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Superficial and deep retinal foveal avascular zone OCTA findings of non-infectious anterior and posterior uveitis compared to healthy controls.

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Purpose

To compare the superficial (FAZ-S) and deep retinal foveal avascular zones (FAZ-D) of non-infectious anterior and posterior uveitis to healthy controls, using optical coherence tomography angiography (OCTA)[1,2] and correlate these measurements with the best corrected visual acuity (BCVA).

Study Design and Methods

Prospective multi-centered observational cross-sectional study of 74 eyes was performed: 45 eyes of patients suffering either from non-infectious posterior or anterior uveitis with and without the presence of macular edema and 29 healthy control eyes were examined in January 2017 in two centres for ophthalmology (University Eye Hospital Basel, Switzerland and Pitié-Salpêtrière Hospital, Sorbonne Universities of Paris, France). This study was approved by the local authorities with a positive vote for prospective observational investigations (**trial number EKNZ BASEC 2017-00937**). OCTA was performed on 34 eyes suffering from non-infectious posterior uveitis (26 eyes without macular edema (post-CME), 8 eyes with macular edema (post+CME)), 11 eyes with non-infectious anterior uveitis (6 eyes without macular edema (ant-CME) and 5 eyes with macular edema (ant+CME). The control group included a group of 29 healthy eyes. All uveitis patients underwent a thorough ophthalmological examination by experienced fellowship-trained uveitis specialists (B.B., N.M., C.T.) with BCVA (logMAR), fluorescein angiography, SD-OCT and OCTA.

OCTA imaging:

30° x 30° OCTA scans centered around the fovea were performed with a non-invasive system; OCT angiography is a module producing detailed three-dimensional representations of the perfused retinal and choroidal vasculatures with the Heidelberg HRA2 Spectralis OCTA device (Heidelberg Engineering Germany). The FAZ-S was defined as the vessel-free zone within the superficial vascular plexus localized between the inner limiting membrane (ILM) and the inner plexiform layer (IPL) of the retina. The FAZ-D was defined as the vessel-free zone within the deep vascular plexus localized between the inner plexiform layer (IPL) and the outer plexiform layer (OPL) of the retina. The measurement of the avascular area in mm^2 was performed via the software's ruler tool of the Heidelberg software.

Statistics:

For data analysis ANOVA-based linear mixed-effects models were calculated with SPSS® for Windows® (Version 17.0, SPSS Inc. Chicago IL). These models are suitable for repeated measurements, also both eyes can be taken into account as covariates. Pairwise comparisons were Bonferroni corrected. A statistical level of $p<0.05$ was required. Data are presented as median +/- SD and as box plot analysis. In addition, we calculated a linear regression analysis for the correlation between FAZ and BCVA in logMAR.

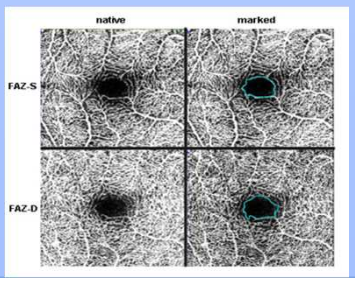


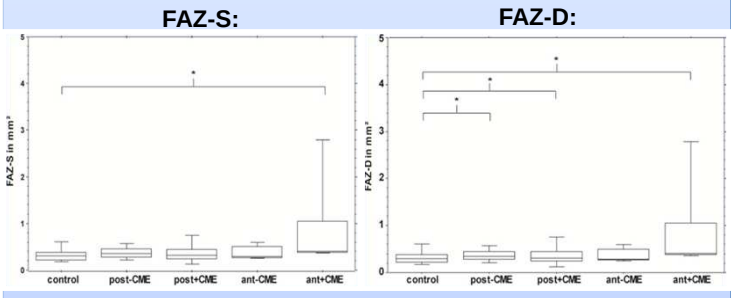
Figure 1. OCTA scan centered around the fovea showing the FAZ-S (upper panel) and FAZ-D (lower panel) in a healthy control eye as native images (left side) and marked zones (right side). The light blue marker represents the measurement of the avascular area in mm^2.

Results

group	sub-group	BCVA (logMAR)	Age (years)	N (number of eyes - number of participants - number of males)			FAZ-S (median±SD)	FAZ-D (median±SD)
Controls	all	0.00 ± 0.01	29.6 ± 9.3	29	19	7	0.30 ± 0.14	0.36 ± 0.13
post-CME	all	0.27 ± 0.43	40.8 ± 18.5	26	16	7	0.35 ± 0.13	0.52 ± 0.15
	MEWDS			1	1	0	0.21	0.30
	Sarkoidosis			3	2	2	0.52 ± 0.07	0.54 ± 0.02
	APMPPE			1	1	1	0.29	0.44
	Ampiginous			2	1	1	0.26 ± 0.04	0.45 ± 0.03
	MFC			4	2	0	0.32 ± 0.06	0.41 ± 0.11
	PIC			2	1	0	0.35 ± 0.00	0.48 ± 0.04
	BD			2	1	0	0.55 ± 0.03	0.62 ± 0.08
	etio-			9	6	3	0.37 ± 0.16	0.56 ± 0.20
	SLE			2	1	0	0.38 ± 0.13	0.60 ± 0.13
post+CME	all	0.24 ± 0.17	50.8 ± 12.9	8	6	1	0.31 ± 0.23	0.94 ± 1.15
	Sarkoidosis			3	2	0	0.25 ± 0.10	0.74 ± 0.25
	MFC			1	1	0	0.47	0.98
	etio-			2	2	1	0.31 ± 0.03	2.36 ± 2.36
	IRVAN			2	1	0	0.48 ± 0.56	1.29 ± 0.54
ant-CME	all	0.12 ± 0.12	33.9 ± 15.4	6	5	0	0.29 ± 0.15	0.44 ± 0.14
	etio-			4	3	0	0.40 ± 0.17	0.47 ± 0.15
	HLA B27			2	2	0	0.28 ± 0.01	0.37 ± 0.08
ant+CME	all	0.50 ± 0.36	42.1 ± 8.2	5	3	2	0.41 ± 1.07	2.27 ± 1.91
	etio-			3	2	1	0.31 ± 0.03	2.36 ± 2.36
	HLA B27			2	1	1	0.42 ± 0.08	0.77 ± 0.11

Table 1 – Demographic parameters

The median ± SD of FAZ-S and FAZ-D measured in mm^2 are shown for all subgroups and all etiologies which were included in the study: Anterior ('ant') and posterior non-infectious uveitis ('post') with the presence ('+CME') or absence of macular edema ('–CME').



Figures 2 & 3: Box Plot analysis illustrates the size of the FAZ-S and FAZ-D. The ordinate shows the FAZ in micrometers for healthy control eyes (left side), versus eyes undergoing non-infectious posterior and anterior uveitis with or without CME (right side) shown on the abscissa. Statistically significant results ($p<0.05$) of comparisons with the healthy control group are marked with an asterisk.

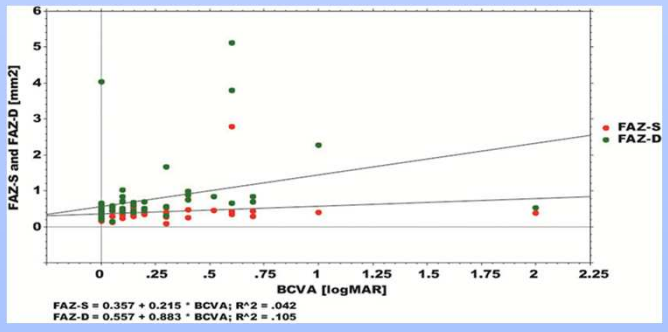


Figure 4: The scatterplot combined with linear regression analysis illustrates the correlation between the size of the FAZ-S and FAZ-D with the best corrected visual acuity (BCVA). The ordinate shows the FAZ-S (red) and FAZ-D (green) color-coded in mm^2 for all eyes examined with best corrected visual acuity shown on the abscissa. The linear function and correlation coefficients are included in the Figure in the bottom left corner. Note the low R^2 correlation coefficients for both, FAZ-S and FAZ-D, indicating that there is no strong linear correlation between the size of FAZ and BCVA.

Summary

In this propesctive study we tried to demonstrate in OCTA that eyes with non-infectious uveitis with or without CME presented with a higher FAZ-D when compared to the control group ($p< 0.001$), thus the result was also significant in eyes with anterior uveitis associated with CME in FAZ-S and FAZ-D versus controls ($p = 0.03$ and 0.001, respectively). However, we found neither a statistical significance between eyes with anterior uveitis without CME vs. controls ($p= 0.6$) nor a significant correlation between the size of the FAZ and BCVA.

Limitations

The limitations of this study include the small sample size, non-homogeneous etiologies, a short follow-up of BCVA and artifacts due to scan positioning errors caused by normal ocular microsaccades.

Conclusion

This preliminary study demonstrated that FAZ-D is enlarged in eyes with posterior non-infectious uveitis with or without CME. Nevertheless, future studies with a homogeneous and larger sample size will allow for a better understanding of the underlying pathophysiology.

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All other authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest.

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