

Background

- Diabetes can have profound effects on vision through changes to the neurons and vasculature in the retina.^{1,2}
- To prevent these vision threatening changes, such as diabetic retinopathy and edema, early detection of retinal changes is key.
- One potential biomarker for early change in the retina is alteration in retinal oxygen saturation.

Purpose

The purpose of this study is to characterize differences in retinal tissue oxygen saturation and superficial vascular density in controls and subjects with type 2 diabetes without retinopathy (DM).

Methods

HbA1c values

Diabetes status was determined following HbA1c testing (Siemens Analyzer): Controls < 5.7%, pre-diabetes 5.7%-6.4%, diabetes >6.4% or on diabetic medication. For this study the grouping was subjects with and without type 2 diabetes.

Macular Retinal Oximetry

Retinal oximetry (Zilia) measurements (300um) of the right eye, within the macula at 3.1 degrees from the fovea: sup/temp, inf/temp, sup/nasal, inf/nasal, were averaged together. (See figure 1 and 2)

Optical Coherence Tomography Angiography (OCTA)

OCTA imaging (Zeiss Cirrus) were completed for the majority of subjects; 26 of the 36 subjects were included in this analysis. Superficial capillary plexus (SCP) slabs were analyzed with ImageJ for density and compared between groups and correlated with oximetry metrics. (See figure 3.) Foveal avascular zone was measured and considered for SCP analysis.



Figure 1. Zilia retinal oximetry fundus camera, Quebec, Canada

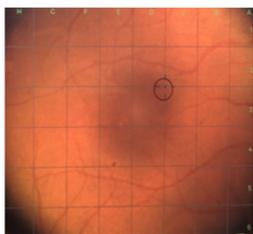


Figure 2. Single macular sup/nasal oximetry measurement



Figure 3. ImageJ inverted OCTA image

Results

Subjects

Duration of DM was noted for all subjects with diabetes.

	N	M:F	Age	HbA1c (%)
*Controls	20	11:9	49 ± 10	5.5 ± 0.4
Diabetes	16	8:8	54 ± 7	7.3 ± 0.7

Table 1. Subject demographics, *Includes 5 subjects with prediabetes

Summary of results:

The relationship between saturation and duration showed that as duration of diabetes lengthens, oxygen saturation increases. (See figure 4)

The relationship between saturation and density showed that as density decreases, oxygen saturation increases. (See figure 5)

No differences were seen in percent oxygen saturation between controls and subjects with diabetes (See figure 6)

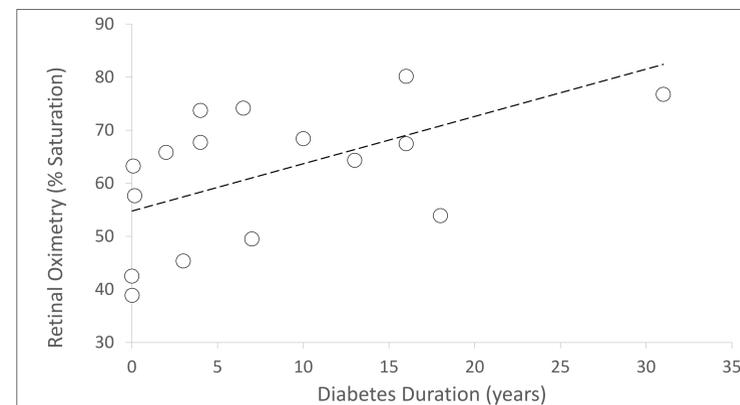


Figure 4. Diabetes duration vs averaged retinal oxygen saturation, p = 0.049

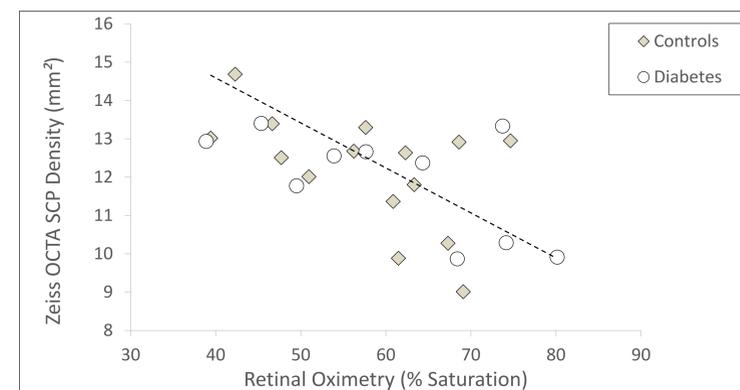


Figure 5. Averaged retinal oxygen saturation vs SCP vessel density, p = 0.003

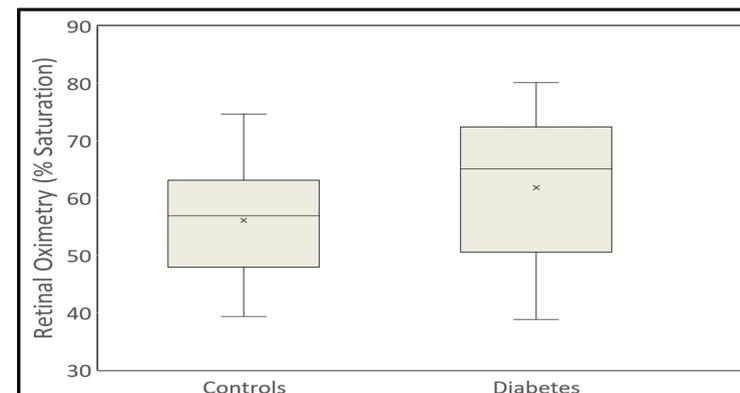
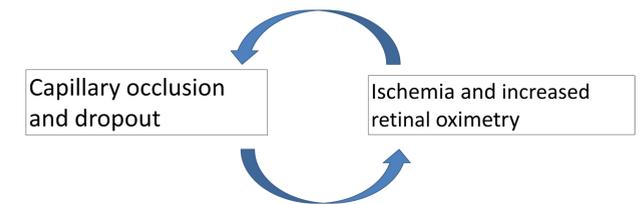


Figure 6. Averaged retinal oxygen saturation in controls and subjects with diabetes P = 0.32, All available oximetry data

Discussion

Macular Oxygen Saturation and Capillary Density Appear Correlated



Additional investigation is needed to help determine if structural or functional change appears first within the capillary beds

Data Suggests Increased Retinal Oxygen Saturation is Associated with Duration of Disease

These data correlate well with established literature:

Duration of disease is associated with retinopathy severity^{3,4}

Increased arterial and venous retinal oxygen saturation in large, peripapillary vessels are also associated with retinopathy severity^{5,6}

Conclusion

Retinal oxygen saturation may be a potential biomarker for early change in the diabetic retina

A larger sample size is needed, as this is an ongoing study.

Longitudinal data are needed to tease out the oxygen saturation metric in subjects with diabetes

Additional subjects with retinopathy are needed to better determine a timeline in the oxygen saturation/duration relationship

References

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