

# Optical Coherence Tomography Angiography (OCTA) in Retinal Vein Occlusions (RVOs): useful in Clinical Practice?

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## INTRODUCTION

This retinal microvasculature is arranged into 2 interconnected plexi: the superficial capillary plexus (SCP) and the deep capillary plexus (DCP) (Kaidonis *et al.*, 2017). Capillaries of the SCP and DCP encircle the fringe of the fovea, demarcating a capillary free foveal avascular zone (FAZ). Fluorescein angiography provides excellent visualisation of the retinal vasculature, but cannot differentiate between the SCP and DCP, while OCTA allows viewing of the SCP and DCP separately. This study was a retrospective real world investigation, with two main aims:

- **Aim 1: In RVOs, do the OCTA parameters of (FAZ) area and perimeter, and SCP and DCP capillary density, differ between eyes with RVOs and their fellow eyes?**
- **Aim 2: Do OCTA parameters at baseline predict best corrected visual acuity (BCVA) in 3 months?**

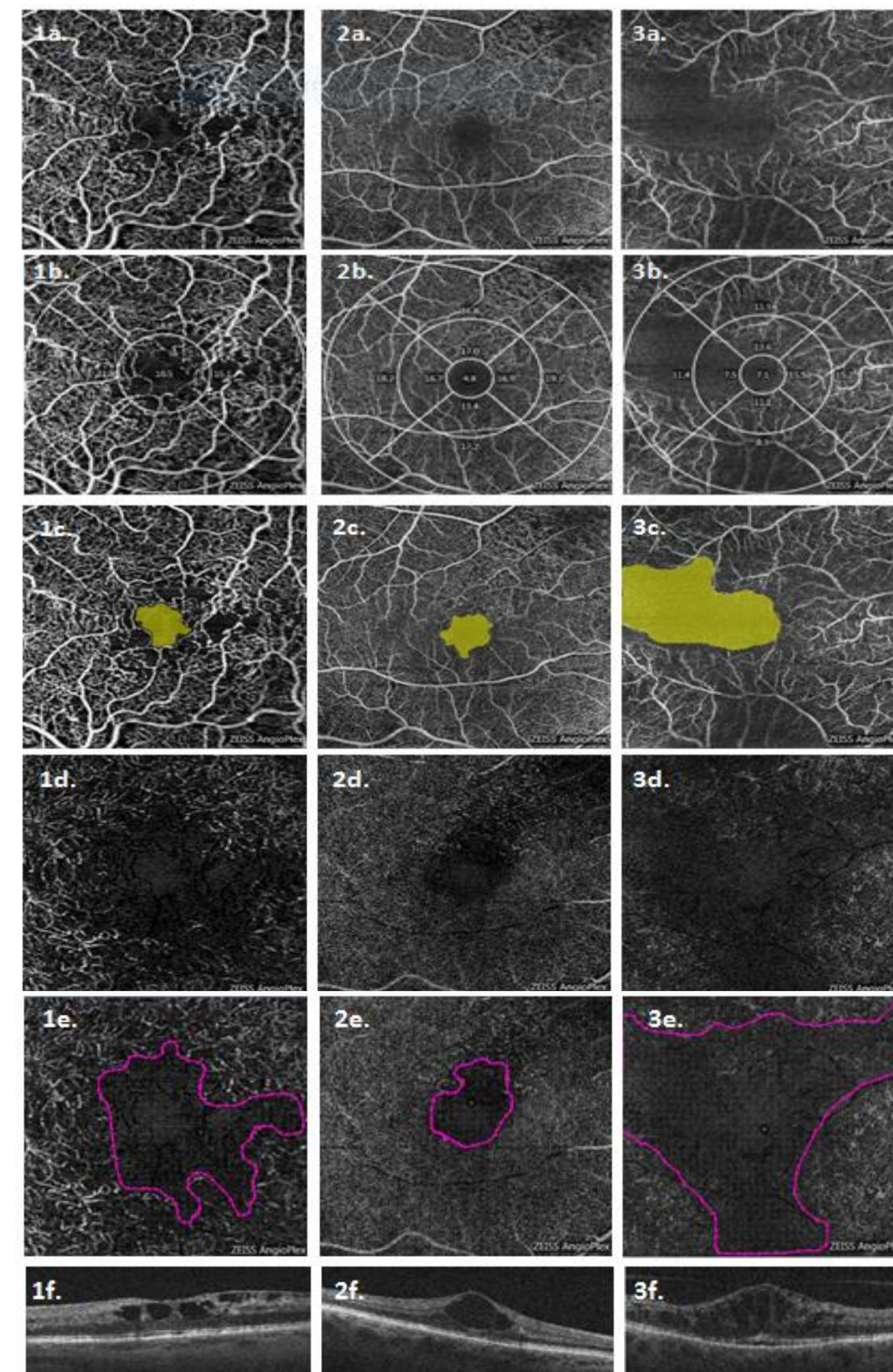
## METHODS

Patients newly diagnosed with RVOs attending the Belfast macular clinic had OCTA (Zeiss AngioPlex OCTA system version 2015.100.0.35) scans as part of their routine clinical care. Eyes were excluded from this analysis if ocular pathology other than RVO impaired visual acuity or rendered scans unreadable, as judged by the investigator. Data were collected on age, type of RVO, estimated duration since onset of RVO, presence or absence of diabetes mellitus (DM) or hypertension, and BCVA at baseline. OCTA parameters measured for both 3x3mm and 6x6mm scans were: capillary density (SCP), FAZ area, FAZ perimeter length, FAZ circularity index. BCVAs were measured using an ETDRS chart by hospital optometrists.

For aim 1, the Wilcoxon signed rank test was used to compare affected and unaffected eyes. A 2-tailed p-value of <0.05 was considered statistically significant.

For aim 2, a Spearman correlation coefficient was calculated for each OCTA parameter at baseline with BCVA at 3 months. Those with significant correlation were then entered into a linear regression model as predictors, along with BCVA as the independent variable. Through manually controlled stepwise elimination, insignificant predictor variables were removed, leaving a model consisting of only predictors that significantly contributed to the variance of the model/the R Squared.

The Zeiss AngioPlex OCTA system automatically calculated SCP parameters, while DCP FAZ area and perimeter were calculated manually using Sketchandcalc™. Whether 3x3mm or 6x6mm scans were taken, or both, was at the discretion of the imaging technicians. See figure 1.



**Fig 1. Illustrative examples of scans from included patients.**

Column 1: CRVO. Column 2: BRVO. Column 3: CRVO.

Row a: SCP images

Row b: ETDRS grids superimposed

Row c: Zeiss software automatically generated outline of SCP FAZ, including an 'off-window' example in column 3.

Row d: DCP images.

Row e: DCP FAZ drawn manually using 'Sketchandcalc™'.

Row f: Corresponding OCTs

## RESULTS

Included were 84 eyes from 43 subjects: 19 eyes with CRVO and 18 fellow unaffected eyes, and 24 eyes with BRVO and 23 unaffected fellow eyes. The mean age was 69.1 years. Forty four point two percent of OCTA scans were obtained >6 months after the occlusive episode and 2 patients had had anti-VEGF injections previously. Of the 19 CRVO patients, 11 (58%) had 3x3mm scans, 17 (89%) had 6x6mm scans and 9 (47%) had both. Of the 24 BRVO patients, 11 (46%) had 3x3mm scans, 22 (92%) had 6x6mm scans and 23 (96%) had both. After their baseline visit and scan, 30 had intra-vitreous anti-VEGF or steroid injections.

### **Aim 1. Do OCTA parameters differ between eyes with RVOs and their fellow eyes? Significant results are as follows:**

**For CRVOs**, in affected compared to unaffected fellow eyes:

- in the SCP: - FAZ area (3x3mm) and FAZ perimeter (3x3mm & 6x6mm) were sig. higher (Z=-2.240, p=0.025; Z=-2.429, p=0.015; Z=-2.756, p=0.006 respectively)

- Capillary density (3x3mm) and FAZ circularity (6x6mm) were sig. lower (Z=-0.521, p=0.012; Z=-3.070, p=0.002 respectively)

- in the DCP, FAZ perimeter was sig. higher (6x6mm) (Z=-0.267, p=0.008)

**For BRVOs**, in affected compared to unaffected fellow eyes:

- in the DCP, FAZ area (3x3 & 6x6mm) and FAZ perimeter (3x3 & 6x6mm) were sig. higher (Z=-0.560, p=0.004; Z=-1.887, p=0.001; (Z=-1.120, p=0.003; Z=-2.667, p=0.001 respectively)

### **Aim 2. Do OCTA parameters at presentation predict BCVA at 3 months in affected eyes?**

**For CRVOs:**

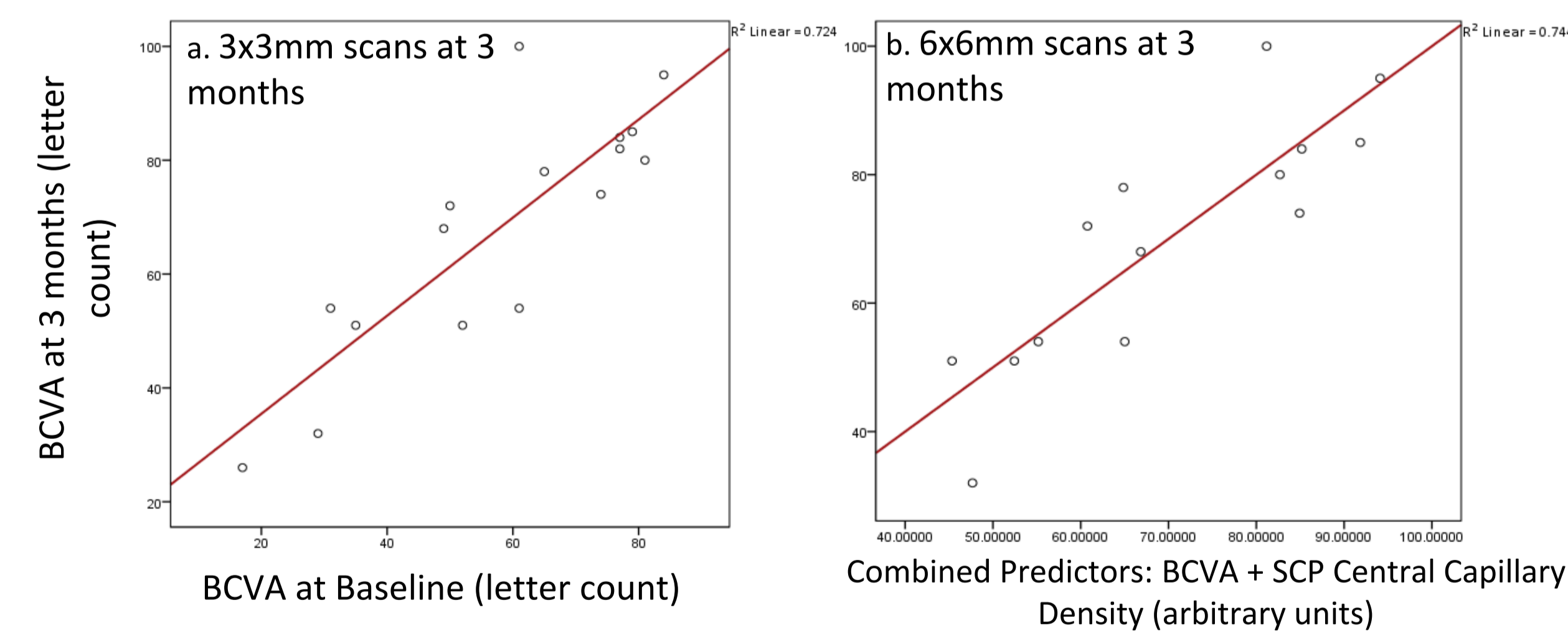
- 3x3mm scans: baseline BCVA ( $\beta=0.798$ , p=0.002), but no OCTA parameters, predicted 3 month BCVA

- 6x6mm scans: baseline BCVA ( $\beta=0.75$ , p=0.001), and SCP central capillary density ( $\beta=1.665$ , p=0.044) predicted 3 month BCVA

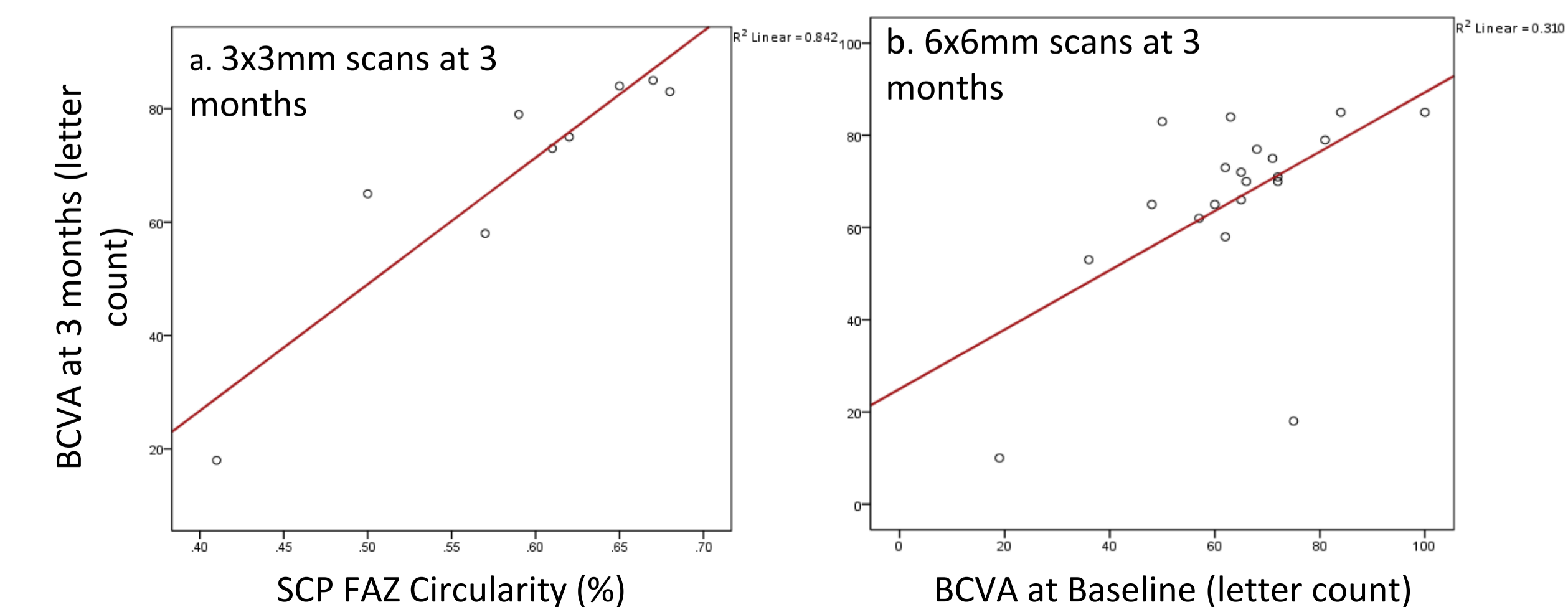
**For BRVOs**

- 3x3mm scans: SCP FAZ circularity predicted 3 month BCVA ( $\beta=223.240$ , p=0.000)

- 6x6mm scans: BCVA at baseline, but no OCTA parameters predicted 3 month BCVA



**Fig 2. Scatter graphs to illustrate regression models showing linear relationship between predictors and BCVA at 3 months in CRVO.**



**Fig 3. Scatter graphs to illustrate regression models showing linear relationship between predictors and BCVA at 3 in BRVO.**

## DISCUSSION

OCTA is a non invasive method of imaging the retinal vasculature. Its clinical utility in RVOs remains to be established.

### **CAPILLARY DENSITY**

Overall capillary density in 3x3mm scans was lower in affected CRVO eyes than in unaffected eyes. This is expected since CRVO impairs perfusion to all quadrants of the retina (Bradvice *et al.*, 2012). However no difference was found in capillary density in 6x6 scans, perhaps because the higher resolution of 3x3mm scans might allow better capture of subtle or early vessel density changes more readily than 6x6mm scans.

In our study in BRVOs there were no significant difference in SCP capillary density overall: BRVOs affect only one half of the fovea. However capillary density in the SCP has found to predict 6 months BCVA in RVOs, along with baseline central retinal thickness and baseline BCVA (Meiía *et al.*, 2022).

Note the Zeiss OCTA software used in this study is unable to calculate capillary density in the deep vascular plexus.

### **FAZ PARAMETERS**

A lower FAZ circularity index is due to a more irregularly shaped FAZ perimeter, seen if there is disruption of the terminal capillary ring when there is less perfusion of the fovea. In our study, in 6x6mm scans for both CRVO and BRVO, the circularity of the FAZ was lower in affected than unaffected eyes. Furthermore, in our sample, in BRVOs the circularity of the SCP FAZ in 3x3mm scans was predictive of BCVA at 3 months. SCP FAZ circularity may be a useful measure of perfusion in RVOs. Tang *et al* (2017) argued that the micro-vascular damage and probable ischaemia, are more related to vision, than the actual size of the FAZ.

### **PREDICTORS OF BCVA**

While the SCP FAZ circularity index may be useful, as Rehak *et al* (2016) found, the best prognostic factor for future BCVA in RVOs may simply be baseline BCVA. Further work is needed to determine what, if any, OCTA parameters add prognostic value.

## CONCLUSION

This real world study explored the potential clinical significance of SCP and DCP measurements. While baseline BCVA was the best predictor of visual prognosis, FAZ circularity on OCTA may be important. This study was retrospective and exploratory: ultimately, how OCTA parameters can be used to offer a more accurate prognosis for RVO patients requires larger prospective studies, and indeed a systematic review on this topic may be timely.

### **References.**

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