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Macular changes after phacoemulsification for diabetic patients with diabetic maculopathy combined with and without triamcinolone acetonide

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Abstract
Background: Diabetic retinopathy and other retinal vascular diseases are the primary causes of visual impairment and blindness. Non-invasive imaging of the retina's microvasculature and the choroid has been made possible by the technique of optical coherence tomography angiography (OCTA). The primary objective of this study was a comparison of outcomes following posterior subtenon injection of triamcinolone acetonide (TA) alongside standard phacoemulsification with standard phacoemulsification alone in patients being treated for diabetic macular edema (DME) undergoing cataract surgery with the aid of optical coherence tomography (OCT) and OCT-A.
Methods: The study used a prospective cross-sectional method and involved 40 eyes of diabetic patients aged 55-75 years, encompassing both sexes with cataracts and DME. Two groups of patients were formed, each containing an equal number of participants. Group A underwent both standard phacoemulsification and a posterior sub-tenon injection of TA, while Group B only underwent phacoemulsification.
Results: The results show that post-surgery, the central foveal thickness and the foveal avascular zone, including both the superficial and deep capillary plexus, were significantly greater in group B than in group A ($p< 0.05$). Similarly, when comparing pre- and post-operative measurements, group B showed significantly higher central foveal thickness and foveal avascular zone (Superficial and deep capillary plexus) areas than group A ($p< 0.05$). In contrast, post-surgery, the vessel area density and best corrected visual acuity were significantly higher in group A than in group B ($p< 0.05$). Likewise, when comparing pre- and post-operative measurements, group A had significantly higher vessel area density and best corrected visual acuity than group B ($p< 0.05$).
Conclusions: Sub-tenon injection of triamcinolone led to improved visual outcomes, a decrease in the increase of CFT, a reduction in the FAZ diameter, and a decrease in the drop of VAD when measured by OCT and OCTA over a short period of one month.

Keywords: Macular changes, phacoemulsification, diabetic maculopathy, triamcinolone acetonide

Introduction
Diabetes mellitus is currently one of the world's fastest-growing chronic health issues. The projected number of individuals with diabetes mellitus is expected to rise to 642 million by the year 2040 [1].
Diabetic retinopathy and other retinal vascular diseases are the primary causes of visual impairment and blindness in many patients, with DR at the forefront [2].
Diabetes most commonly results in DR, a microvascular complication. The likelihood of DR rises as the length of time with diabetes progresses, and nearly all individuals with type 1 diabetes and more than 60% of those with type 2 diabetes develop some retinopathy after 20 years [3].
The loss of pericytes is a key characteristic of the initial stages of diabetic retinopathy, resulting in localized bulging of capillary walls and the formation of microaneurysms, which is the first noticeable clinical indication of DR. The thickening of the basement membrane and apoptosis of endothelial cells both play a key role in disrupting the blood-retinal barrier [4].
Retinopathy, a condition known as DR, is comprised of several distinct stages, the first being mild non-proliferative retinopathy, characterized by the formation of microaneurysms - small swellings in the tiny blood vessels of the retina. As non-proliferative retinopathy advances, certain blood vessels which supply the retina are progressively obstructed. In severe non-proliferative retinopathy, numerous blood vessels become occluded, resulting in several

retinal regions lacking adequate blood supply. In proliferative retinopathy, factors that stimulate the growth of new blood vessels are released by the ischemic retina, resulting in the formation of abnormal and prone to rupture vessels [5].

Optical coherence tomography (OCT) has become the gold standard for DR assessment. It provides rapid, high-resolution, non-invasive, two-dimensional (2D) cross-sectional and three-dimensional mapping of retinal structures [6, 7].

OCT angiography (OCT-A) has developed as a non-invasive method for visualizing the microvasculature of the retina and the choroid [8].

Using OCTA technology, the same tissue area is continuously imaged over multiple scans, enabling the identification of areas with high flow rates by comparing scan results and pinpointing zones where flow is either absent or significantly slower, a pattern that is consistent across multiple scans [9].

Research has shown that diabetic patients are more likely to develop cataracts and often experience this condition at a younger age than individuals without diabetes [10].

The primary objective of this investigation was to contrast the outcomes of posterior subtenon injection of triamcinolone acetonide (TA) in conjunction with phacoemulsification versus phacoemulsification alone in patients with diabetic macular edema (DME) who were undergoing cataract surgery, utilizing optical coherence tomography (OCT) and OCT-A imaging.

Patients and Methods

This prospective cross-sectional study was carried out on 40 eyes of diabetic patients aged from 55 to 75 years old, both sexes, with cataract and diabetic maculopathy (DME) as diagnosed by OCT and FFA. The study was conducted between April 2023 and April 2024 following approval from the Ethical Committee at Tanta University Hospitals in Tanta, Egypt. Consent forms signed by all patients were verified as being fully informed.

The exclusion criteria were individuals with cloudy media or compromised fixation, which interfered with obtaining clear fundus fluorescein angiography (FFA), optical coherence tomography (OCT), or optical coherence tomography angiography (OCTA) images of good quality, any previous intraocular surgery other than phacoemulsification over a period of 6 months, glaucoma, choroidal neovascularization (CNV), high myopic degenerative retinal changes, or any other retinal pathology such as retinal vein occlusion, any associated neurological diseases that interfere with fixation during examination, imaging and any intraoperative or postoperative complications of phacoemulsification.

Two groups of eyes were established: Group A, which received phacoemulsification combined with posterior sub-tenon injection of TA, and Group B, which underwent phacoemulsification alone without posterior sub-tenon injection of TA.

A comprehensive medical evaluation was conducted for all patients, including a thorough medical history, ophthalmological examination and diagnostic imaging tests [OCT, OCTA, deep range imaging (DRI) and FFA].

Ensure sufficient pupil dilation using (Plegica) Cyclopentolate hydrochloric acid (HCL) 1% (Hikma pharmaceutical co.) eye drops. Informing the patient about the procedures, and any adverse effects related to pharmacologic substances to be used. Prepare the patient for imaging.

The body's naturally occurring corticosteroids - including cortisol, cortisone, and corticosterone - are produced in the adrenal gland, where they interact with glucocorticoid and mineralocorticoid receptors. Currently, three synthetic corticosteroids are frequently employed in the treatment of vitreoretinal disease: dexamethasone (DEX), fluocinolone acetonide (FA), and TA [10]. The ocular effects of corticosteroids are influenced by their potency, dosage, and the sustained availability of the drug at the target tissue over a period of time [10]. Following intravitreal dosing in rabbits, the anterior chambers contained significantly lower concentrations of TA compared to the posterior chambers, which stands in contrast to other two types of corticosteroids. Therefore, it was preferred for treating vitreous and retinal diseases [11]. Corticosteroids are essential for managing inflammation. Vitreoretinal disorders such as age-related macular degeneration, branch and central retinal vein occlusion, diabetic retinopathy, and uveitis have a significant role in their pathogenesis with inflammation. A major clinical symptom of inflammation in the retina is macular oedema. Oedema can be located either within cells, especially Müller glia and retinal neurons, or in the interstitial space. Typically, angiographic studies demonstrate fluid leakage across either the inner retinal vascular barrier or the outer retinal pigment epithelium blood–retinal barrier. However, electron microscopy of human donor eyes has found that the majority of macular oedema is actually confined within cells [12, 13]. A wide range of inflammatory substances has been identified as key contributing factors in animal studies of retinal vascular leakage and oedema. This group consists of prostaglandins, leukotrienes, enzymes, and numerous cytokines. Vascular endothelial growth factors-A (VEGF-A) tops the list of cytokines, yet numerous other molecules, specifically VEGF-A, are significant contributors to retinal inflammation [12, 13]. Furthermore, corticosteroids possess a range of effects, involving the repair of tight junction structure and decrease in paracellular permeability as well as the movement of water and solutes between cells. Their diverse actions involve the inhibition of intracellular signalling pathways for inflammatory lipid mediators, such as prostaglandins and leukotrienes. These compounds prevent the release of numerous cytokines and chemokines, and through the regulation of adenosine signalling pathways, they can decrease blood-retinal barrier permeability [12, 13].

The phacoemulsification procedures were carried out by a single, highly skilled surgeon. A 2.8 mm keratome was utilised for a clear corneal incision, following which a continuous curvilinear anterior capsulorhexis was performed. The lens was then removed using the Geuder Megatron S4 device, which is manufactured by Geuder in Heidelberg, Germany. In all cases, the stop and chop technique was executed first, followed by cortical aspiration and the subsequent implantation of a hydrophilic monofocal one-piece intraocular lens in the capsular bag. The main incision was sealed by hydrating its stroma with a balanced salt solution until it was ensured that it was securely closed. The surgical procedure was completed by administering 1 cc of a 40 mg TA solution (specifically, synthecortin, which is preservative-free and is formulated at 40 mg per 1 cc) into the posterior subtenon space in the inferotemporal area.

Preoperative and one month postoperative OCT and OCTA imaging were conducted using DRI OCT Triton, a swept source OCT (SS-OCT) device from Topcon Corp. of Japan, which is distinguished by its use of DRI technology and a

long wavelength of 1050 nm.

Conventional OCT was used to obtain. Macular thickness map in µm and retinal images were classified according to early treatment of diabetic retinopathy study (ETDRS) into foveal (central 1 mm), parafoveal (3 mm), whole macular area (6 mm). Choroidal thickness map in µm and retinal images were classified according to ETDRS as provided by the manufacturer into foveal (Central 1 mm), parafoveal (3 mm), whole macular area (6 mm) using SS-OCT, the choroid was defined as the space between the outer border of the RPE/Bruch's membrane complex and the inner border of the sclera. OCTA was used to obtain: (Qualitatively and quantitatively). OCT-A imaging of the macula was done using the 3 x 3 mm (foveal and parafoveal), the 6 x 6 mm (whole macular area) scanning protocol.

The macular area was assessed at 4 levels

The superficial level of retinal capillary plexus spans from the internal limiting membrane to the edge of the inner plexiform layer. At the deeper level, the retinal capillary plexus extends from the edge of the inner plexiform layer to the edge of the outer plexiform layer, which is part of the deep retinal layer. The choriocapillaris layer reaches from a location at the level of Bruch's membrane down to approximately 30 micrometers below it. Using OCTA, Foveal avascular zone (FAZ) was measured automatically to calculate the superficial FAZ in the 3mmx3mm scans area while the deep FAZ area in the 3mmx3mm scans was calculated manually as the deep FAZ is not automatically calculated in the device used for OCT-A imaging (Topcon, DRI OCT Triton device), the superficial and deep FAZ area was not calculated in the 6 mmx 6 mm scans as 3 mmx 3 mm was found to be more accurate, better resolution, more magnified and less falsies than the 6mmx6mm scans.

Vascular Density index (VDI) maps depicted in color-coded images provide qualitative data, where areas with increased blood flow are represented by hot colours and regions with decreased flow are represented by cooler colours. The processing of these images was carried out using the ImageJ program in order to obtain quantitative data, specifically version 1.46 r of ImageJ, which was developed by Tiago Ferreira and Wayne Rasband at the National Institute of Health in Bethesda, Maryland, USA. The method was employed to collect quantitative data by calculating the VDI as a percentage, using 450 x 350 pixel images that were converted into binary images, where any flow was identified as white and very low or no flow was identified as black. To begin, open Image J and navigate to 'File' > 'Open' to select the desired image. Next, click on 'Image' > 'Type' and choose '8-bit.' Then, select 'Adjust' > 'Auto local threshold' with the Phansalkar method, followed by 'OK'. Proceed to 'Plugins' > 'Vessel Analysis' and choose 'Vascular density.' Select an area and click 'OK' to calculate vascular density measurements and vascular length density measurements.

Following surgery, patients were required to attend follow-up appointments at 1 day, 1 week, and 1 month afterwards. A comprehensive anterior segment examination using the slit lamp to assess the AC reaction was conducted at each scheduled visit, while a BCVA assessment was carried out at one month. OCT and OCTA scans were performed at one month. Applanation tonometry was performed at both 1 week and 1 month intervals to obtain IOP readings.

Statistical analysis

Measurable examination was finished by SPSS v26 (IBM Inc., Chicago, IL, USA). The quantitative factors were communicated as mean and standard deviation and looked at between the two gatherings utilizing an unpaired Understudy's t-test. The subjective factors were communicated as frequencies and rates, and were investigated with the Chi-square or Fisher's careful test depending on the situation. A P worth of under 0.05 was viewed as genuinely critical while testing in the two headings.

Results

Demographic, phacoemulsification data, duration, therapy of DM, comorbidities, eye and grading of DR were insignificantly different between both groups. Previous eye TTT was significantly different between both groups (p<0.008). Table 1.

Table 1: Demographic, Phaco data, duration, therapy of DM, comorbidities, previous eye TTT and grading of DR

		Group A (n=20)	Group B (n=20)	Test	P
Age (years)		62.500±4.454	65.100±5.524	t= -1.639	0.110
Sex	Male	12(60.0%)	15(75.0%)	X^2=1.026	0.311
	Female	8(40.0%)	5(25.0%)		
Phaco data					
Phaco power used		27.000±3.403	26.500±3.285	t=0.473	0.639
Grading of cataract	NII	6(30.0%)	8(40.0%)	X^2=1.686	0.430
	PSC sheet	10(50.0%)	6(30.0%)		
	Cortical	4(20.0%)	6(30.0%)		
DM duration (years)		16.300±4.001	15.600±10.169	t=0.286	0.776
DM therapy	Insulin	16(80.0%)	14(70.0%)	X^2=4.133	0.127
	OHD	2(10.0%)	6(30.0%)		
	Insulin and OHD	2(10.0%)	0(0.0%)		
Comorbidities	HTN	9 (45.0%)	14 (70.0%)	--	0.110
	IHD	0 (0.0%)	4 (20.0%)	--	0.106
Previous eye TTT	NAÏVE	6(30.0%)	14(70.0%)	X^2=11.867	0.008*
	Laser	6(30.0%)	0(0.0%)		
	Intraocular drug injection	6(30.0%)	2(10.0%)		
	Combined laser and drug injection	2(10.0%)	4(20.0%)		
Eye	Right	12(60.0%)	10(50.0%)	X^2=0.404	0.525
	Left	8(40.0%)	10(50.0%)		
Grading of DR	PDR	8(40.0%)	4(20.0%)	X^2=3.733	0.155
	Moderate NPDR	6(30.0%)	12(60.0%)		
	Severe NPDR	6(30.0%)	4(20.0%)		

Data are presented as mean ± SD or frequency (%). * Significant P value <0.05. t: paired t-test, X^2: Chi-square test. Phaco: phacoemulsification, Psc: posterior subcapsular cataract, DM: diabetes mellitus, OHD: oral hypoglycemic drug, HTN: hypertension, IHD: ischemic heart disease, TTT: treatment, DR: diabetic retinopathy, PDR: proliferative diabetic retinopathy, NPDR: non proliferative diabetic retinopathy.

Preoperative CFT, FAZ(SCP) area (observer 1), pre, post operative DRIL and interrupted outer retinal layers were insignificantly different between both groups. Postoperative CFT and FAZ(SCP) area (observer 1) were significantly higher in group B than group A (P<0.05). Pre-post operative CFT and FAZ(SCP) area (observer 1) were significantly higher in group A than group B (P<0.05). Table 2.

Table 2: Comparison between the preoperative and postoperative CFT, DRIL, interrupted outer retinal layers and FAZ(SCP) area (observer 1) in the two studied groups

		Group A (n=20)	Group B (n=20)	Test	P
CFT (micron)					
Pre		290.600±15.836	282.200±22.444	t=1.368	0.179
Post		298.550±19.811	308.700±25.396	t=-2.381	0.022*
Pre-Post	Differences	-0.950±5.934	-26.500±5.405	t=14.236	<0.001*
	t test	0.483	<0.001*		
DRIL					
Pre	Normal	10(50.0%)	12(60.0%)	X^2=0.404	0.525
	DRIL	10(50.0%)	8(40.0%)		
Post	Normal	10(50.0%)	12(60.0%)	X^2=0.404	0.525
	DRIL	10(50.0%)	8(40.0%)		
Interrupted outer retinal layers					
Pre	Normal	16(80.0%)	14(70.0%)	X^2=0.533	0.465
	Interrupted	4(20.0%)	6(30.0%)		
Post	Normal	16(80.0%)	14(70.0%)	X^2=0.533	0.465
	Interrupted	4(20.0%)	6(30.0%)		
FAZ(SCP) area (observer 1)					
Pre		627.000±214.822	627.000±214.822	t=0.000	1.000
Post		627.200±214.203	822.600±100.756	t=-3.692	0.001*
Pre-Post	Differences	-0.200±6.709	-195.600±116.672	t=7.477	<0.001*
	t test	0.895	<0.001*		

Data are presented as mean ± SD or frequency (%). * Significant P value <0.05. t: paired t-test, X^2: Chi-square test. CFT: central foveal thickness, DRIL: disorganization of the retinal inner layers, FAZ: foveal avascular zone, SCP: superficial capillary plexus.

Preoperative FAZ(SCP) area (observer 2), FAZ (DCP) area (observer 1 and 2) were insignificantly different between both groups. Postoperative FAZ(SCP) area (observer 2), FAZ (DCP) area (observer 1 and 2) were significantly higher in group B than group A (P<0.05). Pre-post operative FAZ(SCP) area (observer 2), FAZ (DCP) area (observer 1 and 2) were significantly higher in group A than group B (P<0.05). Table 3.

Table 3: Comparison between pre and post operative values regarding FAZ(SCP) area (observer 2), FAZ (DCP) area (observer 1 and 2) in the two groups

		Group A (n=20)	Group B (n=20)	Test	P
FAZ area SCP (observer 2)					
Pre		585.000±177.007	585.000±177.007	t= 0.000	1.000
Post		586.950±177.884	719.800±77.790	t= -3.060	0.004*
Pre-Post	Differences	-1.950±5.155	-134.800±120.244	t=4.936	<0.001*
	t test	0.107	<0.001*		
FAZ area DCP (observer 1)					
Pre		566.500±136.691	566.500±136.691	t=0.000	1.000
Post		568.800±138.768	663.150±133.893	t=-2.188	0.035*
Pre-Post	Differences	-2.300±11.444	-96.650±8.893	t=29.114	<0.001*
	t test	0.380	<0.001*		
FAZ (DCP) area (observer 2)					
Pre		637.000±151.209	637.000±151.209	t=0.000	1.000
Post		638.550±150.481	764.500±81.643	t=-3.290	0.002*
Pre-Post	Differences	-1.550±7.045	-127.500±85.139	t=6.593	<0.001*
	t test	0.337	<0.001*		

Data are presented as mean ± SD.* Significant P value <0.05. t: paired t-test, FAZ: foveal avascular zone, SCP: superficial capillary plexus, DCP: deep capillary plexus.

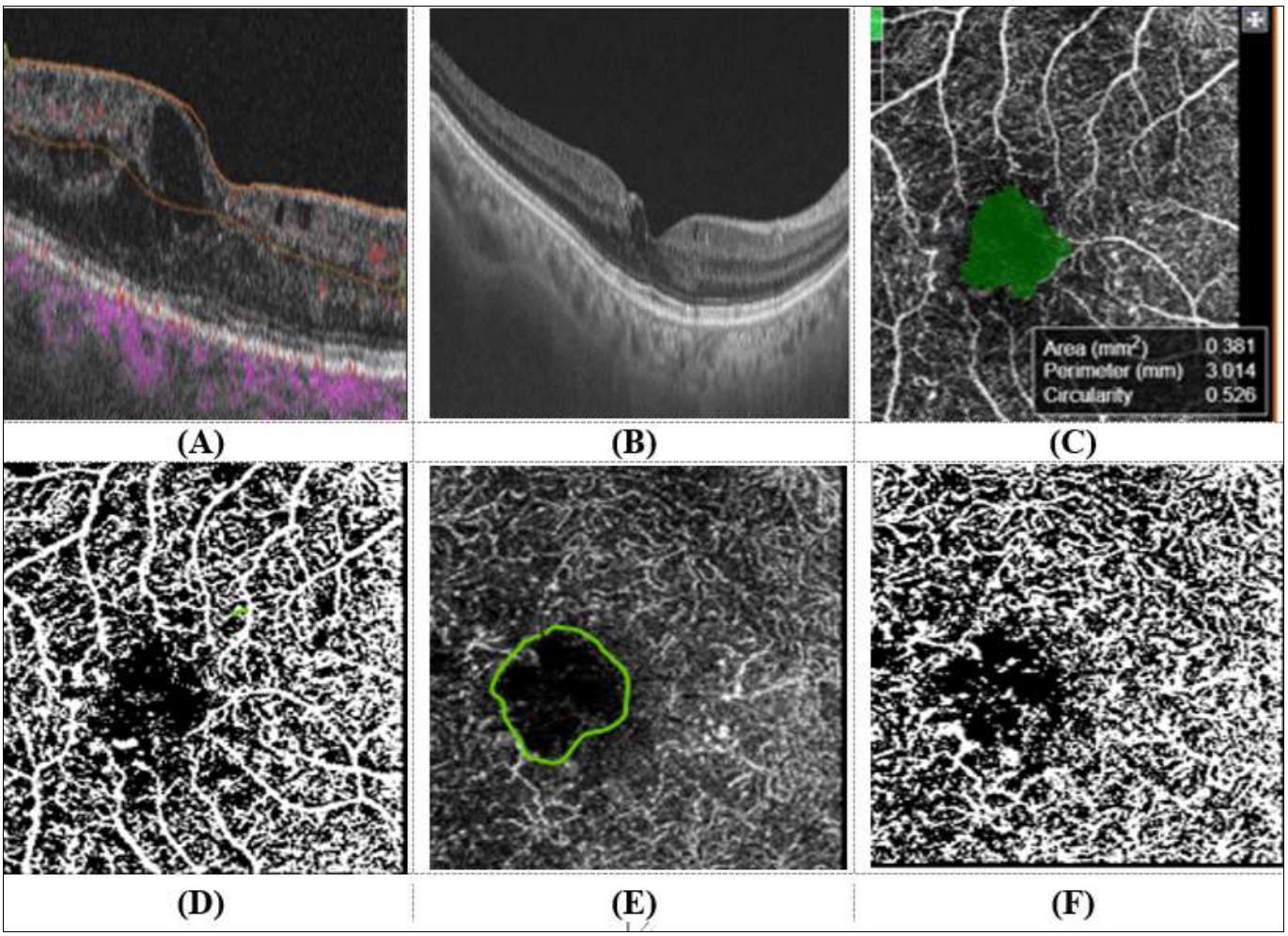
The two groups did not significantly vary in preoperative VAD (SCP and DCP) or BCVA. Group A had significantly higher post-surgery VAD (SCP and DCP) and BCVA ratings than group B (P<0.05). On the other hand, group B's post-surgery VAD (SCP and DCP) and BCVA scores improved more than group A's pre-surgery levels (P<0.05). Both groups' intraocular pressures (IOPs) were nearly identical prior to and following surgery. Table 4.

Case 1: A 61-year-old female with a 15-year history of DM, on insulin treatment with otherwise negative medical history. She had history of previous right eye intraocular drug injection of more than 6 months duration. On examination, her Log Mar BCVA in the right eye was 0.05 and 0.5 preoperatively and postoperatively, respectively. Intraocular pressures were 14 and 16 mmHg preoperatively and postoperatively, respectively. Slit lamp examination showed posterior subcapsular cataract. She underwent phacoemulsification plus posterior sub-tenon injection of TA at the end of operation in group A. Figure 1.

Table 4: Comparison between VAD (SCP and DCP), BCVA and IOP pre and post operative in the two groups

		Group A (n=20)	Group B (n=20)	Test	P
VAD SCP					
Pre		56.690±4.972	57.030±5.004	t= -0.216	0.830
Post		55.790±5.711	51.770±5.297	t= 2.308	0.027*
Pre-Post	Differences	0.900±1.213	5.260±2.638	t=-6.715	<0.001*
	t test	0.004*	<0.001*		
VAD DCP					
Pre		64.950±1.046	64.850±1.104	t=0.294	0.770
Post		64.470±1.555	62.560±2.115	t=3.254	0.002*
Pre-Post	Differences	0.480±1.349	2.290±2.152	t=-3.187	0.003*
	t test	0.128	<0.001*		
BCVA					
Pre		0.110±0.050	0.090±0.060	t=1.145	0.259
Post		0.510±0.117	0.220±0.062	t=9.841	<0.001*
Pre-Post	Differences	-0.400±0.095	-0.130±0.062	t=-10.644	<0.001*
	t test	<0.001*	<0.001*		
IOP					
Pre		13.500±2.039	14.200±2.331	t=-1.011	0.318
Post		17.200±2.331	18.050±2.564	t=-1.097	0.280
Pre-Post	Differences	-3.700±1.867	-3.850±1.899	t=0.252	0.803
	t test	<0.001*	<0.001*		

Data are presented as mean ± SD.* Significant P value <0.05. t: paired t-test, VAD: vessel area density, SCP: superficial capillary plexus, DCP: deep capillary plexus, BCVA: best corrected visual acuity, IOP: intraocular pressure.



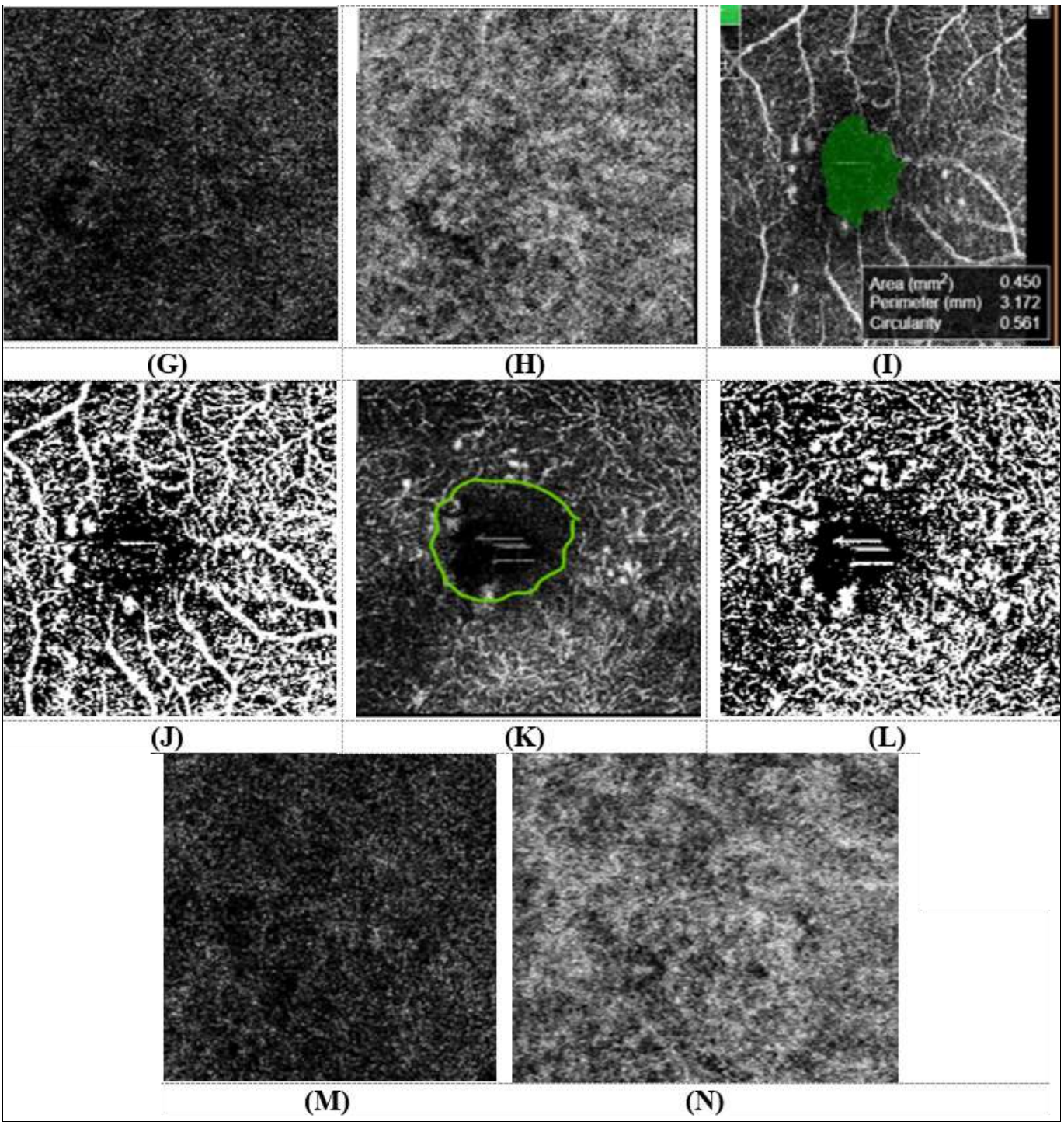


Fig 1: (A) Preoperative, (B) postoperative B- scan swept source optical coherence tomography with central foveal thickness of (302 and 331micron respectively) (calculated manually by Caliber) with paracentral spongy macular oedema, 3 x 3 frame within the macular area preoperatively and postoperatively respectively (C, I) automated foveal avascular zone of surgical reversal of presbyopia = 0.381, 0.450 mm^2, (D, J) binary image of density flow map of superficial capillary plexus level (vascular density index:40.603%, 38.340%), (E, K) manual foveal avascular zone of deep capillary plexus =332, 386 µm, (F, L) binary image of density flow map of deep capillary plexus (vascular density index:41.782%, 39.504%), (G, M) of deep retinal level and (H, N) of choriocapillaris level in group A

Case 2: A 65-year-old male with a 15-year history of DM, on insulin treatment with otherwise negative medical history. On examination, his Log Mar BCVA in the right eye was 0.05 and 0.1 preoperatively and postoperatively, respectively. Intraocular pressures were 10 and 12 mmHg preoperatively and postoperatively, respectively. Slit lamp examination showed posterior subcapsular cataract. He underwent standard phacoemulsification only in group B. Figure 2.

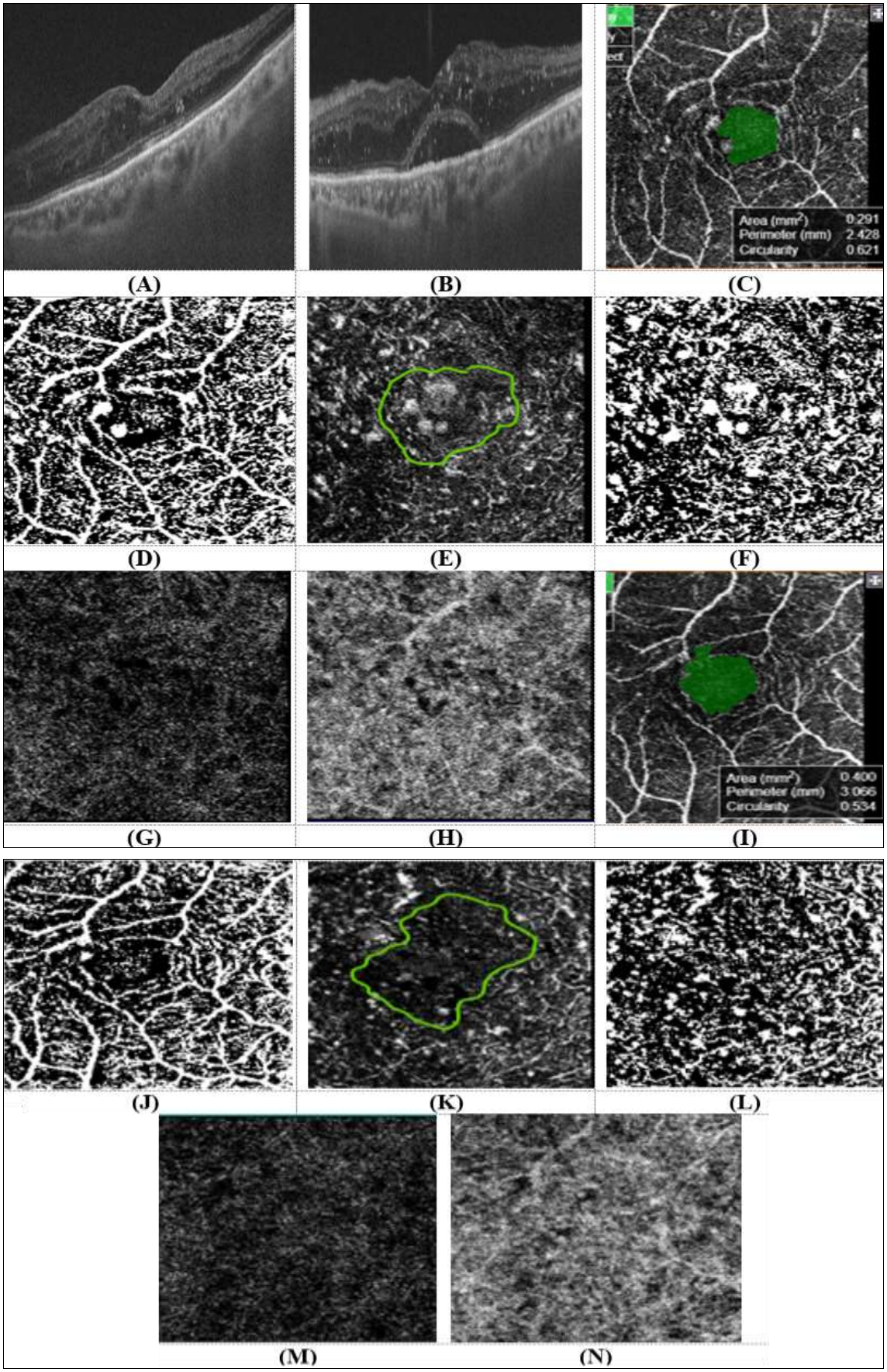


Fig 2: (A) Preoperative, (B) postoperative B- scan swept source optical coherence tomography with central foveal thickness of (292 and 433micron respectively) (Calculated manually by Caliber) with paracentral spongy macular oedema and exudate with neurosensory retinal detachment, 3 x 3 frame within the macular area preoperatively and postoperatively respectively (C, I) automated foveal avascular zone of surgical reversal of presbyopia = 0.291, 0.400 mm^2, (D, J) binary image of density flow map of superficial capillary plexus level (Vascular density index: 52.034%, 46.032%), (E, K) manual foveal avascular zone of deep capillary plexus =317, 420 µm, (F, L) binary image of density flow map of deep capillary plexus (Vascular density index: 52.135%, 44.233%), (G, M) of deep retinal level and (H, N) of choriocapillaris level in group B

Discussion

One of the most prevalent causes of blindness in people in their working years is diabetic retinopathy (DR) [14].

Diabetes duration appears to be a significant factor that raises the likelihood of DR advancement. The mean duration of DM in the patients of the two studied groups was almost equal (16 years in group A and 15 years in group B), as Li *et al.* [15] demonstrated that the duration of DM is an independent risk factor for the development of varying degrees of DR as well as NDR among type 2 diabetic patients.

In our study: 40% of the patients had PDR, 30% of them had severe NPDR and 30% of them had moderate NPDR. There is a considerable correlation between the severity of DR and the existence of macular oedema, as evidenced by the high percentage of PDR instances across the groups under study. This supports the idea that both disorders share a pathogenic process that results in capillary nonperfusion, as described by Rabiolo *et al.* [16], who found a relationship between peripheral and macular perfusion. On the other hand, Sim *et al.* [17] found no correlation between the advancement of macular oedema or ischaemia and the severity of diabetic retinopathy or maculopathy grades.

The degree of macular oedema was assessed by CFT in microns using OCT and macular perfusion (degree of maculopathy preoperatively and postoperatively) were assessed using two parameters: Macular vascular density is measured using VAD and FAZ area in mm2. The Samara *et al*. study served as inspiration for the use of those two factors. [18] measured macular vascular density using VLD in addition to VAD and assessed FAZ using FAZ area in mm2. VLD is determined by measuring the total vessel length in the acquired scan, whereas VAD is determined as the proportion of the area filled by blood vessels. We did not notice appearance of CME in any of patients of the two groups. This disagrees with Su-Young Kim *et al.* [19] revealed that CME only happened in untreated control eyes and that its incidence following cataract surgery was 8.7%. Consequently, the incidence of CME following cataract surgery was considerably reduced by an intraoperative sub-tenon injection of TA. Our findings that the triamcinolone group had considerably bigger alterations in BCVA lines at one month were supported by the fact that the eyes in the triamcinolone group in our present investigation had a smaller rise in CFT one month after surgery.

This agrees with Su-Young Kim *et al.* [19] reported that there was an increase in the CFT one month postoperative in both groups. On the other hand, this disagrees with Suzan Amana *et al.* [20] reported that at 1 month and 3 months visits, there was no significant difference in CFT. This difference is due to lack of control group in their study.

In line with Sikander A K Lodhi1 *et al*., [21] we did not find a statistically significant increase in IOP in any of the two research groups in our current investigation found that although the triamcinolone group's IOP increased more than the control group's from baseline to one month after surgery, the difference between the two groups was never statistically significant. We hypothesise that ocular hypertension or glaucoma are less likely to result from posterior sub-Tenon injections of corticosteroids than from anterior sub-Tenon injections. I concur with L. P. Aiello on this [22]. Found that, in comparison to posterior sub-Tenon's triamcinolone injections, anterior peribulbar triamcinolone injections were linked to a higher risk of IOP rise and cataract formation. Moreover, in the present study, no complications occurred in the triamcinolone group.

In our current study, we can't evaluate effect of posterior subtenon injection of TA on DR progression due to our short time follow up for only one month, this disagrees with Sikander A K Lodhi1 *et al.* [21] showed that sub-Tenon's injection of triamcinolone did not affect DR progression at six months postoperatively.

In our current study, there is a statistically significant difference in the mean change of BCVA one month postoperatively between the two studied groups as the mean change is higher in the triamcinolone group, this agrees with Sikander A K Lodhi1 *et al.* [21] and Su-Young Kim *et al.* [19] said that the triamcinolone group had a higher mean change at one month after surgery than the non-injection group, but they also stated that the mean change at six months was not statistically significant between the groups. Regretfully, we were unable to get this lengthy follow-up time.

In our current study, the non-injection group experienced a greater mean change in the diameter of FAZ (SCP, DCP) than the triamcinolone group, and both groups experienced a lower mean change in the VAD (SCP, DCP) compared to the baseline preoperative condition.

In the current study, a great number of the obtained OCTA images showed different types of artifacts that we couldn't neglect – especially that the device used for OCTA imaging in this study is, yet, without projection resolving software - at the time of the study, but we excluded images with artifacts that prevented reasonable interpretation of them. Spaide *et al.* [23] described image artifacts of OCTA and their underlying causative mechanisms, aiming at establishing a common vocabulary for the artifacts observed, a similar work was also done by Chen *et al*.[24]

One of the study's limitations was the very small sample size. For a comparatively short time, there was little patient follow-up.

Conclusions: In the short term (one month), a sub-tenon injection of triamcinolone decreased the rise in CFT and FAZ diameter, enhanced visual recovery, and decreased the reduction in VAD by OCT and OCTA.

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References

1. Sun Z, Yang D, Tang Z, Ng DS, Cheung CY. Optical coherence tomography angiography in diabetic retinopathy: An updated review. Eye (London). 2021;35:149-161.
2. Cardoso JN, Keane PA, Sim DA, Bradley P, Agrawal R, Addison PK, *et al.* Systematic evaluation of optical coherence tomography angiography in retinal vein occlusion. American Journal of Ophthalmology. 2016;163:93-107.
3. Mohamed Q, Gillies MC, Wong TY. Management of diabetic retinopathy: A systematic review. JAMA. 2007;298:902-916.
4. Wang W, Lo ACY. Diabetic retinopathy: pathophysiology and treatments. International Journal of Molecular Sciences. 2018;19:200-260.
5. Yun W, Acharya U, Venkatesh YV, Chee C, Lim C, Ng E. Identification of different stages of diabetic retinopathy using retinal optical images. Journal of Information Science. 2008;178:106-121.

6. Tran K, Pakzad-Vaezi K. Multimodal imaging of diabetic retinopathy. Current Opinion in Ophthalmology. 2018;29:566-575.
7. Koustenis A Jr., Harris A, Gross J, Januleviciene I, Shah A, Siesky B. Optical coherence tomography angiography: an overview of the technology and an assessment of applications for clinical research. British Journal of Ophthalmology. 2017;101:16-20.
8. Spaide RF, Klancnik JM Jr., Cooney MJ. Retinal vascular layers imaged by fluorescein angiography and optical coherence tomography angiography. JAMA Ophthalmology. 2015;133:45-50.
9. Liao SB, Ku WC. Progression of diabetic retinopathy after phacoemulsification in diabetic patients: a three-year analysis. Chang Gung Medical Journal. 2003;26:829-834.
10. Whitcup SM, Cidlowski JA, Csaky KG, Ambati J. Pharmacology of corticosteroids for diabetic macular edema. Investigative Ophthalmology & Visual Science. 2018;59:1-12.
11. Kamppeter BA, Cej A, Jonas JB. Intraocular concentration of triamcinolone acetonide after intravitreal injection in the rabbit eye. Ophthalmology. 2008;115:1372-1375.
12. Fine BS, Brucker AJ. Macular edema and cystoid macular edema. American Journal of Ophthalmology. 1981;92:466-481.
13. Yanoff M, Fine BS, Brucker AJ, Eagle Jr RC. Pathology of human cystoid macular edema. Survey of Ophthalmology. 1984;28:505-511.
14. Kropp M, Golubnitschaja O, Mazurakova A, Koklesova L, Sargheini N, Vo T-TKS, *et al*. Diabetic retinopathy as the leading cause of blindness and early predictor of cascading complications-risks and mitigation. EPMA Journal. 2023;14:21-42.
15. Li Z, Tong J, Liu C, Zhu M, Tan J, Kuang G. Analysis of independent risk factors for progression of different degrees of diabetic retinopathy as well as non-diabetic retinopathy among type 2 diabetic patients. Frontiers in Neuroscience. 2023;17:114-476.
16. Rabiolo A, Cicinelli MV, Corbelli E, Baldin G, Carnevali A, Lattanzio R, *et al*. Correlation analysis between foveal avascular zone and peripheral ischemic index in diabetic retinopathy: A pilot study. Ophthalmology Retina. 2018;20:46-52.
17. Sim DA, Keane PA, Zarranz-Ventura J, Bunce CV, Fruttiger M, Patel PJ, *et al*. Predictive factors for the progression of diabetic macular ischemia. American Journal of Ophthalmology. 2013;156:684-692.
18. Samara WA, Shahlaee A, Adam MK, Khan MA, Chiang A, Maguire JI, *et al*. Quantification of diabetic macular ischemia using optical coherence tomography angiography and its relationship with visual acuity. Ophthalmology. 2017;124:235-244.
19. Kim S-Y, Yang J, Lee Y-C, Park Y-H. Effect of a single intraoperative sub-tenon injection of triamcinolone acetonide on the progression of diabetic retinopathy and visual outcomes after cataract surgery. Journal of Cataract and Refractive Surgery. 2008;34:823-826.
20. Amana-Rattan S, Kadhim-Mutasher M, Farhood Q, Al-Attar Z. Posterior subtenon triamcinolone acetonide combined with phacoemulsification for patients with diabetic maculopathy. Regional Medical Officer. 2022;96:111-117.
21. Lodhi S, Shailaja M, Jehan K. Efficacy and safety of intra-operative posterior sub-tenon's triamcinolone injection in cataract surgery associated with diabetic retinopathy. International Journal of Scientific Study. 2015;30:82-87.
22. Aiello LP. Randomized trial of peribulbar triamcinolone acetonide with and without focal photocoagulation for mild diabetic macular edema. Ophthalmology. 2007;40:700-50.
23. Spaide RF, Fujimoto JG, Waheed NK. Image artifacts in optical coherence tomography angiography. Retina. 2015;35:2163-2180.
24. Chen FK, Viljoen RD, Bukowska DM. Classification of image artefacts in optical coherence tomography angiography of the choroid in macular diseases. Clinical and Experimental Ophthalmology. 2016;44:388-399.

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