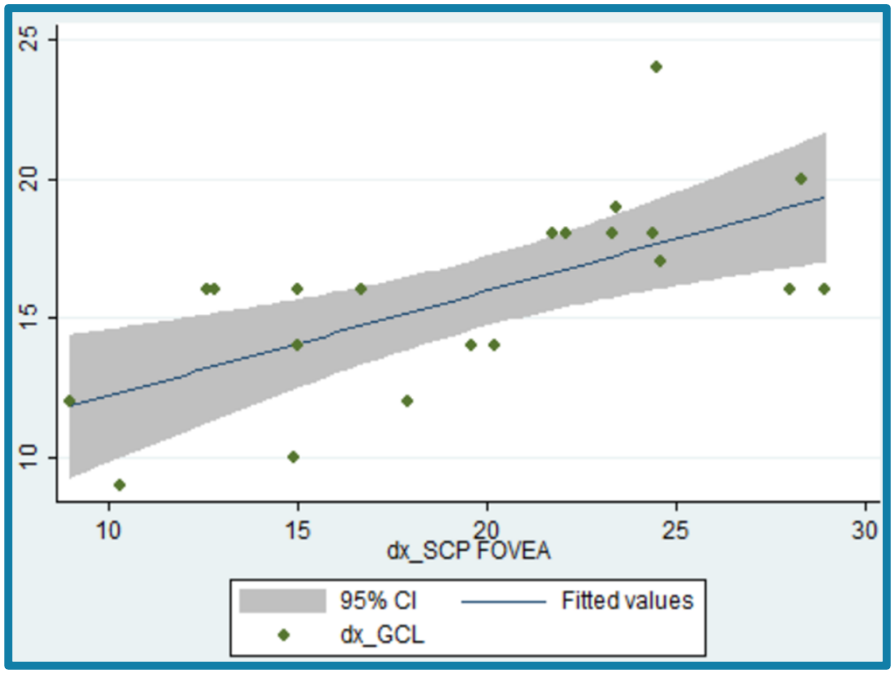
Note: in brackets values adjusted for age, sex and hypertension.

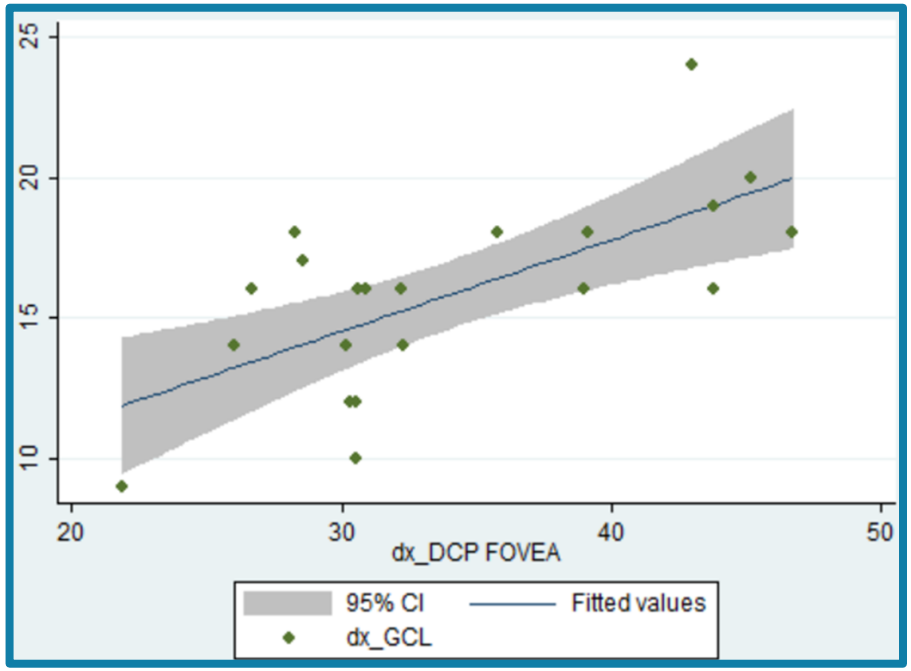
r: 0.63 (0.18),
p-value: 0.002 (0.04)

RESULTS

Correlation between retinal layers thickness and SCP and DCP

B. Correlation between GCL and foveal SCP and DCP





r: 0.65 (0.37**),**
p-value: 0.001 (0.006)

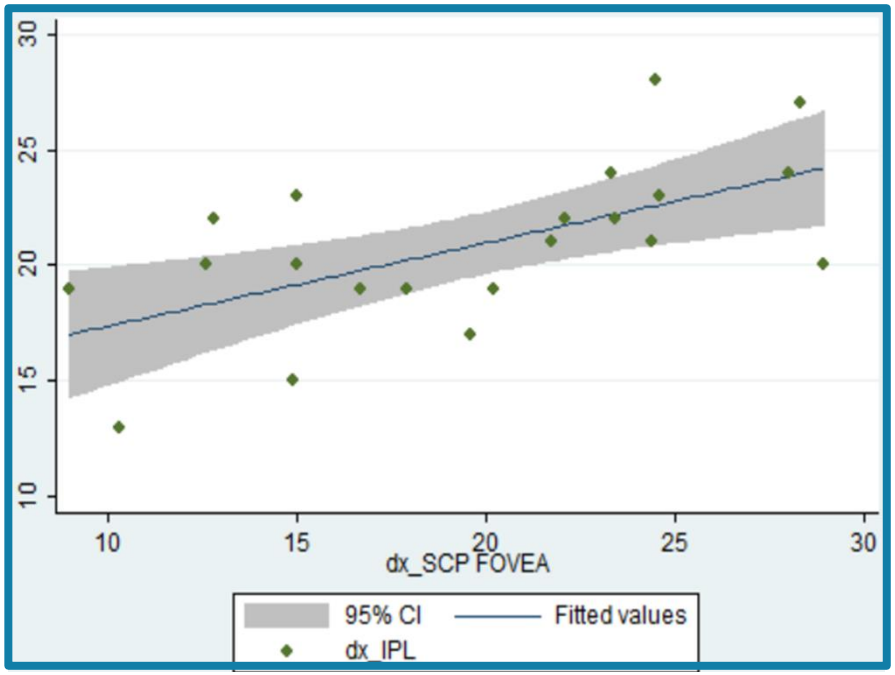
Note: in brackets values adjusted for age, sex and hypertension.

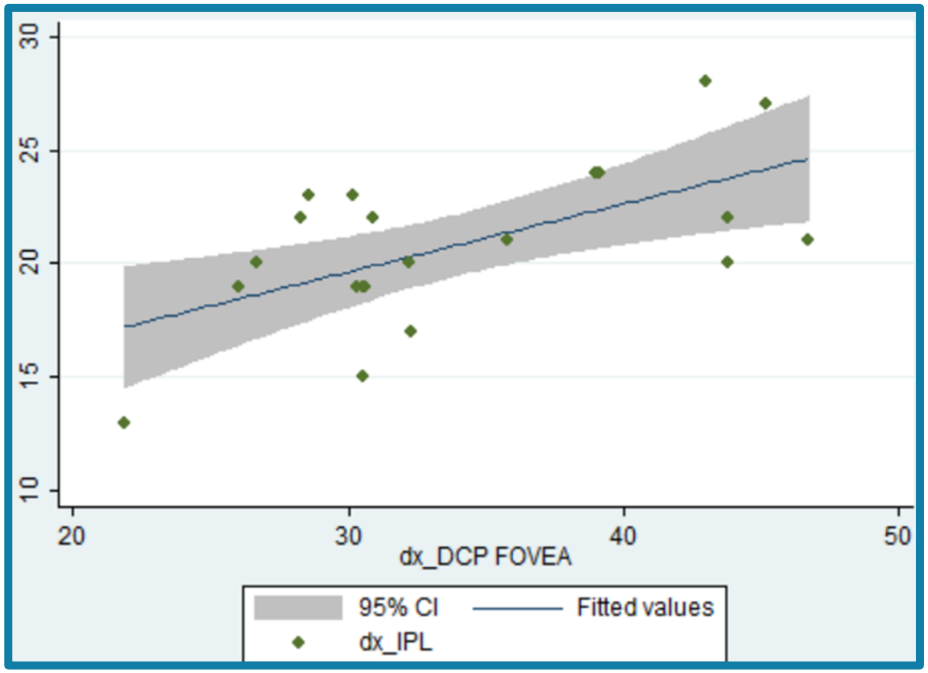
r: 0.68 (0.32),
p-value: <0.001 (0.02)

RESULTS

Correlation between retinal layers thickness and SCP and DCP

C. Correlation between IPL and foveal SCP and DCP





r: 0.61 (0.35),
p-value: 0.003 (0.02)

Note: in brackets values adjusted for age, sex and hypertension.

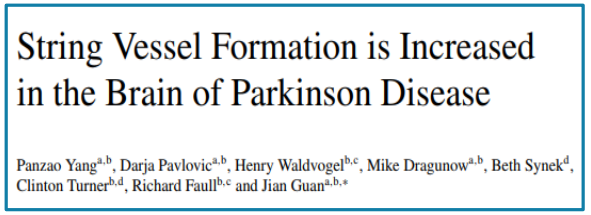
r: 0.61 (0.34),
p-value: 0.004 (0.02)

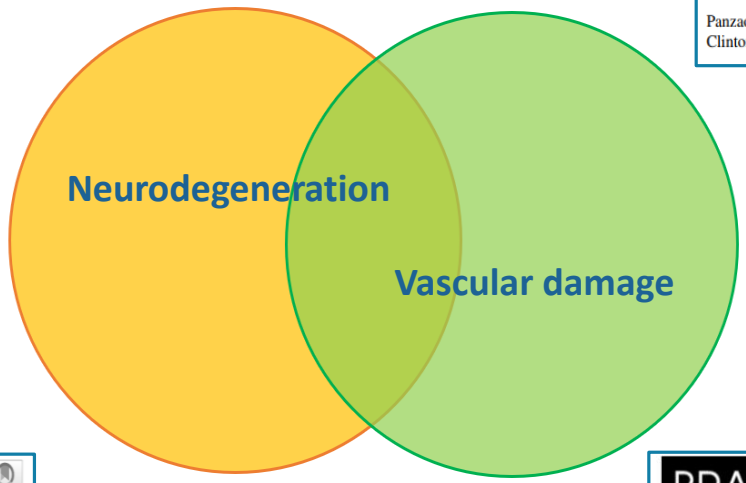
DISCUSSION AND CONCLUSION

✓ A thinning of intraretinal layers was found in PD patients compared to healthy controls, irrespective of dopaminergic treatment.

✓In PD patients an interesting positive correlation was found between microvascular density and inner retinal layers thickness in the foveal region.

DISCUSSION AND CONCLUSION





CONCLUSION

Retina as Biomarker for PD?

J Parkinsons Dis. 2014;4(2):197-204. doi: 10.3233/JPD-130306.

Optical coherence tomography in Parkinson's disease: is the retina a biomarker?

Lee JY[1], Ahn J[2], Kim TW[2], Jeon BS[3].

Mov Disord. 2015 Oct;30(12):1692-5. doi: 10.1002/mds.26411. Epub 2015 Sep 4.

A novel retinal biomarker for Parkinson's disease: Quantifying the foveal pit with optical coherence tomography.

Slotnick S[1,2], Ding Y[3], Glazman S[4], Durbin M[5], Miri S[6], Selesnick I[3], Sherman J[2], Bodis-Wollner I[4,7,8].

Nat Rev Neurol. 2016 Oct;12(10):555. doi: 10.1038/nrneurol.2016.138. Epub 2016 Sep 2.

Parkinson disease: Retinal changes could be an early marker of PD.

Malkki H.

Retina is a **«window to the brain»** and it is easy to visualize using noninvasive methods