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# Retinal Oxygen Saturation Measurements - Repeatability and Influence of Vessel Diameter -



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## Purpose

Retinal oxygenation is believed to be disturbed in several common diseases. Measurements of retinal vessel oxygen saturation have been found to depend on vessel diameter [Beach et al. 1999, Hammer et al. 2008]. The purpose of the study was

1. to test whether retinal vessel oxygen saturation measurements are affected by vessel diameter.
2. to test the repeatability of oxygen saturation measurements

## Methods

The retinal oximeter (Oxymap ehf., Reykjavik, Iceland) is composed of a fundus camera, beam splitting optics and two digital cameras.



Figure 1. The retinal oximeter.

The oximeter simultaneously yields two images of the same area of the fundus, one with 570nm light and one with 600nm. Calculated light absorbance is used to estimate hemoglobin oxygen saturation.

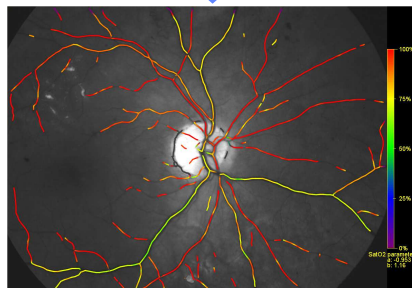
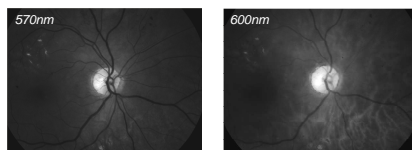


Figure 2. A color-coded map of hemoglobin oxygen saturation is generated automatically from images, taken simultaneously at 570nm and 600nm.

Fundus images of 12 healthy individuals were obtained with the retinal oximeter.

### 1. Vessel diameter and saturation measurements:

Oxygen saturation was measured in first and second degree vessels (parent and daughter vessels) and the ratio compared to the theoretical value of 1 (see figure 3).

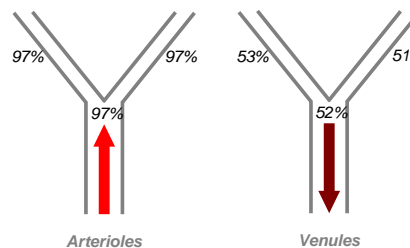


Figure 3. Close to a bifurcation, the ratio of saturation values (parent /daughter vessel) should be one in retinal arterioles. In venules, the average of two ratios should be close to one. Deviations from the theoretical value are most likely due to an effect of vessel diameter on saturation measurements.

### 2. Repeatability of saturation measurements:

Oxygen saturation was measured twice in the same vessel segment and the standard deviation between the measurements calculated (ANOVA).

## Results

### 1. Vessel diameter and saturation measurements:

- The ratio of oxygen saturation in the first degree arteriole to saturation in second degree arterioles was  $0.97 \pm 0.02$  ( $n=12$ , mean  $\pm$  SD).
- The corresponding ratio for venules was  $0.90 \pm 0.04$ .
- Both ratios were significantly different from 1.00 ( $p < 0.001$ ).

### 2. Repeatability of saturation measurements:

- The standard deviation between repeated measurements was 1.5% and 3.5% for first degree arterioles and venules, respectively.
- The corresponding value was 0.9% for second degree arterioles and 4.3% for second degree venules.

## Conclusions

### 1. Vessel diameter and saturation measurements:

Oxygen saturation measurements depend on the vessel diameter where narrower vessels show higher oxygen saturation. This agrees with previous reports by Beach et al. and Hammer et al. Vessel diameter measurements in the data allow this offset to be corrected.

### 2. Repeatability of saturation measurements:

Oxygen saturation measurements in first and second degree vessels show good repeatability.

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