Research Square

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Retinal and Choroidal Morphometric Analysis in Fellow Eye of Unilateral Wet Age related Macular Degeneration Using Optical Coherence Tomography Angiography

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Abstract

Background: Age-related macular degeneration (AMD) when associated with macular neovascularization can cause severe visual morbidity. This study aims to evaluate the retinal and choroidal microvascular alterations using optical coherence tomography angiography (OCTA) in eyes with unilateral wet age-related macular degeneration (AMD) termed as “affected eye” (AE) and compare it with their fellow eyes (FE).

Methods: This cross-sectional study included 60 patients (120 eyes) with age over 50 years. Vessel density (VD), perfusion density (PD), and foveal avascular zone (FAZ) in the superficial capillary plexuses (SCP), deep capillary plexus (DCP) and avascular layer were assessed using OCTA. Enhanced depth imaging was used to evaluate subfoveal choroidal thickness (SFCT) and choroidal vascularity index (CVI).

Results: The mean age was 73.9±9.54 years (51-89 years) with 51.7% male. Quantitative OCTA analysis showed no significant inter-eye differences in VD or PD in SCP or DCP ($p > 0.05$). However, FAZ was significantly enlarged in affected eyes compared with fellow eyes in SCP (0.91 ± 0.40 vs 0.64 ± 0.20 mm²; $p < 0.001$) and DCP ($p < 0.001$). FAZ enlargement in the avascular layer was not statistically significant (p 0.20). Pattern I macular neovascular membrane (MNV) was significantly associated with the shape, presence of anastomoses, and overall activity scores. Inter-eye differences choroidal parameters were statistically significant for SFCT (p 0.019), haller layer (p 0.014) and CVI ($p < 0.001$). AE status was significantly associated with age, smoking, and lens status.

Conclusion: FAZ enlargement represents the most sensitive OCTA parameter distinguishing AE from FE in unilateral wet AMD. OCTA-based assessment of FE may aid in detecting early microvascular alterations and guiding timely intervention as they exhibit early AMD changes, which may be potentiated by retinal and choroidal vascular insufficiency.

Introduction

Age-related macular degeneration (AMD) is a leading cause of vision loss in elderly, which rises exponentially when complicated by macular neovascularization.[1,2] AMD affects approximately 10% over 65 years, and increases to 25% after 75 years. In our region, it is the fourth leading cause of blindness with a prevalence of 5.3%.[3] It is a multifactorial disease, with age, genetics, race, gender, smoking, nutrition plays established roles, however the contribution of systemic co-morbidities remains controversial. [4,5]

AMD is broadly classified as dry and wet type. Dry AMD occurs with drusen accumulation and retinal pigment epithelium (RPE) dysfunction.[6] Wet AMD is caused by abnormal neovascular growth from the choriocapillaris causing subsequent leakage/hemorrhage leading to serous RPE detachment provoking scar.[7,8] Alteration of choroidal perfusion, vessel density and thickness are crucial for disease pathogenesis.[9,10,11]

Optical Coherence Tomography angiography (OCTA) enables non-invasive, depth resolved visualization of retina and choroidal microcirculation, allowing detailed assessment of superficial, deep capillary plexuses, choriocapillaris and foveal avascular zone (FAZ).[12,13,14,15] It has a significant advantage with blood flow visualization, therefore areas of choroidal ischemia, microvascular changes, precise localization and delineation of the lesion can be made.[15,16,17] This aids in earlier disease identification than conventional imaging and enhances the effectiveness of recent treatments.[18,19]

This study aims to determine the changes in retinal and choroidal layer in patients with wet AMD in affected eye (AE) and their fellow eyes (FE) in order to pickup the subtle changes and early disease process identification. As AMD primarily affects a vulnerable elderly population, early detection and timely intervention is crucial to prevent vision loss and preserve overall well-being.

Materials and Methods

This was a cross-sectional, hospital-based study conducted for a duration of one year in Retina clinic of Nepal Eye Hospital, Tripureshwor, including all the treatment naive, consecutive patients above 50 years with evidence of unilateral wet AMD termed as “Affected eyes” and their “Fellow eyes”. A total of 75 patients were examined, however the patients with presence of wet AMD in both eyes were excluded and only 60 patients (120 eyes) were included. The diagnosis of wet AMD in the affected eye was based on clinical examination, enhanced depth imaging (EDI) OCT and OCTA. On OCTA, the eyes with macular neovascular membrane (MNV) showed the scans of the outer retinal layer with a vascular network, where flow signals are normally absent. When outer retinal slabs showed faint flow signal, choroidal slabs were used as a reference. Exclusion criteria were maculopathy secondary to causes other than AMD. Diabetic and hypertensive patient included did not have maculopathy associated with the systemic diseases. High myopia (spherical equivalent >6 diopters, axial length ≥26.0 mm), glaucoma, ocular trauma, past intraocular surgeries of < 6 months, patients with solid organ transplants, patients under any treatment that lead to potential independent effects on the retinal microvasculature, poor OCTA images with a signal strength index (SSI) less than 50 due to motion artifacts or media opacities and disability to cooperate with image acquisition. Informed written consent was obtained prior to the enrollment. This study adhered to the tenant of the declaration of Helsinki and was approved by the institutional review committee of National Academy of Medical Sciences, Bir Hospital with reference number 33/2082/83.

Detailed clinical history including age, gender, presence of systemic disorders was taken. The ophthalmologic examination included best corrected Snellen visual acuity (BCVA). Slit lamp bio-microscopy of anterior as well as dilated posterior segment using 90 D and 20 D Volk biconvex lens was performed.

Each subject underwent OCTA imaging (OCTA; Spectralis OCTA, Heidelberg Engineering, Heidelberg, Germany) of both the eyes by the same examiner (OP). Light source used by this device was 870 nm superlumuinescent diode, providing A scans at a speed of 85,000 per second and the maximum scan depth was approximately 1.9mm. Axial resolution was 3.9 µm and lateral resolution 6 µm. Scan pattern used was 6*6mm for quantitative analysis of macular perfusion and choriocapillaris flow with A scan density of 512*512 pixels. The system employed the full spectrum amplitude decorrelation algorithm for

generating angiographic flow images. For correcting the motion artifact between the consecutive images, TrueTrack active eye tracking and motion correction technology was utilized.

Automated layer segmentation was performed using the Heidelberg Eye Explorer (HEYEX) software and manually verified by two masked graders. Superficial capillary plexus (SCP) was segmented between internal limiting membrane (ILM) to outer boundary of the inner plexiform layer (IPL). Deep capillary plexus (DCP) was segmented between an inner boundary of the IPL and outer boundary of the outer PL (OPL). Vessel density (VD) and perfusion density (PD) of SCP, DCP was performed for SCP, DCP and avascular layer centering the prafovea and FAZ perimeter was measured for SCP, DCP and avascular layer using the polygonal tool. Image processing and quantitative morphometric measurements were performed using ImageJ (National Institutes of Health, Bethesda, USA). Qualitative evaluation for the OCTA biomarkers of choroidal neovascularization (CNV) morphology was documented as described by Coscas et al. [20] Five criteria were considered to determine the pattern of MNV: shape, vessel branching, presence of anastomoses and loops, morphology of the vessel termini, presence of a perilesional hypointense halo (flow impairment, steal or localized atrophy). If a MNV lesion showed at least three of these features, it was assessed as Pattern I (active-recent lesion) and if it showed less than three criteria, it was considered as Pattern II (mature lesion).

A 1500-μm wide region centered on the fovea was selected from the outer border of the RPE to the inner scleral interface. The image was converted to 8-bit, and binarization was performed using Niblack's auto local thresholding and the total choroidal area (TCA) area was observed by measuring the luminal area (LA), color threshold was applied, and the CVI was computed as (LA/TCA) × 100. All measurements were independently performed by two masked observers, and the mean values were used.

For statistical purposes, BCVA was converted to the logarithm of the minimal angle of resolution (log MAR). Data was entered and analyzed using SPSS software (version 20, IBM Corp., Chicago, IL, USA). Descriptive statistics like means and standard deviation was applied for continuous variable. The significance of vessel density, perfusion density and FAZ perimeter was evaluated by paired t test. Correlation between OCTA parameters and choroidal thickness was assessed using Pearson's or Spearman's correlation coefficients. After the analysis, a p-value <0.05 was considered statistically significant.

Results

A total of 60 patients (120 eyes) with unilateral wet AMD were included with a mean age 73.9 ± 9.54 years (41–89 years). Male comprised 51.7% (n 31) and female were 48.3% (n 29). History of smoking was present in 63.3% (n 38). Systemic co-morbidities were present in 46.7% (n 28), most common was hypertension in 21.7% (n 13), type II diabetes mellitus in 18.4% (n 11), coronary artery disease in 3.4% (n 2), dyslipidemia in 1.7% (n 1) and chronic obstructive pulmonary disease in 1.7% (n 1). Mean visual acuity of affected eyes (AE) was 1.28 ± 0.50 and FE was 0.75 ± 0.59. Lens status as well as the fundus findings of the affected and the fellow eye is mentioned in Table 1.

Table 1
showing status of the lens and fundus findings

Parameters		Affected Eyes		Fellow Eyes	
		N	%	N	%
Lens	CLEAR	3	5.1	3	5.1
	CC	6	10.2	5	8.5
	NS	24	40.8	24	40.8
	PSCC			3	5.1
	PCIOL	27	45.9	25	42.5
Fundus Findings	WNL			27	45
	DRY			33	55
	MNV I	21	35		
	MNV II	28	46.6		
	MNV III	5	8.3		
	DISCIFORM SCAR	6	10		

CC Cortical cataract, MNV macular neovascular membrane NS nuclear sclerosis, PSCC posterior sub capsular cataract, PCIOL posterior chamber intraocular lens, WNL within normal limit

The most common MNV morphological pattern was glomerular in 35% (n 21) followed by seafan in 25% (n 15), dead tree in 25% (n 15), medusa head in 13.3% (n 8) and filament in 1.6% (n 1). The morphological patterns are shown in Fig. 1.

Pattern I MNV (active) was observed in 75% (n 45) whereas Pattern II MNV (inactive) in 25% (n 15). Pattern I MNV showed a significant association with lesion shape (p 0.026), presence of anastomosis (p 0.029), and higher overall activity score (p 0.001). Perilesional halo (p 0.15), vessel branching (p 0.17) and peripheral arcade (p 0.14) did not demonstrate significant association with MNV activity.

Quantitative OCTA analysis revealed modest inter-eye differences in VD and PD, with the affected eye demonstrating slightly reduced SCP VD (16.2 ± 9.7% vs 18.5 ± 13.1%) and PD (5.66 ± 3.0% vs 6.15 ± 3.6%) compared with the fellow eyes (Table 2), however, these differences were not statistically significant (VD: p = 0.28; PD: p = 0.41). DCP values were nearly identical between eyes for VD (18.7 ± 5.6% vs 19.1 ± 5.8%; p 0.65) and PD (7.74 ± 3.1% vs 7.99 ± 4.0%; p 0.69). In contrast, FAZ metrics demonstrated pronounced differences, with the affected eye exhibiting a substantially larger SCP FAZ area (0.91 ± 0.40 mm² vs 0.64 ± 0.20 mm²).

Table 2
showing Vessel Density, Perfusion density and FAZ of Affected eyes and their fellow eye

	SCP			DCP			AVAS
	VD (%)	PD (%)	FAZ (mm^2)	VD (%)	PD (%)	FAZ (mm^2)	FAZ (mm^2)
Affected eye	16.2 ± 9.7	5.66 ± 3	0.91 ± 0.4	18.7 ± 5.6	7.74 ± 3.1	0.56 ± 0.3	0.24 ± 0.1
Fellow eye	18.5 ± 13.1	6.15 ± 3.6	0.64 ± 0.2	19.1 ± 5.8	7.99 ± 4	0.42 ± 0.1	0.21 ± 0.1

DCP deep capillary plexus, FAZ foveal avascular zone, PD perfusion density, SCP superficial capillary plexus, VD vessel density

The paired t-test results for VD, PD and FAZ in the SCP, DCP, and avascular layer were performed which showed negative t-values, when AE was compared to the FE. Significant FAZ enlargement in both the SCP ($p < 0.001$) and DVC ($p < 0.001$) is observed, whereas avascular layer FAZ is enlarged with a positive t value (1.283) but did not reach significant level (p 0.20).

Inter eye clinical significance discrimination map is shown in Fig. 2, where left lower quadrant denotes the AE OCTA metrics cluster into a low discrimination zone, non significant and has high variability. The FE OCTA metrics in right upper quadrant denotes strong clinical discrimination and are statistically significant which indicated that the FE parameters are sensitive to subtle microvascular variations and clinically informative.

Choroidal parameters including SFCT, Haller layer thickness, Sattler layer thickness, and choroidal vascularity index (CVI) for affected and fellow eyes are summarized in Table 3.

Table 3
showing choroidal parameters of Affected and Fellow eye

Parameters	Sattler Layer (µm)	Haller Layer (µm)	Sub-foveal Thickness (µm)	Choroidal Vascular Index (%)
Affected eye	65 ± 30	99.8 ± 37.2	165 ± 62.2	39.1 ± 5.59
Fellow eye	70.9 ± 29	110 ± 41.5	181 ± 64.6	58.95 ± 5.36

Inter-eye differences in these parameters were statistically significant for SFCT (p 0.019), haller layer (p 0.014) and CVI ($p < 0.001$) as shown in Table 4.

Affected eye is significantly associated with age (p 0.04), smoking history (p 0.01) and lens status (p 0.05). Other parameters such as gender, race, and co-morbidities didi not have any association with affected eye.

Table 4
showing comparison of choroidal parameters of affected and fellow eyes

Comparison	T-Score	P-Value
AE vs FELLOW (CVI)	-16.55	< .001
AE vs FELLOW (HALLER)	-2.54	0.014
AE vs FELLOW (SFT)	-2.41	0.019
AE vs FELLOW (SATTLER)	-1.68	0.098

AE Affected eye, CVI choroidal vascular index, FE Fellow eye, SFT subfoveal thickness

Discussion

This prospective paired-eye OCTA study evaluated retinal and choroidal micro-vasculature in patients with unilateral wet AMD, with particular emphasis on differences between the AE and the FE. The key finding of our study is that FAZ enlargement, particularly in the SCP and DCP is the most sensitive parameter distinguishing AE from FE. It is a marker of parafoveal capillary loss, impaired autoregulation, and ischemic stress, which contributes to photoreceptor and RPE dysfunction. Macular involvement is characterized primarily by central capillary disruption and ischemia rather than diffuse microvascular density loss, a

pattern previously described in OCTA-based AMD studies.[1,2,6] Also, FAZ measurements, being less affected by projection artifacts and segmentation variability, may therefore serve as a more robust and reproducible biomarker in neovascular AMD.

VD and PD in both SCP and DCP were only marginally reduced in AE and did not reach statistical significance. This observation aligns with prior reports indicating that global density metrics may be relatively insensitive in AMD, partly due to compensatory vascular remodeling, segmentation inaccuracies, and masking effects from exudation or hemorrhage.[1,6,14]

Fellow Eye as a Window to Early Disease

Paired-eye design is one of the key strength of this study, that controlled for systemic and demographic confounders. Although FE were non-exudative, OCTA parameters clustered in a zone of high clinical discrimination, could be an indication of subtle microvascular alterations. This supports the concept that AMD is a bilateral disease with asymmetric clinical expression, and fellow eyes of unilateral wet AMD has early biomarker potential, as it represents a preclinical disease stage.[9,18,19] Histopathological studies have demonstrated bilateral choriocapillaris loss even in eyes without clinically evident neovascularization, reinforcing the biological plausibility of our findings.[11] These results emphasize the importance of routine OCTA surveillance of fellow eyes, as it may be more sensitive for tracking disease progression, as its vascular changes represent potential intervention window through early identification of microvascular compromise.

Choroidal Structural and Vascular Alterations

Choroidal assessment demonstrated statistically significant inter-eye differences in SFCT, Haller layer thickness, and CVI. These findings are consistent with growing evidence that choroidal vascular insufficiency plays a crucial role in AMD pathogenesis, particularly in the development of neovascular complications.[10,11] CVI has emerged as a more stable and physiologically meaningful parameter than choroidal thickness alone, as it reflects the proportion of vascular luminal area within the choroid and is less influenced by age or diurnal variations.[10,11] The significantly lower CVI observed in affected eyes in our study supports prior reports linking reduced choroidal vascularity with ischemia-driven VEGF upregulation and MNV formation.[10,11]

MNV Morphology and Activity

Qualitative OCTA analysis demonstrated that Pattern I (active) MNV was significantly associated with lesion shape, presence of anastomoses, and higher activity scores. These findings closely mirror the OCTA-based MNV activity criteria described by Coscas et al., who highlighted the diagnostic value of vascular complexity and anastomotic loops in identifying disease activity.[20] Jia et al. also demonstrated that OCTA can non-invasively delineate MNV architecture and quantify lesion activity.[13,14] This further enhances its role in disease monitoring and therapeutic interventions, particularly in assessing treatment response and recurrence.

AE was significantly associated with age and smoking history, which are well-established risk factors.[4,5,8] Smoking is known to promote oxidative stress, endothelial dysfunction, and choroidal vascular damage accelerating the AMD progression.[4,5] The association with lens status may reflect age-related factors or improved imaging quality in patients without cataract, although this finding requires further research. Other systemic co-morbidities did not show significant associations, consistent with the heterogeneous results reported in previous epidemiological studies.[4,8]

Clinical Implications

The findings of this study reinforces the clinical role of OCTA in AMD management. FAZ enlargement serves as a sensitive and clinically meaningful biomarker of macular ischemia in neovascular AMD, potentially preceding detectable changes in vessel density or perfusion. OCTA-based evaluation of FE may facilitate early risk stratification and guide individualized follow-up strategies, particularly in high-risk populations.

The limitations of this study include its cross-sectional design, which precludes assessment of longitudinal disease progression and conversion of fellow eyes to neovascular AMD. The lower sample size limits subgroup evaluation. Additionally, OCTA measurements remain susceptible to motion artifacts and segmentation errors despite stringent image quality control.

In conclusion, this study demonstrates that FAZ enlargement is the most sensitive OCTA parameter distinguishing affected from fellow eyes in unilateral wet AMD, while reduced SFCT and CVI highlight underlying choroidal vascular insufficiency. OCTA-based assessment of fellow eyes provides valuable insights into early microvascular alterations and may play a pivotal role in early detection, monitoring, and prevention of vision-threatening disease progression.

Declarations

Ethics approval and consent to participate: This study adhered to the tenant of the declaration of Helsinki and was approved by the institutional review committee of National Academy of Medical Sciences, Bir Hospital with reference number 33/2082/83.

Consent for publication: Not Aplicable

Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interest: NA

Funding: Nil

Authors' contributions: Conceptualization: SR, KS, PB ; Methodology: SR, KS,PB,LS, SS, RA; Data collection: SR Imaging analysis: SR, KS, PB ; Statistical analysis and result interpretation: SR, KS,PB Original draft preparation: SR Manuscript review and editing: SR, KS,PB,LS, SS, RA. All authors have read and agreed to the final version of the manuscript.

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References

1. Kirikkaya E, Kaynak S. Role of OCTA in the prognosis of dry-type AMD. European Review for Medical & Pharmacological Sciences. 2023 Dec 1;27(23).https://www.researchgate.net/profile/Esin-Kirikkaya/publication/377117726_Role_of_OCTA_in_the_prognosis_of_dry-type_AMD/links/66bc27d28f7e1236bc55b45a/Role-of-OCTA-in-the-prognosis-of-dry-type-AMD.pdf
2. Lutsenko N, Rudycheva O, Isakova O, Kyrylova TS. Assessing OCTA changes in morphology and structure of retinal microvascular bed in patients with exudative AMD. Journal of Ophthalmology (Ukraine). 2019 Mar 1;2:2- https://www.ozhurnal.com/sites/default/files/2019-2-2.pdf
3. Kumar Mishra S, Shah R, Gogate P, Sapkota YD, Gurung R, Shrestha MK, Mactaggart I, McCormick I, Shahi BB, Khandekar R, Burton M. Prevalence and causes of blindness and vision impairment among people 50 years and older in Nepal: A national Rapid Assessment of Avoidable Blindness survey. PloS one. 2025 Feb 13;20(2):e0309037.https://doi.org/10.1371/journal.pone.0309037
4. Smith W, Assink J, Klein R, Mitchell P, Klaver CC, Kle in BE, Hofman A, Jensen S, Wang JJ, de Jong PT. Risk factors for age-related macular degeneration pooled findings from three continents. Ophthalmogy 2001; 108: 697-704. 2).https://doi.org/10.1016/S0161-6420(00)00580-7
5. Lambert NG, El Shelmani H, Singh MK, Mansergh FC, Wride MA, Padilla M, Keegan D, Hogg RE, Ambati BK. Risk factors and biomarkers of age-related macular degeneration. Prog Retina Eye Res 2016; 54: 64-102.https://doi.org/10.1016/j.preteyeres.2016.04.003
6. Dugiełło B, Wylęgała A, Kijonka M, Prus-Ludwig A, Górska G, Wylegała E, Orzechowska-Wylęgała B. Vascular changes in optical coherence tomography angiography unveiling the depths of dry age-related macular degeneration: a review. Expert Review of Medical Devices. 2024 Nov 1;21(11):1015-29.https://doi.org/10.1080/17434440.2024.2419961
7. Sadda SR, Guymer R, Holz FG, et al. Consensus definition for atrophy associated with age-related macular degeneration on OCT: Classification of trophy Report 3. *Ophthalmology* 2018; **125**: 537–548. https://doi.org/10.1016/j.ophtha.2017.09.028
8. Armstrong RA, Mousavi M. Overview of risk factors for age-related macular degeneration (AMD). J Stem Cells. 2015 Jul 1;10(3):171-91.https://www.researchgate.net/profile/Richard-Armstrong-17/publication/355297068_Overview_of_risk_factors_for_age-related_macular_degeneration/links/665830aebc86444c720b7da4/Overview-of-risk-factors-for-age-related-macular-degeneration.pdf
9. Ouyang Y, Heussen FM, Hariri A, Keane PA & Sadda SR. Optical coherence tomography-based observation of the natural history of drusenoid lesion in eyes with dry age-related macular degeneration. *Ophthalmology* 2013https://doi.org/10.1016/j.ophtha.2013.05.029
10. Farazdaghi MK & Ebrahimi KB. Role of the choroid in age-related macular degeneration: A current review. *J Ophthalmic Vis Res* 2019; **14**: 78–87.doi: 10.4103/jovr.jovr_125_18
11. Seddon JM, McLeod DS, Bhutto IA, et al. Histopathological insights into choroidal vascular loss in clinically documented cases of age-related macular degeneration. *JAMA Ophthalmol* 2016; **134**: 1272–1280. doi:10.1001/jamaophthalmol.2016.3519
12. Lumbroso B, Huang D, Jia Y, Fujimoto JG, Rispoli M. Clinical guide to Angio-OCT: non invasive, dyeless OCT angiography. 1st ed. New Delhi: Jaypee Brothers Medical Publisher (P) Ltd;2015.https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Lumbroso+B%2C+Huang+D%2C+Jia+Y%2C+Fujimoto+JG%2C+Rispoli+M.+Clinical+guide+to+Angio-OCT%3A+non+invasive%2C+dyeless+OCT+angiography.+1st+ed.+New+Delhi%3A+Jaypee+Brothers+Medical+Publisher+%28P%29+Ltd%3B+2015.&btnG
13. Jia Y, Tan O, Tokayer J, Potsaid B, Wang Y, Liu JJ, Kraus MF, Subhash H, Fujimoto JG, Hornegger J, Huang D. Split-spectrum amplitude-decorrelation angiography with optical coherence tomography. Opt Express. 2012 Feb 13;20(4):4710-25.https://doi.org/10.1364/OE.20.004710
14. Jia Y, Bailey ST, Wilson DJ, Tan O, Klein ML, Flaxel CJ, Potsaid B, Liu JJ, Lu CD, Kraus MF, Fujimoto JG, Huang D. Quantitative optical coherence tomography angiography of choroidal neovascularization in age-related macular degeneration. Ophthalmology. 2014 Jul;121(7):1435-44https://doi.org/10.1016/j.ophtha.2014.01.034
15. Savastano MC, Lumbroso B, Rispoli M. In vivo characterization of retinal vascularization morphology using optical coherence tomography angiography. Retina. 2015 Nov;35(11):2196-203. *DOI:* 10.1097/IAE.0000000000000635
16. Chen C-X, Liu M-L, Cao K, et al. Diagnostic value of optical coherence tomography angiography for choroidal neovascularization in age-related macular degeneration: a systematic review and meta-analysis. Ophthalmic Res. 2021;64(5):704–712. doi: 10.1159/000511265
17. Nikolopoulou E, Lorusso M, Micelli Ferrari L, et al. Optical coherence tomography angiography versus dye angiography in age-related macular degeneration: sensitivity and specificity analysis. Biomed Res Int. 2018;2018:1–7. doi: 10.1155/2018/6724818
18. Klein R, Meuer SM, Myers CE, et al. Harmonizing the classification of age-related macular degeneration in the three-continent AMD consortium. *Ophthalmic Epidemiol* 2014; **21**: 14–23. https://doi.org/10.3109/09286586.2013.867512
19. Ferris FL, Davis MD, Clemons TE, et al. A simplified severity scale for age-related macular degeneration: AREDS Report No. 18. *Arch Ophthalmol* 2005; **123**: 1570–1574.https://doi.org/10.1001/archopht.123.11.1570
20. Coscas GJ, Lupidi M, Coscas F, Cagini C, Souied EH. Optıcal coherence tomography angıography versus tradıtıonal multımodal ımagıng ın assessıng the actıvıty of exudatıve age-related macular degeneratıon: A new diagnostic challenge. Retina 2015;35:2219–28.*DOI:* 10.1097/IAE.0000000000000766

Figures

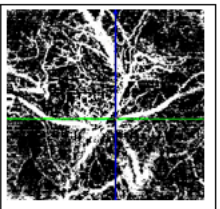
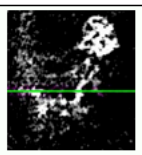
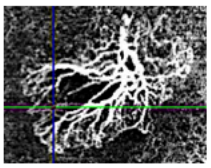
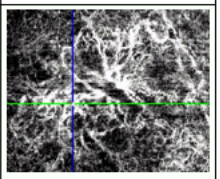
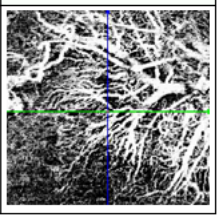
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B	Glomerular	
C	Seafan	
D	Medusa head	
E	Filament	

Figure 1

showing different MNV morphological patterns

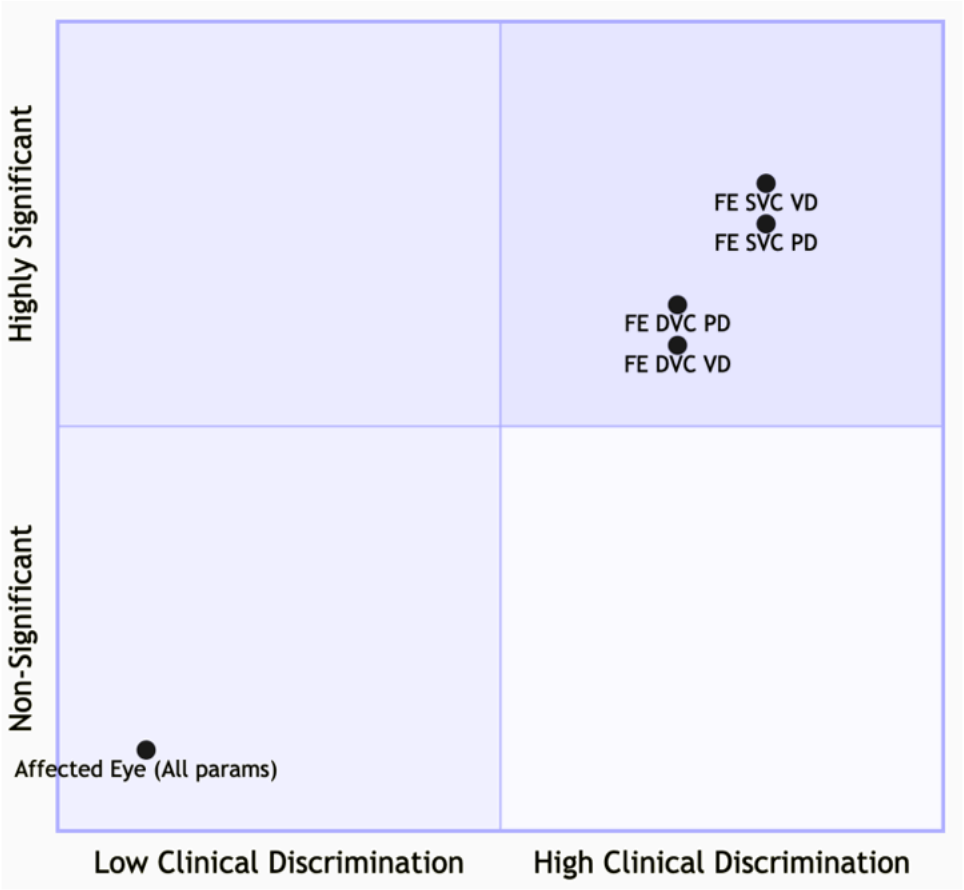


Figure 2

Inter eye clinical significance discrimination map