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## CAN RETINAL VASCULAR PERFUSION ON ANGIO-OCT BE A DIAGNOSTIC INDICATOR IN PATIENTS WITH DIABETIC RETINOPATHY?

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### ABSTRACT

Angio-OCT clearly presents the blood supply to the retinal vascular plexus in the macular area. The purpose of this study is to compare the data received from the examination of the vascular microvascular network in patients with diabetic retinopathy. Vascular density and perfusion have been found to be important indicators in diagnosing and monitoring disease progression.

**Key words:** Angio-OCT, diabetic retinopathy, retinal vascular density.

### INTRODUCTION

Diabetic retinopathy (DR) as one of the microvascular complications of type 1 and type 2 diabetes mellitus is the leading cause of blindness worldwide. Therefore, timely diagnosis and treatment could make their favorable contribution to slowing the progression of the disease.

Optical coherence tomography angiography (Angio-OCT) is a non-invasive technique for assessing ocular vasculature, including the retina, macula, choroid, and optic nerve. Angio-OCT has a wide range of clinical applications in various pathological changes of the visual system, which have been independently reported in the literature. It is of paramount importance for the diagnosis and treatment of patients with diabetic retinopathy.

This overview aims to provide a review of the current literature on the clinical use of Angio-OCT in monitoring the changes in the superficial and deep capillary plexus in patients with diabetic retinopathy. It is based on a reference covering the period 2016-2020 in the following databases: Cochrane Library of Systematic Reviews, Medline, Scopus – Web of Science, LIVIVO – The Search portal for Life

Sciences. The main variables are vessel density, area and diameter of the foveal avascular zone, vascular flow rate and flow index.

Angio-OCT provides a three-dimensional image of the retina and helps to obtain information about the changes in the superficial and deep capillary plexus. (1) According to *De Carlo et al.*, the area of the foveolar avascular zone is more extensive in patients with diabetes mellitus. In addition, there are areas of vascular ischemia. Microaneurysms and vascular ischemia become clearly distinguishable by Angio-OCT before being detected after a thorough ophthalmologic examination of the patient's dilated pupils.

Clinical understanding of changes at the microvascular level may provide important information about the retinal perfusion status during the various stages of DR and the likelihood of developing a more severe form of the disease.

Retina has the ability to regulate blood flow to the visual analyzer. Histologically, there are four different capillary plexuses of the retina and only three of them are clearly visible in the macula: superficial, middle and deep capillary plexus.

Vessel density (VD) is defined as a percentage of the total area occupied by the lumens of the vessels obtained after binary reconstruction of images. VD and foveal avascular zone (FAZ) *in vivo* quantification helps detect and monitor the progression of the vascular diseases in the retinal area.

The percentage of vessels in relation to the total area is sectorally located (upper, temporal, lower and nasal sectors), where the fovea is automatically determined. The inner and outer rings are 1 and 2.5 mm in diameter, respectively, around the fovea.

Degeneration of retinal capillary pericytes and endothelial cells represents early and seemingly invariable features in the pathogenesis of diabetic retinopathy. The loss of these cells leads to acellular capillaries with impaired or absent perfusion. The resulting ischemia stimulates increased levels of vascular endothelial growth factor (VEGF) and erythropoietin, which leads to increased vascular permeability and is the basis of disease proliferation.

In the initial non-proliferative form of diabetic retinopathy, there are microaneurysms, hemorrhages and dry exudates. (6) Angio-OCT gives us comprehensive information about the areas of ischemia. In places, cystoid spaces may be seen as round, black formations with different arrangements in the direction of the superficial to the deep capillary plexus. Moderate non-proliferative diabetic retinopathy has intermediate changes.

The clinical signs of advanced nonproliferative diabetic retinopathy are more than 20 intraretinal hemorrhages in the four quadrants of the retina, vascular dilatation, and increased areas of ischemia at the level of the superficial and deep capillary plexus.

In proliferative diabetic retinopathy, there is neovascularization with extensive areas of ischemia. Angio-OCT images show a significant increase in the area of the foveal avascular zone and consequently, the area of vascular ischemia. (2-4)

On Angio-OCT, FAZ in a healthy individual is depicted as a well-demarcated circle or oval area with reduced capillary density with no-gap borders of the capillary network and in the superficial and deep plexus. The longest diameter may be along the vertical or horizontal axis (5). FAZ diameters in patients with no abnormalities are similar for the superficial (SCP), middle (MCP) and deep capillary plexus (DCP). In diabetics, FAZ is increased due to changes in vasculature (5). FAZ often appears asymmetric due to the gaps or rupture of capillary networks that form irregular circles with weak reflection, outlining the extended FAZ (5).

Angio-OCT increases the possibilities for qualitative assessment of FAZ. The most impressive are the quantitative assessments of FAZ as its values significantly increase with the progression of the disease. (2, 4, 5). **Table 1** shows a summary of the mean FAZ values at different stages of the disease. The table does not distinguish between values in the superficial and deep plexus.

**Table 1.** FAZ size correlations with diabetic retinopathy grade in the articles reviewed.

Subjects	Mean diameter in micron (Range)	Mean area in mm <sup>2</sup> (Range)
Healthy individual	350-659	0.25-0.40
Diabetics with no DR	370-696	0.34-0.54
NPDR	370-813	0.40-0.46
PDR	410-1,150	0.47

According to a study based on an automated microstructural analysis of 48 eyes with diabetic maculopathy and 47 healthy eyes evaluated by Spectralis OCT-A, perifoveal arcade disorders, linear vascular dilatations, microaneurysms, intraretinal microvascular abnormalities and

avascular zones were detected and proven. For this purpose, the superficial and deep capillary plexuses were examined. A fully automated microstructural analysis of the indicators of the foveal avascular zone, vascular and avascular areas was performed.(6-8) Quantitative values of

diabetes patients were compared with those in healthy individuals and it was found that there was a significant difference in the values of the two plexuses in the presence or absence of disease. (9-11)

## CONCLUSION

This study proves the importance of Angio-OCT in the diagnosis and monitoring of diabetic retinopathy. Quantitative and qualitative changes may be a criteria for disease progression.

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