OCT Angiography

Basic Principles and Interpretation
OCT Angiography
Basic Principles

- **Ultra-clear** visualization of *microvascular* blood flow using non-invasive OCT Angiography.
- OCTA allows visualization of both perfused vasculature and vascular abnormalities of the retina by detection of movement in tissue → **Red Blood Cells**
How OCT-A Works?
OCT – A in Normal Eye (Topcon)

OCT-A of a normal eye.
AngioPlex™ Technology detects motion of scattering particles such as red-blood cells within sequential OCT B-scans performed repeatedly at the same location of the retina.

AngioPlex Maps consist of reconstruction of the perfused microvasculature within the retina and choroid.
<table>
<thead>
<tr>
<th>OCTA</th>
<th>FFA</th>
<th>ICGA</th>
</tr>
</thead>
<tbody>
<tr>
<td>New technology not validated</td>
<td>Well-validated technology</td>
<td>Well-validated technology</td>
</tr>
<tr>
<td>Correlation to multimodal imaging and</td>
<td>Correlation to multimodal imaging and</td>
<td>Invasive, need for dye risk of anaphylaxis</td>
</tr>
<tr>
<td>histology</td>
<td>histology</td>
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<tr>
<td>Non-invasive, no need for dye</td>
<td>Invasive, need for dye</td>
<td></td>
</tr>
<tr>
<td>Rapid acquisition time</td>
<td>Time-consuming to perform</td>
<td>Time-consuming to perform</td>
</tr>
<tr>
<td>Interpretation may require more time</td>
<td>Image viewing may be faster</td>
<td>Image viewing may be faster</td>
</tr>
<tr>
<td>Provides depth information of both retinal</td>
<td>No information about individual layers</td>
<td>No information about individual layers</td>
</tr>
<tr>
<td>and choroidal vasculature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Able to segment various layers</td>
<td>Retina imaged in entirety</td>
<td>Choroid imaged in entirety</td>
</tr>
<tr>
<td>Able to image through blood</td>
<td>Blockage from blood</td>
<td>Able to penetrate blood</td>
</tr>
<tr>
<td>Artefacts may hamper interpretation</td>
<td>Less artefact</td>
<td>Less artefact</td>
</tr>
<tr>
<td>Detection of flow but not leakage</td>
<td>Detection of leakage and activity</td>
<td>Detection of leakage and activity</td>
</tr>
<tr>
<td>High resolution down to capillaries in the</td>
<td>Lower resolution, able to image large retinal vessels but not capillaries</td>
<td>Able to image large choroidal vessels but not choriocapillaries</td>
</tr>
<tr>
<td>retina</td>
<td>Wide-field option available</td>
<td>Wide-field option available</td>
</tr>
<tr>
<td>Small field of view</td>
<td>Stereoscopic option</td>
<td>Stereoscopic option</td>
</tr>
<tr>
<td>No stereoscopic function</td>
<td>Video function available</td>
<td>Video function available</td>
</tr>
<tr>
<td>No dynamic video function</td>
<td></td>
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</tr>
</tbody>
</table>
OCTA interpretation and potential artefacts

High-quality image acquisition for each OCTA platform has a learning curve; hence good technical support is essential and poor quality images should be identified.

Instrument-related factors that may affect image quality include differences in acquisition time.

Patient-related factors include age, ability to cooperate and maintain fixation, and the presence media opacity.

Similar to image acquisition, OCTA interpretation by the clinician, also has a learning curve.

The user interfaces of most of the current OCTA platforms vary; however, the basic components are similar.
<table>
<thead>
<tr>
<th>Specifications</th>
<th>AngioVue</th>
<th>Angioplex</th>
<th>Spectralis OCTA</th>
<th>SS OCT Angio</th>
<th>Angioscan</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCT platform</td>
<td>AngioVue RTVue XR</td>
<td>CIRRUS HD-OCT</td>
<td>Spectralis OCT-2</td>
<td>DRI-OCT Triton</td>
<td>RS-3000 Advance</td>
</tr>
<tr>
<td>Imaging company</td>
<td>Avanti</td>
<td>Carl Zeiss Meditec, Inc</td>
<td>Heidelberg Engineering</td>
<td>Topcon Corporation</td>
<td>Nidek</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Fremont, CA, USA</td>
<td>Dublin, CA, USA</td>
<td>Heidelberg, Germany</td>
<td>Tokyo, Japan</td>
<td>Gamagori, Aichi, Japan</td>
</tr>
<tr>
<td>Scanning speed</td>
<td>70 000 scans/s</td>
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<td>256 × 256 A scans</td>
</tr>
<tr>
<td>Algorithm</td>
<td>SSADA</td>
<td>OMAG</td>
<td>Probabilistic model that predicts whether a voxel contained flow or not.</td>
<td>OCTA—ratio analysis (full-spectrum amplitude)</td>
<td>Complex difference (full-spectrum amplitude)</td>
</tr>
<tr>
<td>Type of algorithm</td>
<td>Amplitude</td>
<td>Amplitude+phase</td>
<td>Probabilistic model</td>
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<td>Amplitude +phase</td>
</tr>
<tr>
<td>Scan area (macula)</td>
<td>3 × 3, 6 × 6, 8 × 8 mm</td>
<td>3 × 3, 6 × 6, 8 × 8 mm</td>
<td>3 × 3 mm with (5.7 × 5.7) μm/px</td>
<td>3 × 3, 4.5 × 4.5, 6 × 6, 9 × 9 mm</td>
<td>3 × 3-9 × 9 mm (12 × 9 montage)</td>
</tr>
<tr>
<td>Optical resolution</td>
<td>3 μm</td>
<td>5 μm</td>
<td>7 μm</td>
<td>8 μm</td>
<td>7 μm</td>
</tr>
<tr>
<td>Axial</td>
<td>15 μm</td>
<td>15 μm</td>
<td>14 μm</td>
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<tr>
<td>Lateral</td>
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<td>840 nm</td>
<td>880 nm</td>
<td>1050 nm</td>
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</tr>
<tr>
<td>Light source</td>
<td>2-3 mm</td>
<td>2 mm</td>
<td>1.9 mm</td>
<td>2.6 mm</td>
<td>2.1 mm</td>
</tr>
<tr>
<td>Automated</td>
<td>Superficial retinal capillary plexus</td>
<td>Retina depth encoded</td>
<td>Four presets matching vasculature in retinal nerve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>segmentation options</td>
<td>Deep retinal capillary plexus</td>
<td>Vitreo-retinal interface</td>
<td>fibre layer, ganglion cell layer and</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Outer retina</td>
<td>Superficial retina</td>
<td>retinal nerve</td>
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<tr>
<td></td>
<td>Choriocapillaries</td>
<td>Deep retina</td>
<td>fibre layer, ganglion cell layer and</td>
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<tr>
<td></td>
<td></td>
<td>Avascular layer</td>
<td>retinal nerve</td>
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<td></td>
<td></td>
<td>Choriocapillaris</td>
<td>Three presets to cover the retina</td>
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<td></td>
<td></td>
<td>Choroid</td>
<td>(superficial,</td>
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<tr>
<td></td>
<td></td>
<td>Superficial retinal layer</td>
<td>deep vascular plexus and avascular layer</td>
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<tr>
<td></td>
<td></td>
<td>Deep retinal layer</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Avascular</td>
<td></td>
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<tr>
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<td></td>
<td></td>
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<tr>
<td>Colour coding of</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>segmentations</td>
<td></td>
<td></td>
<td>Yes (TruTrack)</td>
<td>Yes (Smart Track)</td>
<td>Yes</td>
</tr>
<tr>
<td>Cross-sectional OCTA</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (Fast Trac)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>image</td>
<td></td>
<td></td>
<td>Available with newer models</td>
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<td></td>
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</tr>
</tbody>
</table>
Steps of OCTA Interpretation

Assess the scan quality
Assessment of the scan centration, resolution and signal strength. Signal strength may be affected by patient co-operation, fixation or medial opacity.
ID: 0014
Name: Teleangiectasia

OD (R)  Image Quality: 70  Analysis mode: Fine (2.0.7)
Myopia Mode  Capture Date: 26/01/2016
Angiography (Superficial)  Angiography (Deep)  Angiography (Outer retina)  Angiography (Choriocapillaris)

OCT B-Scan  Composite Angiography  Fundus

Comments:

Signature:  Date:
Identify the layer and the area of interest
Notice the detailed clinical exam and structural OCT → at which layer the pathology lies
Choose the scan options (depends on OCTA platform)
OCTA scan may be decentered from the fovea
## Overview

### OCT Angiograms

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*Zeiss AngioPlex*

Image source: ZEISS Clinical Database
AngioPlex™ Map consists of a 2D representation of retinal the vasculature of a particular region of interest.

AngioPlex™ Maps

Superficial Retina Map
Visualization of blood flow in superficial retina.
ILM - IPL

Deep Retina Map
Visualization of blood flow in deep retina.
IPL - OPL

Avascular Retina Map
Avascular region of the retina in healthy eyes. Allows for detection of abnormal vascular growth.
OPL - RPE
Choose the preset segmentation pattern that best captures the area of abnormal flow

All the commercially available OCTA instruments are built with automated segmentation (Table 2). If no particular segmentation pattern is able to accurately capture the area of abnormal flow, (for example, for studying large choroidal vessels or pre-retinal neovascularisation), customised segmentations patterns may be necessary to obtain an optimised en face OCTA image.
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OCT Angiograms

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Image source: ZEISS Clinical Database
Manual manipulation of the segmentation to optimize the en face OCTA image
The exact depth and thickness of the preset segment varies according to individual instrument. Further manual adjustment of the lower and the upper boundaries of various segmentation patterns will allow the en face OCTA image to be easily tailored towards the clinical question.
In some pathological cases, where the anatomy is severely disrupted, automated segmentation may not be accurate
Correlate to other imaging modalities

OCTA is a new technology, which has yet to be validated; hence, interpretation should be done with caution and in equivocal cases correlation with more conventional modalities such as fundus fluorescein angiography (FA) or indocyanine green angiography (ICGA).
Be mindful of artefacts
<table>
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<th>SS OCT Angio DRI-OCT Triton swept source OCT Topcon Corporation</th>
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<td>Light source</td>
<td>840 nm</td>
<td>840 nm</td>
<td>880 nm</td>
<td>1050 nm</td>
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</tr>
<tr>
<td>Axial imaging depth</td>
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<td>1.9 mm</td>
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<td></td>
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<td>segmentation options</td>
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<td>Colour coding of</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>No</td>
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<tr>
<td>image</td>
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<td>Eye tracker</td>
<td>Software update for</td>
<td>Yes (Fast Trac)</td>
<td>Yes (TruTrack)</td>
<td>Yes (Smart Track)</td>
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<td></td>
<td>older models</td>
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<td></td>
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<td>Motion correction</td>
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<td>Projection artefact removal</td>
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<td>Under development</td>
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<tr>
<td>Optic nerve OCTA</td>
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<td>Yes</td>
<td>Under development</td>
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<td>Anterior segment OCTA</td>
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<td>Yes</td>
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<tr>
<td>OCTA function</td>
<td>Yes</td>
<td>Under development</td>
<td>Yes (prototype)</td>
<td>Yes (prototype)</td>
<td>Yes</td>
</tr>
<tr>
<td>Quantitative analysis</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>No</td>
</tr>
<tr>
<td>Comparative follow-up</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Summary

ASSESS THE SCAN QUALITY

IDENTIFY AREA AND LAYER OF INTEREST

EXAMINE CROSS-SECTIONAL OCTA FOR ABNORMAL FLOW

AN APPROACH TO OCTA INTERPRETATION

CHOOSE SEGMENTATION PATTERN THAT BEST CAPTURES ABNORMAL FLOW

BE MINDFUL OF ARTEFACTS

CORRELATE TO OTHER IMAGING MODALITIES

MANUAL MANIPULATION OF SEGMENTATION TO OPTIMISE ENFACE OCTA IMAGE
Next would be examples of pathology findings and features on OCTA machine

Thank you
AngioPlex™ Color Depth Map

The color depth map combines superficial, deep and avascular retina maps and allows for depth visualization of retinal blood flow.
Overview
Vitreoretinal interface

This representation permits analysis of the vitreoretinal interface. In normal findings no vascular structures are displayed there. In OCT angiography, verifiable vascular networks always indicate a pathological change on the vitreoretinal interface.

Normal

Neovascularizations on the vitreoretinal interface

Inner limit: 300 µm above the internal limiting membrane (ILM)
Outer limit: Internal limiting membrane (ILM)

Image source: ZEISS Clinical Database
Overview
Neurosensory retina

This representation examines the neurosensory retina. This provides an initial complete overview of pathological changes within the retina, e.g.
- Damage to vascular networks (e.g. ischemic areas, see arrow)
- Ingrowths of pathologically changed vessels from the choroid

Normal

Diabetic retinopathy

Inner limit: Internal limiting membrane (ILM)
Outer limit: 70 µm above Bruch's membrane

Image source: ZEISS Clinical Database
The choriocapillaris is a thin vascular layer which is only several micrometers thick and, in normal findings, exhibits a regular, homogeneous and netlike vascular pattern. In the case of pathological changes such as the occurrence of neovascular structures, significant deviations from this homogeneous pattern occur.

Normal

Choroidal neovascularization

Inner limit: 29 µm below RPE
Outer limit: 49 µm below RPE
With normal findings in OCT-A, the choroid exhibits a regular, homogeneous and relatively dense vascular pattern. In the case of pathological changes, for instance the occurrence of neovascular vessel structures, significant deviations from this homogeneous pattern appear.

Inner limit: 64 µm below Bruch's membrane
Outer limit: 115 µm below Bruch's membrane
Detailed analysis
Layers of the retina

Retina (color coded)
Superficial vascular plexus
Deep vascular plexus
Avascular zone

Image source: ZEISS Clinical Database
Detailed analysis

Neurosensorry retina (color coded)

In this representation, different vascular networks are highlighted in color: superficial plexus = red, deep vascular plexus = green, avascular area = blue. In normal findings, only the red and green components of the superficial and deep vascular plexus appear. Changes in this color distribution enable the localization of pathological changes via depth selection.

Normal

Macular telangiectasia

Inner limit: Internal limiting membrane (ILM)
Outer limit: 70 µm above Bruch's membrane

Image source: ZEISS Clinical Database
Detailed analysis
Superficial vascular plexus

With normal findings, the superficial vascular plexus is displayed as a fine capillary network with a strong signal. Especially the large vessels define a characteristic vascular pattern. The area of the fovea does not display any capillary structures (foveal avascular zone, FAZ, see arrow).

Normal
Diabetic retinopathy

Inner limit: Internal limiting membrane (ILM)
Outer limit: Inner plexiform layer

Image source: ZEISS Clinical Database
The deep vascular plexus exhibits a very dense and branched capillary network. With normal findings, this ranges up to and into the perifoveal area. The following case study shows perfusion disruptions in the deep vascular plexus (see arrow).
In normal findings, no flow effects can be observed due to the missing vessels in OCT-A. Signal components in the area of the avascular zone may be an indication of pathologically altered retinal layers or vascular structures.
# Case study 1: Diabetic retinopathy

## Overview

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<tr>
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</tr>
</tbody>
</table>

- **Retina (color-coded)**
- **Superficial vascular plexus**
- **Deep vascular plexus**
- **Avascular zone**

*Image source: ZEISS Clinical Database*
Case study 1: Diabetic retinopathy
OCT-A overview

Along the interface of the vitreous body, proliferative vascular structures appear.

Vitreoretinal interface

Image source: ZEISS Clinical Database
Case study 1: Diabetic retinopathy
OCT-A overview

The neurosensory retina displays an overall regular vascular pattern. Temporally, areas with a considerably reduced signal intensity can be detected (see arrows). These indicate perfusion disorders in this area.
Case study 1: Diabetic retinopathy
OCT-A overview

Choriocapillaris

In the images of the choriocapillaris, the hypointense areas (see arrows) probably indicate existing laser effects.

Illustration is subject to copyright. Carl Zeiss Meditec, AG
Case study 1: Diabetic retinopathy
OCT-A overview

The images display existing laser effects (see arrows). The hypotense vascular structures are probably based on shadowing effects and should not be confused with perfusion disorders.

Illustration is subject to copyright. Carl Zeiss Meditec, AG
Case study 1: Diabetic retinopathy
OCT-A detailed analysis

The color coded representation of the retinal layers shows a loss of the red and green coded information in the abnormal areas (see arrows).
Case study 1: Diabetic retinopathy
OCT-A detailed analysis

Superficial vascular plexus

In the detailed analysis of the retina it becomes apparent that the restricted hypointense area pervades both the superficial and the deep vascular plexus.
Case study 1: Diabetic retinopathy
OCT-A detailed analysis

In the detailed analysis of the retina it becomes apparent that the restricted hypointense area pervades both the superficial and the deep vascular plexus.
Case study 1: Diabetic retinopathy
OCT-A detailed analysis

Avascular zone

The OCT-A representation from the avascular zone shows no abnormalities. Only several projection artifacts can be detected, which clearly must be assigned to the overlying vascular layers.

Illustration is subject to copyright. Carl Zeiss Meditec, AG
Case study 3: Retinal vein occlusion

Overview

Vitreoretinal interface

Retina

Choriocapillaris

Choroid

Retina (color coded)

Superficial vascular plexus

Deep vascular plexus

Avascular zone

Image source: ZEISS Clinical Database
Case study 3: Retinal vein occlusion
OCT-A overview

The OCT-A image of the vitreous body interface shows very pronounced and finely branched neovascularizations.

Illustration is subject to copyright. Carl Zeiss Meditec, AG
Case study 3: Retinal vein occlusion
OCT-A overview

The overview display of the retina shows clearly pronounced areas of low signal intensity. This indicates extensive ischemic areas.
Case study 3: Retinal vein occlusion
OCT-A overview

In the area of the choriocapillaris and choroid, no abnormal changes can be observed.

Illustration is subject to copyright. Carl Zeiss Meditec, AG

Image source: ZEISS Clinical Database
Case study 3: Retinal vein occlusion
OCT-A overview

In the area of the choriocapillaris and choroid, no abnormal changes can be observed.
Case study 3: Retinal vein occlusion
OCT-A detailed analysis

The detailed analysis of the retinal layers shows that the hypointense areas without perfusion affect both the superficial and the deep vascular plexus.
Case study 3: Retinal vein occlusion
OCT-A detailed analysis

An abnormally altered vascular network can be recognized. The localization of this neovascularization agrees well with the abnormal vascular pattern in the vitreous body interface and therefore probably represents a projection artifact.
Case study 3: Retinal vein occlusion
OCT-A detailed analysis

The localization of the visible neovascularization agrees well with the abnormal vascular pattern in the vitreous body interface and therefore probably represents a projection artifact.
Case study 3: Retinal vein occlusion
OCT-A detailed analysis

In the avascular zone, projection artifacts of the inner retinal layers can be detected.
Case study 4: Diabetic macular edema

Overview

Vitreoretinal interface  Retina  Choriocapillaris  Choroid

Retina (color coded)  Superficial vascular plexus  Deep vascular plexus  Avascular zone

Image source: ZEISS Clinical Database
Case study 4: Diabetic macular edema
OCT-A overview

The vitreous body interface shows no particular abnormalities.

Source: Courtesy of the ophthalmologists of St. Franziskus Hospital, Münster.
Case study 4: Diabetic macular edema
OCT-A overview

The OCT angiogram shows an irregularly altered and extended foveal avascular zone. The OCT sectional image shows a pronounced macular edema. Characteristically altered vascular structures are identifiable in the entire image section.
Case study 4: Diabetic macular edema
OCT-A overview

Choriocapillaris

The macular edema leads to shadowing effects in the underlying OCT-A representations of the choriocapillaris and choroid.

Illustration is subject to copyright. Carl Zeiss Meditec, AG

Source: Courtesy of the ophthalmologists of St. Franziskus Hospital, Münster.
Case study 4: Diabetic macular edema
OCT-A overview

The macular edema leads to shadowing effects in the underlying OCT-A representations of the choriocapillaris and choroid.

Source: Courtesy of the ophthalmologists of St. Franziskus Hospital, Münster.
Case study 4: Diabetic macular edema
OCT-A detailed analysis

The color-coded OCT-A representation shows an altered foveal avascular zone and a pronounced red component.

Illustration is subject to copyright. Carl Zeiss Meditec, AG

Source: Courtesy of the ophthalmologists of St. Franziskus Hospital, Münster.
Case study 4: Diabetic macular edema
OCT-A detailed analysis

The pathological changes in the representation of the superficial vascular plexus can easily be detected.
Case study 4: Diabetic macular edema
OCT-A detailed analysis

Deep vascular plexus

In the area of the macula, a reduced signal intensity appears. At this location, the corresponding OCT sectional image shows intraretinal fluid. It cannot be assessed with certainty whether the deep vascular plexus is extensively affected at this location.

Source: Courtesy of the ophthalmologists of St. Franziskus Hospital, Münster.
Case study 4: Diabetic macular edema
OCT-A detailed analysis

In the avascular area, there are no particular abnormalities.

Illustration is subject to copyright. Carl Zeiss Meditec, AG

Source: Courtesy of the ophthalmologists of St. Franziskus Hospital, Münster.
Case study 6: Choroidal neovascularization

Overview

Vitreoretinal interface

Retina

Choriocapillaris

Choroid

Retina (color coded)

Superficial vascular plexus

Deep vascular plexus

Avascular zone

Image source: ZEISS Clinical Database
In the area of the vitreous body interface, no abnormal structures can be observed.
Case study 6: Choroidal neovascularization
OCT-A overview

Focal, unclearly demarcated areas of increased signal intensity appear. In the upper and lower hemisphere, diffuse patterns of increased signal intensity also can be detected.
Case study 6: Choroidal neovascularization
OCT-A overview

In the area of the choriocapillaris, a clearly pronounced and tree-like vascular pattern of neovascularizations appears.
Case study 6: Choroidal neovascularization
OCT-A overview

These also can be detected in the area of the choroid, however, not sharply separable from the associated projection artifacts. The hypointense areas here represent shadowings caused by the overlying detachment of the RPE.
Case study 6: Choroidal neovascularization
OCT-A detailed analysis

Retina (color coded)

In the color coded retinal depth, the abnormal focal areas and the diffuse areas appear nasally in blue color coding.

Illustration is subject to copyright. Carl Zeiss Meditec, AG

Image source: ZEISS Clinical Database
Case study 6: Choroidal neovascularization
OCT-A detailed analysis

Superficial vascular plexus

An abnormal focal area can be seen in the representation of the superficial vascular plexus (see arrow).

Illustration is subject to copyright. Carl Zeiss Meditec, AG

Image source: ZEISS Clinical Database
Case study 6: Choroidal neovascularization
OCT-A detailed analysis

Deep vascular plexus

The abnormal focal areas and the diffuse areas can be detected in the representation of the deep vascular plexus (see arrows).

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Case study 6: Choroidal neovascularization
OCT-A detailed analysis

Avascular zone

At this location, the OCT shows a detachment of the retinal pigment epithelium in the area of the avascular zone. This involves mainly projection artifacts of overlying vascular layers here.
Cases Example 1

Name: AngioPlex Case 611, Proliferative DR (w/NVE) + Mac Cube, HD Cross
ID: PDRwNeo
DOB: 01-Jan-00
Gender: Other
Technician: Operator, Cirrus

High Definition Images: HD Cross

OD  OS

Scan Angle: 0°  Spacing: 0.25 mm  Length: 6 mm

Horizontal Thumbnails  Vertical Thumbnails

1  1  2  2  4  4  5  5
Non-perfusion Area - PDR
Cases Example 2 - PDR

PROLIFERATIVE DIABETIC RETINOPATHY

Color photo (1) and red-free filter image (2):
No anomaly of the macular reflection.
No hemorrhage at the posterior pole.

Fluorescein angiographic sequence (3,4):
There are small paracentral hyperfluorescent areas associated with microaneurysms at the posterior pole.
The examination shows, in the vicinity of the inferior temporal artery, a small preretinal choroidal neovascularization.
OCT-Angiography of the suspected area of preretinal neovascularization.

The scan passing through the superficial retina (A) clearly shows the ischemic area and the preretinal choroidal neovascularization. The choroidal neovascularization is better analyzed in front of the retinal plane (B), which confirms the preretinal location of the neovascularization. The AngioFlex mapping (C) allows superimposition of the vascular information.
Case Example 3

POLYPOIDAL VASCULOPATHY

**Color photo (1)** shows a rounded appearance of the macular reflection. This appearance is more visible on **fundus autofluorescence (2).**

**In the intermediate phases of the indocyanine green angiography (3,4), the polyps are well individualized.**

**The OCT B-scan (5) confirms the presence of exudates with localized elevation of the retinal pigment epithelium connecting through a right angle with the remaining retinal pigment epithelium. There is a serous retinal detachment.**
Case Example 3 - PCV

En-face OCT (A) shows a rounded image that may correspond to the polyp (yellow arrow).
OCT-Angiography: The scans performed at the pigment epithelium detachment in the choriocapillaris (B) and in the choroid (C) show vascular anomalies within the lesion forming an abnormal vascular network called a branching vascular network (red arrows).
PDR, male 36 yo

**Superficial slab**
1. Widefield OCTA 14x14 mm (montage of five 8x8 mm scans)
2. OCTA 8x8 mm

**Vitreoretinal Interface (VRI) slab**
3. Widefield OCTA 14x14 mm (montage of five 8x8 mm scans)
4. OCTA 8x8 mm
BRVO
PDR

AngioPlex Montage 10x14mm Proliferative Diabetic Retinopathy
FOLLOW-UP OF TREATED CHROIDAL NEOVASCULARIZATION

**Color photo:** Fundus of the left eye of a patient who had choroidal neovascularization previously treated with anti-VEGF, then retreated on a PRN basis in case of neovascular reactivation. The macula has a greyish appearance.

**Red-free filter image:** The color difference between the macula and the remaining portion of the fundus is more obvious.

**Fundus autofluorescence image:** There is a central hypoautofluorescence.
TREATED TYPE 2 CHOROIDAL NEOVASCULARIZATION

Color photo (1) shows a small disturbance of the macular reflection associated with micro-hemorrhages.

The OCT mapping (2) suggests the presence of exudations primarily developed in the superotemporal part of the macula.

The corresponding OCT B-scan (3) confirms the presence of exudations with serous retinal detachment, intraretinal edema and hyper-reflective pre-epithelial subretinal lesion.

The corresponding OCT-Angiography (4) shows a well-individualized neovascular network with a typical medusa-shaped complex.
Cases Example 1 – Monitoring Progression

After treatment with monthly anti-VEGF injections, we observe the evolution of the color photo, OCT mapping and OCT B-scan, and OCT-Angiography at 2 months (A) and at 4 months (B).

The OCT mappings suggest some resistance of the neovascularization to anti-VEGF treatment.

OCT-Angiography shows a change in new vessel morphology over time. The lesion decreases and retracts after treatment but persistent anastomotic arcades are seen in the lesion periphery, which could suggest the persistence of some degree of neovascular activity.
Diagnosis Statement: ?
Clinical case: Wet AMD with CNV
69y Female, OS
Clinical case: Wet AMD with CNV
69y Female, OS

AngioPlex
Superficial Retina Map

AngioPlex
Choroid Map

CNV lesion
Clinical Case: AMD/CNV OU
3x3 AngioPlex™
Clinical Case: PED with CNV
3x3 AngioPlex™

Video Mode
PDR, male 36 yo

**Superficial slab**
1. Widefield OCTA 14x14 mm (montage of five 8x8 mm scans)
2. OCTA 8x8 mm

**Vitreoretinal Interface (VRI) slab**
3. Widefield OCTA 14x14 mm (montage of five 8x8 mm scans)
4. OCTA 8x8 mm
BRVO
PDR
New Vascular Metrics for Diabetic Retinopathy Management

**Clinical Value**
- Retinal vascular density is known to be affected by the presence of Diabetic Retinopathy (DR).
- DR is also characterized by an irregular, large foveal avascular zone (FAZ)

**AngioPlex Metrix**
Objectively assess change over time
  - Vascular density
  - Perfusion density

Help flag patients with early diabetic retinopathy changes.
  - Automatic detection of FAZ Area and Circularity
Quantitative Parameter in Angiography Analysis
More effective chronic disease management

- Vascular density measurements based on OCTA performed with Cirrus AngioPlex are associated with accepted clinical measures.

- Early detection and accurate staging of DR:
  - Macular ischemia is a key sign of diabetic retinopathy, associated with function and useful for predicting DR progression.
  - Center-involving macular edema, have been shown to be directly associated with poor microvascular perfusion and increased leakage, respectively.
Quantitative Parameter in Angiography Analysis
More effective chronic disease management

Vessel density → total number of vessel in the area
Can indicate neovascularization

Perfusion density → total amount blood flowing in the area
Can indicate how large is ischemic area

FAZ Area → The area within the boundary of the FAZ

FAZ Perimeter → The length of the boundary of the FAZ

FAZ Circularity Index → How similar the boundary of the FAZ is to a circle
• FAZ enlargement, can indicate the microcirculatory state of the central fovea; such changes are most likely related to macular ischaemia, especially in DR
• As the shape becomes less round or less smooth, the circularity approaches zero
How Powerful is OCT-Angiography?

1. Provide comprehensive examination data in a quick and accurate way to detect early defect
2. Great tool to monitoring progression after treatment.