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# Assessment of Macular Perfusion in Normal and Myopic eyes by Optical Coherence Tomography Angiography

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**Abstract**

Background: Myopia has become a significant public health issue around the world, and high myopia is expected to affect approximately 10 percent of the population worldwide. Myopia at a high level has negative effects on the economy and society as well as permanent vision damage.With information about the macula's structures and vascular characteristics, the pathogenesis of macular degeneration can be investigated. Objective: Assess the macular perfusion in normal and myopic eyes by OCTA. Patients and methods This research involved 60 eyes from 60 participants, which were split evenly between two groups. The first group, which served as the study's control group, comprised 30 normal eyes, while the second group comprised 30 myopic eyes. Every case that was included was subjected to a comprehensive history review as well as a thorough ophthalmological examination. Along with measuring the superficial and deep macular vessels density, the OCTA was used to measure the thickness of the various retinal regions. Results: When compared to the myopia group, the Average, Superior , Inferior , Nasal, and Temporal RNFL were all significantly elevated in terms of statistical significance (P) (less 0.001).The mean density of superficial, deep macular vessel and superficial fovea vessel in the control when compared to the myopic group, had a value that was statistically and significantly higher. Conclusion: Myopia thins retinal layers and reduces macular and foveal density. The Coherence of Light Tomography angiography is a sensitive measurement that can detect changes in macula and fovea that are brought on by myopia.

**Key words:** Myopia, OCTA, RNFL, vessel density.

## 1.Introduction

In many developed countries, myopia is a leading contributor to the development of legal blindness. When pathologic myopia is present, elongation of the posterior segment can potentially result in the development of macular complications. These side effects include myopic choroidal neovascularization, lacquer crack (LC) formation, chorioretinal atrophy, and posterior staphyloma. Other macular complications include posterior staphyloma and chorioretinal atrophy (CNV)**[1]**.

Previous research conducted with a variety of imaging techniques has demonstrated that high myopia is associated with decreased retinal and choroidal perfusion.**[2, 3]**.

Observing ocular circulation in myopia has been done with fluorescein angiography (FA), However, FA did not perform well in imaging the deep capillary or radial peripapillary networks **[4]**. It was difficult to see the microvasculature using indocyanine green angiography, which was used to observe retrobulbar and choroidal vasculatures in Pathological myopia.**[5]**. In addition, the invasive nature of FA and ICGA, as well as the difficulty in quantifying their effects, prevented their widespread use in myopia research.**[6]**.

Additionally, the complexity of the choriocapillaris (CC) cannot currently be quantified by current clinical imaging techniques, making it challenging to identify morphologic changes in CC. This is due to the fact that deeper penetration causes a higher signal attenuation roll-off.**[7]**.

A noninvasive, reproducible tool called OCT-A , has recently been developed for better imaging and assessment retinal layers microvasculature . The introduction of OCT-recent A allowed for this evaluation**[8]**.

The CC was measured using OCTA in earlier studies, and flow voids were visible in both healthy and diseased eyes. These flow voids' size and number change in predictable ways as people age which suffer from degenerative diseases like AMD, and hypertension as an example of sysremic diseases. Previous studies have also noted areas of flow voids. **[3, 9, 10]**.

This research was conducted to assess the peripapillary and macular perfusion in normal and myopic eyes by OCTA**.**

## 2.Patients and methods

This research was carried out at the Benha University's department of ophthalmology in Benha, Egypt.

This study included 60 eyes of 60 subjects distributed into two groups; the first group included 30normal eyes as control group while the second group included 30 myopic eyes. The patient group included myopic cases with different grades of myopia and normal subject with emmtropia

Cases that met the following criteria were excluded ; any patient with previous major ocular surgery ex(retinal or corneal), myopic choroidal neovascularization, significant media opacity that prevent high quality imaging, retinal vascular disease and presence of degenerative myopic complications such as CNV and fovioschiesis.

All of the cases were put through a thorough general examination and a comprehensive history taking process after receiving a permission of the Benha Faculty of Medicine's institutional review board (MS/17.03.91) and obtaining an informed

written consent from the participants who were included in the study.

For each and every one of the cases, a comprehensive ophthalmic exam was performed, which included a Landolt's VA chart was used to assess the patients' visual acuity (VA). This data was then transformed for statistical analysis into logarithms of the minimal angle of resolution units

Slit lamp biomicroscopy was utilised in order to evaluate the corneal clarity, the depth and regularity of the anterior chamber, the shape, size, regularity, and reactivity of the pupil, as well as the state of the lens. An examination of the fundus was carried out using a +90 D volk lens.

Axial length was measured by IOL master (Zeiss IOL master 500 Jena Germany). All the included subjects underwent assessment by **OCT angiography** (Angio Vue; optivue Inc, Fremont, (California. USA) machine in Boston Diagnostic Eye Center).

**Patient preparation:**

All patients were examined without mydriatic eye drop and lubricant eye drops was installed to relieve dryness some patient need topical anesthetic for relieve burning sensation.

Patient was asked to put his chin in chin rest of machine, look in the center to internal fixation target that was central in position during macular scanning.

Machine captured the Image with high resolution and fast tracking through30 sec and patients were encouraged to blink during examination to moisture of the cornea without interrupting image acquisition due to auto tracking just by pressing joystick button.

To examine S macula vasculature, we choose from option list HD Angio retina 3x3 and HD Angio disc 4.5x4.5.

As regarding the assessment of density of the retina, a 3×3 millimeter macular angiogram of both SRL and DRL were analyzed by utilizing Optovue with density functions. All layers were segmented utilising Optovue. DRL propagated from the interface passivation layer with an interface offset of sixteen micrometres to the interface passivation layer with an interface offset of sixty-nine micrometres, whereas SRL propagated from the interface passivation layer with an interface offset of three micrometres from the inner limiting membrane to the interface passivation layer with an interface offset of sixteen micrometres. According to the ETDRS shape, flow density was individually measured in 5 locations. In addition, the overall en-face and parafoveal flow densities were calculated.

**Statistical analysis**

The software known as SPSS (version 27, distributed by IBM/SPSS Inc. of Chicago, Illinois) was utilised for the purpose of conducting the analysis of the data. The characteristics of the study population at the beginning of the research were outlined in the form of frequencies and percentages (percent), SD, and median values (Range).

It was decided whether to use Fischer's exact test or the Chi-Square test to compare two independent sets of categorical data. To determine the degree and direction of association between two continuous, parametric numerical variables, the Pearson correlation coefficient was used. To compare the Pearson correlation coefficient (Normally distributed) between two groups, one with parametric data and the other with non-parametric data, the Mann-Whitney U-test and Independent samples t-test were used. The data were deemed statistically significant if the probability of (p value) was less than 0.05

**3.Results**

Table (1) shows that the mean age in the control group was 37.80 ± 10.15 years and in the myopic group was 39.30 ± 6.29 years with with no significant relation between both groups. There were 73.3% and 63.3% females in the control and myopic group respectively, with neither group showed a difference that is statistically significant.

In the myopic, the spherical equivalent was statistically significantly lower. group ($p < 0.001$). Between control group and myopic group, a statistically significant difference was found, as determined by $p< 0.001$ for both the VA and the BCVA.

Comparing control group's mean IOP to that of the myopia group was 12.80± 1.40 mmHg, which, in terms of statistics, was significantly lower than the IOP associated with myopiagroup (15.33 ± 2.04 mmHg; $p< 0.001$ for both comparisons).

**Table (1)** Analysis of the demographic and clinical data in 2 study groups.

| | Control group (N=30) | | Myopia group (N=30) | | P value |
|---|---|---|---|---|---|
| Age (Years) | 37.80 ± 10.15 | | 39.30 ± 6.29 | | 0.494 |
| **Sex** | | | | | |
| **Males** | 8 | 26.7 % | 11 | 36.7 % | 0.405 |
| **Females** | 22 | 73.3 % | 19 | 63.3 % | |
| **OD** | 16 | 53.3 % | 16 | 53.3 % | 1 |
| **OS** | 14 | 46.7 % | 14 | 46.7 % | |
| Spherical equivalent | -0.50 (-1.25: 0.75) | | -10.50 (-19.75: 6.50) | | < 0.001* |
| **Hand movement** | 0 | 0 % | 5 | 16.7 % | 0.020* |
| VA | 1 (0.50 :1) | | 0.10 (0.10:0.30) | | < 0.001* |
| BCVA | 1 (0.90: 1) | | 0.30 (0.10:0.90) | | < 0.001* |
| IOP (mmHg) | 12.80 ± 1.40 | | 15.33 ± 2.04 | | < 0.001* |
| Axial length (mm) | 22.86 ± 0.54 | | 27.12 ± 1.12 | | < 0.001* |

The data presented in this table demonstrates that the average, Superior, Inferior, nasal, and Temporal RNFL in the control were statistically elevated as regard to the group with myopia ($p < 0.001$) for all of the variables.

Control group's mean whole superficial macular vessel density was statistically significantly elevated ($p< 0.001$) as regard to myopic group. In comparison to the myopic group, the control group's mean superficial fovea vessel density was statistically higher ($p = 0.038$). In addition, control group's mean whole deep macular vessel density was statistically significantly elevated than that of myopic. The mean deep fovea vessel density between myopic and control groups did not differ statistically from one another ($p = 0.711$).

Table (3) demonstrates that in the control group, axial length and the density of the superficial whole macular vessels had a statistically significant negative correlation. Also, superficial foveal vessel density correlated negatively with Spherical equivalent, VA, axial length, and Superior RNFL Statistically, superficial foveal vessel density correlated positively with nasal RNFL.

Age, Spherical equivalent, VA, IOP, and Superior RNFL correlated negatively with superficial whole macular vessel density. Also, superficial foveal vessel density decreased with age and IOP. However, superficial foveal vessel density correlated positively with Average RNFL and Nasal RNFL.

Table (4) In the myopic group, superficial whole macular vessel density correlated negatively with axial.

On the other hand, there was a positive correlation that could be considered statistically significant between the density of superficial macular vessels and spherical equivalent, BCVA, and inferior RNFL. Additionally, it was found that there is a statistically significant inverse relationship between the density of the deep whole macular vessels and axial length. A positive statistical significance correlation existed between the inferior RNFL, BCVA, and superficial whole macular vessel density VA.

**Table (2)** Analysis of RNFL, thickness (Mm), superficial and deep macular vessel density in 2 study groups.

| | Control group (N=30) | Myopia group (N=30) | P value |
|---|---|---|---|
| **Retinal nerve fibre layer (RNFL) thickness (Mm)** | | | |
| **Average RNFL** | 105.13 ± 5.72 | 86.23 ± 11.55 | < 0.001* |
| **Superior RNFL** | 124.47 ± 14.12 | 95.90 ± 19.12 | < 0.001* |
| **Inferior RNFL** | 128.20 ± 9.44 | 111.40 ± 19.36 | < 0.001* |
| **Nasal RNFL** | 89 ± 14.86 | 66.73 ± 15.69 | < 0.001* |
| **Temporal RNFL** | 78 ± 8.01 | 70.93 ± 14.76 | 0.025* |
| **Superficial macular vessel density % (in 3.00 x 3.00 mm)** | | | |
| **Whole macular vessel density (%)** | 50.12 ± 1.35 | 42.98 ± 4 | < 0.001* |
| **Fovea vessel density (%)** | 21.91 ± 3.54 | 19.80 ± 4.12 | 0.038* |
| **Deep macular vessel density % (in 3.00 x 3.00 mm)** | | | |
| **Whole macular vessel density (%)** | 53.78 ± 3.80 | 50.30 ± 5.27 | 0.005* |
| **Fovea vessel density (%)** | 35.46 ± 8.30 | 36.21 ± 7.33 | 0.711 |

**Table (3)** Relationship between the control group's parameters and the density of the superficial and deep macular vessels

| **Variables** | **Superficial macular vessel density** | | | | **deep macular vessel density** | | | |
|---|---|---|---|---|---|---|---|---|
| | **Whole macular vessel density** | | **Fovea vessel density** | | **Whole macular vessel density** | | **Fovea vessel density** | |
| | **r** | **P** | **r** | **P** | **r** | **P** | **r** | **P** |
| **Age** | - 0.374 | 0.061 | - 0.154 | 0.416 | - 0.523 | 0.003* | - 0.477 | 0.008* |
| **Spherical equivalent** | - 0.256 | 0.172 | - 0.464 | 0.010* | - 0.590 | 0.001* | 0.026 | 0.893 |
| **VA** | - 0.308 | 0.098 | - 0.698 | < 0.001* | - 0.451 | 0.012* | - 0.229 | 0.223 |
| **BCVA** | - 0.062 | 0.745 | -0.031 | 0.871 | - 0.309 | 0.096 | -0.247 | 0.187 |
| **IOP (mmHg)** | - 0.289 | 0.121 | - 0.260 | 0.166 | - 0.467 | 0.009* | - 0.479 | 0.007* |
| **Axial length (mm)** | - 0.580 | 0.001* | - 0.463 | 0.049* | 0.164 | 0.385 | 0.032 | 0.866 |
| **Average RNFL** | - 0.061 | 0.750 | - 0.026 | 0.890 | - 0.154 | 0.416 | 0.440 | 0.015* |
| **Superior RNFL** | - 0.337 | 0.069 | - 0.618 | < 0.001* | - 0.541 | 0.002* | - 0.215 | 0.255 |
| **Inferior RNFL** | - 0.183 | 0.332 | - 0.005 | 0.997 | - 0.081 | 0.672 | 0.357 | 0.053 |
| **Nasal RNFL** | 0.068 | 0.720 | 0.435 | 0.016* | 0.258 | 0.169 | 0.487 | 0.006* |
| **Temporal RNFL** | - 0.065 | 0.734 | 0.022 | 0.910 | - 0.172 | 0.363 | 0.260 | 0.165 |

**Table (4)** Correlation between Superficial and deep macular vessel density and other parameters in the myopic group

| Variables | Superficial macular vessel density | | | | deep macular vessel density | | | |
|---|---|---|---|---|---|---|---|---|
| | Whole macular vessel density | | Fovea vessel density | | Whole macular vessel density | | Fovea vessel density | |
| | r | P | r | P | r | P | r | P |
| **Age** | - 0.334 | 0.071 | - 0.033 | 0.863 | - 0.348 | 0.059 | - 0.295 | 0.113 |
| **Spherical equivalent** | 0.419 | 0.021* | 0.257 | 0.171 | 0.344 | 0.069 | 0.332 | 0.073 |
| **VA** | - 0.188 | 0.368 | - 0.223 | 0.284 | 0.532 | 0.006* | - 0.016 | 0.938 |
| **BCVA** | 0.367 | 0.046* | -0.098 | 0.606 | 0.569 | 0.001* | 0.197 | 0.296 |
| **IOP (mmHg)** | 0.062 | 0.745 | 0.164 | 0.387 | - 0.113 | 0.552 | - 0.086 | 0.671 |
| **Axial length (mm)** | - 0.377 | 0.040* | 0.108 | 0.568 | - 0.388 | 0.034* | - 0.141 | 0.458 |
| **Average RNFL** | 0.199 | 0.293 | - 0.033 | 0.863 | 0.348 | 0.060 | 0.226 | 0.229 |
| **Superior RNFL** | - 0.148 | 0.437 | 0.096 | 0.615 | 0.157 | 0.409 | 0.250 | 0.183 |
| **Inferior RNFL** | 0.396 | 0.030* | - 0.230 | 0.222 | 0.405 | 0.026* | 0.021 | 0.913 |
| **Nasal RNFL** | 0.125 | 0.512 | - 0.200 | 0.290 | 0.289 | 0.122 | 0.066 | 0.730 |
| **Temporal RNFL** | 0.330 | 0.221 | 0.081 | 0.671 | 0.242 | 0.198 | 0.157 | 0.407 |

**3.Discussion**

In this article , we used OCTA to measure the perfusion of the macula in normal and myopic eyes.

This research utilised a total of 60 eyes from 60 participants, which were split evenly between two groups. The first group, which served as the study's control group, comprised 30 normal eyes, while the second comprised 30 myopic eyes.

Between the control and myopic groups, the VA and BCVA both discovered a statistically significant difference (p less than 0.001 for both).

This was in accordance with the findings of Mo et al., who conducted research on a total of 131 eyes and divided them into 3 groups: 45 eyes with emmetropia (EM), 41 eyes with high myopia (HM), and 45 eyes with pathological myopia (PM) . The WM group had the highest visual acuity of the three groups that were tested, and BCVAwas significantly differed between groups. **[6]**.

This was in contradiction to the findings of MIN et al., who demonstrated that (Logarithm of the minimum angle of resolution was 0.02 ±0.04 in control group, whereas it was 0.06± 0.09 in the myopia group. Between these two groups, there was no statistically significant difference (p = 0.122).**[11]**.

The varying sample size may help to explain the variation, in addition to the fact that participants had varying degrees of myopia.

When compared to the myopic group, which had an average ALof 27.12± 1.12 mm, the control group's mean AL of 22.86± 0.54 mm which was statistically significantly lower than the myopic group's value (p < 0.001) in this research study.

This came in agreement with Min et al. who showed that the mean AL in control group was 24 ± 1.1 mm that was statistically significantly lower as compared to the myopic group (27.5 ± 1.1 mm) (p < 0.001) **[11]**.

Within the same line, our results agreed with Ucak who showed that the mean AL in control group was 23.09 ± 0.78 mm was statistically lower than it was for the group with myopia (26.97 ± 0.79 mm) (p < 0.001) **[12]**.

In the current research, the mean whole superficial macular vessel density in the control group was 50.12± 1.35 percent, which was Statistically higher than myopic (42.98 ±4 percent) value (p < 0.001 for both comparisons). In addition, the myopic group had a mean whole deep macular vessel density of 50.30 ±5.27 percent, whereas the control group had 53.78± 3.80 percent, which was statically lower (p< 0.001) than the myopic group's value (53.78 3.80 percent).

This was in accordance with the findings of Min et al., who examined 52 eyes belonging to 52 patients with high myopia and fifty-two eyes belonging to 52 normal, age- and sex-matched controls. The authors demonstrated that the average parafoveal VD in the SCP was 54.8 ±3.0 percent for the control group, and it was 52.7 ±4.2 percent for the myopia group (p = 0.007).**[11]**.

The mean parafoveal VD in the SCP was 54.8 ± 3.4% and 52.6 ± 4.1% in the nasal sector (p = 0.007), and 55.1 ± 4.8% and 52.4 ± 5.3% in the inferior sector (p = 0.005) in the control and myopia groups, respectively. They came in at 62.2± 2.2 percent and 61.6± 3.0 percent, respectively, in the DCP, and neither group was differed statistically (p = 0.426).**[11]**.

Ucak and his coworkers discovered that high myopia patients had lower superficial (p = 0.005) and

deep ($p < 0.001$) vascular densities than controls...**[12]**.

According to Jiang and his colleagues, the overall macular VFD was higher in the NHM group than in the HM group in the superficial retinal layer ($51.27 \pm 3.74$ vs. $48.07 \pm 5.69$, $p < 0.05$).There were significant differences between the NHM and HM in parafovea ($52.58 \pm 5.78$ vs. $49.4 \pm 6.43$, $p < 0.05$), superior-hemi ($53.38 \pm 4.03$ vs $49.78 \pm 6.84$, $p < 0.05$) and inferior-hemi regions ($53.49 \pm 4.61$ vs $49.05 \pm 6.41$, $p < 0.05$), but not in the fovea region. Similarly, in the deep retinal layer, The NHM group's overall macular VFD was significantly higher than the HM group's. ($58.69 \pm 2.46$ vs. $56.90 \pm 4.08$, $p < 0.05$).

HM and NHM superior-hemi differed significantly ($61.97 \pm 2.68$ vs. $60.08 \pm 3.98$, $p < 0.05$). Fovea, parafovea, and inferior-hemi showed no significant differences. (Jiang et al., 2021).

This also agreed with Al-Sheikh et al. who included fifty eyes of 28 patients with myopia and thirty-four eyes of 20 age-matched healthy individuals as a control group. Myopic eyes had lower VD in both capillary plexuses (superficial and deep) ($P < 0.001$).**[7]**. Our results are in line with earlier research using different methods.

Using laser blood flowmetry, Shimada and colleagues discovered that high myopia was associated with decreased retinal blood flow. They determined that the smaller diameter of the retinal vessels was the cause of the decreased blood flow. Myopic eyes were reported by Shimada et al. to have an unaltered velocity of blood flow within the vessel**[13]**.

Our research suggests that the retina's microvasculature may be stretched, resulting in decreased VD rather than loss.

Using laser Doppler velocimetry, Tokoro found similar results, the myopia reduces the diameter and blood flow of the vessels in the retina.**[14]**.

Mo et al. discovered that, with the exception of the foveal, deep temporal, and deep nasal regions, the PM group had lower macular flow density than the HM and EM groups. Both the deep and surface retina contained this.Mo et al. found that the PM group had lower macular flow density than the HM and EM groups, except in the foveal, deep temporal, and deep nasal regions**[6]**.

One study discovered severe choriocapillaris atrophy and shifted anatomical levels in eyes with pathological myopia; however, the choriocapillaris layer was still autosegmented by RPE software with an RPE offset of 31–59. μm. It may be due to this that PM and HM in this study did not have significantly different choriocapillary flow densities. (Jonas and Xu, 2014).

In paediatric cases, the exact same thing was reported. In the course of conducting their research, Gobiewska et al. recruited a total of 96 myopic children in orderly succession in addition to 60 emmetropic children (2019). According to the findings of this research, Controls had higher whole SRVD, parafovea SRVD, and PFT than myopic subjects (p less than0.001, p = 0.007, and p less than 0.01 respectively).**[15]**.

In this research, the mean superficial fovea vessel density in the control group was $21.91 \pm 3.54$ % that was statistically significantly greater than the myopic e.group ($19.80 \pm 4.12\%$) ($p = 0.038$). Despite this, the mean deep fovea vessel density between myopic group and control group did not differ in a manner that could be considered statistically significant ($p = 0.711$).

Al-Sheikh et al. found that foveal density in the SCP and DCP was statistically lower (SCP $P < 0.001$, DCP $P = 0.001$) **[7]**.

In highly myopic eyes, excessive axial elongation may cause retina, choroid, and sclera biomechanical stretching. This theory has been put forth.

When the vessels in highly myopic eyes are stretched mechanically, this can lead to a straightening and narrowing of the vessels as well as a reduction in the associated branching.**[16, 17]**.

Despite this, the mean deep fovea vessel density between the myopic group and control group did not differ in a manner that could be considered statistically significant.

Fan et al. found a significant decrease in SCP VD in moderate and high myopia, but a significant decrease in DCP VD in high myopia, which was linked to the severity of myopia **[18]**.

This implies that to the myopic eye, the SCP VD is smaller than the DCP. The vessels in the parafoveal DCP may be closer together than in other areas..**[19]**.

This disparity between the pieces of research might also be attributable to the populations that were studied. The age ranges of patients in studies show that VD of myopic and high-myopic patients found no significant difference**[20]**. Macular vascular degeneration decreases at a more rapid rate as one gets older.**[21]**.

The average, superior, inferior, nasal, and temporal RNFL all demonstrated a statistically significant reduction in the myopic eyes when compared to normal eyes.

The findings of Ucak et al., which were consistent with our own, demonstrated that the(four quaderant RNFL) and ETDRS thicknesses (p less than 0.001) of the 2 groups were significantly different from one another.**[12]**.

In high myopia cases, the average and focal RNFL thinning were significantly thinner than in healthy controls . According to Qu et al., this. Despite the fact that retinal blood flow velocities between patients with moderate and high myopia and healthy controls were not significantly different, SVD and DVD were significantly lower in the myopia groups than in control group. Although the SVD or DVD between the myopia and the control group did not significantly differ from one another, this was the case. **[22]**.

This was also in line with what Hao et al., who examined a group consisting of 40 myopia patients with retinopathy and 40 healthy individuals who were part of the control group during the same time period. The authors' findings showed that the study group's nerve thickness was significantly different from that of the control group in terms of both the nerve thickness above and below the optic disc as well as the temporal and nasal nerve thickness of the optic disc ($P < 0.001$) **[23]**.

Al-Sheikh et al. reported that the mean subfoveal choroidal thickness was 123.538 ± 73.477 μm (range, 20–309 μm) in the myopic eyes and 246.97 ± 41.745 μm (range, 187–346 um) in the control group ($P < 0.05$) **[7]**.

In terms of retinal and choroidal thickness, Min and his colleagues found no differences between the two groups. Parafoveal thickness varied significantly (312.4 ± 15.3 m in myopia and 320.0 ± 19.3 m in control, $p = 0.046$). Parafoveal thickness varied significantly.In the group of people with myopia, the mean SFCT was 153.6± 84.4 m, while in the group of people who served as controls, it was 256.4± 61.8 m ($p< 0.001$). **[11]**.

This suggests that choriocapillaris perfusion is independent and that choroidal thinning is a result of ocular elongation **[24]**.

The development of lacquer cracks and choroidal neovascularization can result from choroidal thinning, which is a precursor to non-pathological myopia. Compared to other eye conditions, its prognosis is worse.**[25, 26]**.

However, there is disagreement over the findings of the choriocapillaris blood flow study in the relevant literature.. This could be because myopic eyes have a significant amount of choroidal thinning, which makes it challenging to evaluate the amount of blood flow in the choriocapillaris.**[27, 28]**.

This may confirm a redistribution of retinal thickn ess related to the increased AL of myopic eyes. Read e t al. found a reduced thickness in the parafoveal region of myopic children**[29]**.

In the present investigation, we found that there is an inverse relationship between age and both the deep whole macular vessel density as well as the deep fovea vessel density. Leng et al. discovered that age caused a decrease in the vessel densities of both the superficial and deep capillary plexuses. **[30]**.

The choroidal neovascularization area was also found to be significantly smaller in younger patients (less than 55 years old) compared to older patients by Leveziel et al., who used fluorescein angiography and spectral-domain OCT in highly myopic patients**[31]**.

The density of the superficial whole macular vessels and BCVA were found to have a statistically significant negative correlation in the current study. This came within the same context as Mo et al., who showed that in the superficial retinal layers, BCVA was shown to be positively correlated with whole en face flow density ($p <0.001$). In addition, choriocapillary flow density and BCVA were found to be positively correlated ($p = 0.001$)**[6]**.

A statistically significant inverse correlation between the density of deep whole macular vessels and BCVA was discovered within the context of the current investigation.

According to Ucak et al., there is a negative correlation between vascular densities and logMAR converted BCVA. Patients' visual acuity is impacted by changes in vascular structures. The best corrected visual acuity is LogMAR. **[12]**.

We believe that ophthalmologists need to be made aware of the link between vascular changes and visual disturbances.This is so because high myopia, in our opinion, is a significant etiological factor for visual impairment.

The results of this research revealed an inverse relationship between AL and the superficial and deep levels of whole macular vessel density that was statistically significant. Deep foveal vessel density inversely correlated with AL.

. Mo and his coworkers found that whole en face flow density was significantly negatively correlated with AL in both the superficial and deep retinal layers (superficial: $\beta=-0.542$, $p<0.001$; deep: $\beta=-0.282$, $p=0.002$). Between AL and choriocapillary flow density, no meaningful correlation was discovered. **[6]**.

Reduced main retinal vessel dimensions appeared to have an inverse relationship with AL, according to Spina et al..**[3]**, Yang et al.25 used OCTA to measure the microvessel density in 33 eyes with severe myopia, 47 eyes with mild myopia, and 47 eyes with emmetropia. They discovered that the density of the microvessels significantly decreased with A.L**[32]**.

Yang et al.25 used OCTA to examine the microvessel density in 33 highly myopic eyes, 47 mildly myopic eyes, and 47 emmetropic eyes. They discovered that the microvessel density significantly decreased with A.L. The impact that AL has had in some cases may be explained by the result of transverse magnification. The scanning area in the retina will be larger if the AL is longer**[12]**.

As one moves away from the central fovea, you and your colleagues showed that the superficial retinal vessel density increases from 0.3 to 1.5 mm. The density of the superficial retinal vessels gradually decreased with distance from 1.5 mm and increased in the nasal direction.**[33]**.

The current study discovered that the inferior RNFL and the superficial whole macular vessel density significantly positively correlate. There was a statistically significant correlation. The density of the deep fovea vessels correlated positively and statistically significantly with both the average and nasal RNFL. The correlation between the two eyes was found.

.Min et al. found a positive correlation between inner retinal thickness and SCP VD ($r = 0.228$, $p = 0.033$). Significant correlations between SCP

parafoveal VD and inner retinal thickness were found in all four quadrants: temporal ($r = 0.391$, $p < 0.001$), superior ($r = 0.396$, $p < 0.001$), nasal ($r = 0.442$, $p < 0.001$), and inferior sectors ($r = 0.460$, $p < 0.001$), respectively **[11]**.

There were only a few cases in this single-center, cross-sectional, monoracial study. The ocular vasculature of myopia may be better understood by a larger study.

## 4.Conclusion

Based on the results of the current study, Myopia is a common eye condition that has a high prevalence rate. Myopia is linked to a reduction in the overall macular and foveal density, as well as a thinning of the retina's various layers. OCTA is a sensitive device for detection of macular and foveal changes associated with myopia.

## Conflict of Interest

The authors have stated that there are no competing interests.

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