IMEDOS BASICS
METHODOLOGY OF DYNAMIC VESSEL ANALYSIS

Basic principle

Dynamic vessel analysis is a worldwide unique method for non-invasive examination of the function and autoregulation of retinal vessels, in which vessel diameters are recorded and analyzed. Using digital images of the ocular fundus, this is performed along the vessels and as a function of time.

During the acquisition of the image sequence, the autoregulation mechanisms are stimulated or provoked, and their vascular response – in terms of changes in vessel diameters – is recorded and analysed. The analysis is performed in temporal and spatial dependence along vessel segments. The different autoregulation or local regulation mechanisms can thereby be selectively investigated by targeted stimuli. Some examples are:

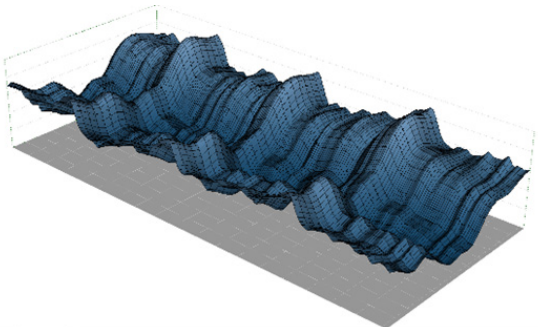
- Stimulation with flicker light to study neurovascular coupling and vascular endothelial function,
- Stimulation by blood pressure elevation to study myogenic autoregulation (Bayliss effect),
- Stimulation by inhalation of respiratory gases of different compositions, for example 100 percent oxygen, to study the contractility of vascular segments.

The Imedos systems use flicker light as a standard functional diagnostic stimulation to investigate retinal, endothelium-dependent microvascular dysfunction (MVD). The vascular response is NO-mediated (endothelial NO synthase) and plays a key role among the regulatory mechanisms of autoregulation and in many microcirculatory disorders and vascular diseases of various organs.

The database for dynamic vessel analysis

Dynamic vessel analysis can only be performed with the Imedos Dynamic Analyzer (IDA), a worldwide unique system, which was developed especially for this method. First, the desired retinal area of the eye is set under mydriasis. Then all necessary vessel sections are marked and the analysis process is started.

The vessel diameters are determined segment by segment with a local resolution of 10 µm per segment, along the marked vessel section (the measuring resolution is <1 µm). This is repeated, in real time in each subsequent image in the sequence, at the same position. Image shifts are automatically detected and corrected. This results in the temporal course of the vessel diameters in the time interval selected for the investigation for each 10 µm thin vessel segment of a vessel section. The time resolution of the measurements is 25 ms.



Example of a 3D database with recording of vessel diameters over a period of time

The determined vessel diameters along the vessel and as a function of time subsequently form the 3D database of dynamic vessel analysis shown on the left.

Depending on the medical or medical-experimental question, the database can be evaluated in different ways, e.g. investigations of the local dependence along the vessels (constriction and dilation), pulsation analyses, time progression analyses or functional analyses using stimulations or provocations of the microcirculation.

Phases and parameters of standard functional diagnostics using flicker light

1. Baseline phase: The baseline state of the retinal vessels is recorded over 50 s in order to subsequently calculate the dilation or constriction of the vessels in percent compared to the baseline.

2. Stimulation or flicker light phase: For functional diagnosis of the MVD, flicker light is used for 20 s during the recording of the vessel diameter (stimulation phase). The green measuring light is interrupted as the image sequence changes (12.5 Hz), so that a dark image alternately follows an illuminated one. The vascular response is recorded continuously and in real time.

3. Post phase: The stimulation phase is followed by a post phase, in which vessel diameter values usually return to baseline levels.

4. Repetition: Phases 2 and 3 are both repeated twice. The software displays the vascular response as a time course in real time, based on locally calculated mean values, with a check for plausibility and outliers.

5. Summary: The three flicker periods are combined using signal averaging. The median values are then calculated and displayed graphically as the examination result.

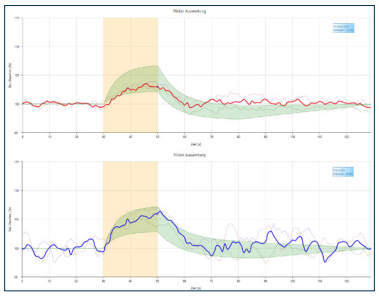
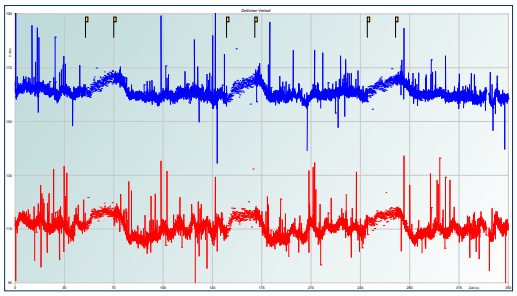


Figure on the left: Graphical representation of the calculated median values of all three flicker phases for the artery (top) and vein (bottom).

Figure on the right: Graphical representation of the vascular response of a complete examination as a course of time



The Imedos examination protocol is based on a strict standardisation of the evaluation and is limited to the following three vascular parameters:

- **Flicker light induced dilation of the artery** (FID art):
  Arterial dilation maximum of the vascular response to flicker light stimulation in % compared to baseline.
- **Flicker light induced dilation of the vein** (FID ven):
  Venous dilation maximum of the vascular response to flicker light stimulation in % compared to baseline.
- **Flicker light constriction of the artery** (FIC art):
  Arterial constriction maximum of the post phase of the vascular response to flicker light stimulation in % compared to baseline.

These vascular parameters characterise the MVD, the function or dysfunction of the autoregulation and at the same time the autoregulatory reserve.

Please contact us for more information!

Imedos Health GmbH

Tatzendpromenade 2A • 07745 Jena • Germany
☎ +49 3641-63960
info@imedos.com • www.imedos.com