Treatment of macroaneurisms in macular oedema patients

Navigated laser leads next generation of photocoagulation therapy

By Dr Jean-Christophe Ramel

Macular oedema is the pathological accumulation of exudate or transudate within or beneath the layers of the macula and, because the retina is without lymphatic drainage, this fluid has limited recourse for reabsorption.

Macular oedema is associated with several conditions such as systemic hypertension leading to vein occlusions, natural aging processes and, most commonly, diabetes. These conditions promote disordered vascularisation, changes in the permeability of vessels that promote leakiness, and failure of the normal function of the retinal pigment epithelium (RPE), leading to the formation of microaneurysms and macroaneurisms that cause oedema.

These pathological changes in turn can result in distorted vision and even blindness.

Traditional treatment options for macular oedema involve the use of lasers to induce photocoagulation. Briefly, laser light pulsed for 10–200 ms on micro/macroaneurysms and regions of oedema generates coagulation through a thermal effect that causes vaporisation of liquids and denaturation of proteins,

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controlled tissue necrosis, scar formation, and relief of autoregulatory vasoconstriction[1].

This process has been shown effective for the closure of microaneurisms[1] as well as macroaneurisms[2].

However, all structures to be treated should be located far enough from the fovea as coagulation leads to significant vision reduction.

Administering the laser traditionally involves the use of a slit lamp and a foot-pedal-controlled laser. A contact lens placed on the eye allows the visualisation of the retina and the cone-shaped laser beam to be focused and deployed on the retina in the region with oedema.

Focusing slit lamp for photocoagulation

First, the retina is brought into focus with the slit lamp to identify areas to be treated.

If the targeted structure is a macroaneurism, the slit lamp is slightly re-positioned to only get the top part of the Macroaneurism in visualisation focus. This is done in order to protect the RPE.

However, as laser is – due to its characteristics of a collimated beam – a displacement of the beam primarily results into an increased area over which the laser is applied and decreases the intensity and fluence of the beam on the level of the RPE.

To protect other layers of the retina from unintended damage by the laser, the wavelength of the beam needs to be selected based on the absorption characteristics of different retinal layers. Yellow wavelengths (570–590 nm) are ideal because they are absorbed primarily by oxyhemoglobin and reduced hemoglobin.

Macroaneurisms are usually located 'above' the RPE and photoreceptor layers.

Due to the absorption profile, the majority of laser energy will be absorbed by the blood instead of the structures beneath this blood contained in macro-

IN SHORT

Macular oedema and several of its appearances such as micro- and macroaneurisms have commonly been treated by slit-lamp photocoagulation. Despite several functional differences, the Navilas 577s promises to lead clinicians and patients into the next generation of photocoagulation therapy with its use of automated positioning, eye-tracking software and retinal navigation, which greatly enhance the safety, speed and precision of treatment.

and microanerisms. This means that a lateral correct targeting of the microaneurisms has a larger effect on tissue sparing treatment than focusing.

of treatment with a conventional laser. The pre-planning capabilities combined with the eye-tracking features significantly improve the lateral positioning of the laser to

> ‘Navilas augments clinicians’ competence in treating patients by improving the safety, speed and precision of photocoagulation treatment.’
>
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In addition, the operator’s own ocular accommodation and the depth of focus can vary widely, which can significantly influence the size of the focal point application and the energy density at the level of the retina.

Despite the success of slit-lamp-mediated photocoagulation therapy, the process is tedious for both the clinician and the patient because of the intricate dance between positioning, focusing and defocusing the laser and the slit lamp, which can be further complicated by even slight ocular movements on the patient’s part.

Looking to the next generation

The Navilas 577s is a yellow laser equipped with a camera coupled to an eye tracker that allows previously unachievable precision micro- or macroaneurysms.[3]

While the slit lamp as a traditional laser delivery device provides a stereoscopic view of the retina, the Navilas is based on a computer screen. This enables a slightly different use principle.

The Navilas compensates for the operator’s own ocular accommodation, as Navilas is based on a computer screen that uses focus bars for assistance.[4]

While on the slit lamp depth perception is needed to localise oedema, this is readily mapped by importing either optical coherence tomography (OCT) thickness mapping or an ICG/FA (indocyanine green chorioangiography/fluorescein angiography) image.

For the treatment of large microaneurysms as well as macroaneurysms, lateral precision is more important than depth focusing. With the Navilas, the laser is well stabilised, and its positioning is controlled by eye-tracking software. Empirical evidence from clinicians suggests that if they are exclusively focused on a microaneurysm, the power from the laser beam will stop at the aneurysm and will not reach the RPE.

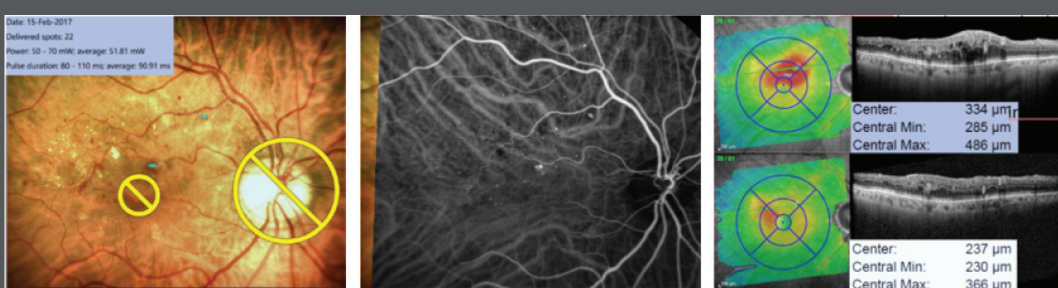
Thus, focalisation is not a problem, and the risk of unintentional injury to other structures is diminished. This is highlighted in the cases below.

Additionally, among the many possible applications of this new laser, the treatment of macroaneurysms with the non-contact objective is one of the most attractive, both in terms of implementation and anatomical/functional results.

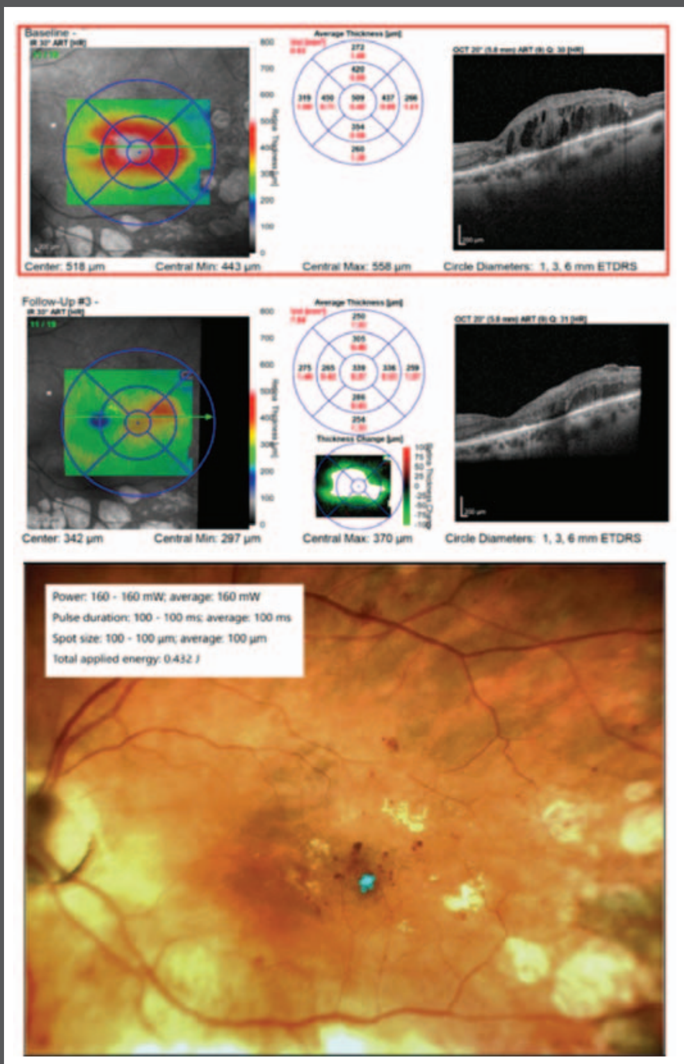
Other advances include the eye-tracking software, which can register and follow eye movements as well as apply caution zones to aid clinicians in avoiding compromise of these vulnerable areas.

The use of overlays to visualise what has been treated previously is clinically valuable for long-term management, as is the detailed post-treatment report generated by the software.

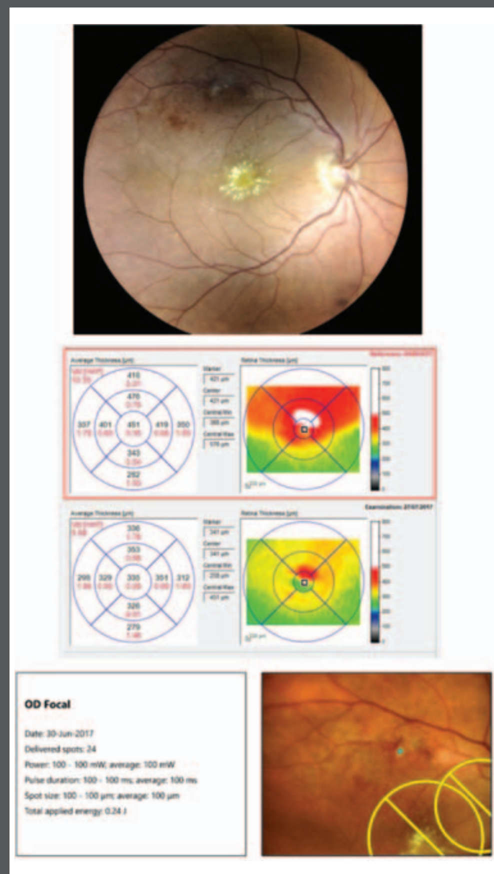
For these reasons, Navilas has accumulated a substantial track record in significantly improving the precision of treatment and comfort for clinicians and patients alike.



(FIGURE 1) 3-month post-treatment results of perifovelar oedema on fundus photography with laser report, ICG/FA and OCT.



(FIGURE 2) **5-months post-treatment of a parafoveal microaneurysm on OCT (top) and fundus photography with laser report (bottom).**



(FIGURE 3) **1-month post-treatment of macroaneurysm, chronic oedema and dry exudates. Fundus photography (top) at baseline shows diffuse macular oedema. Retinal thickness maps (middle) show decreased macular thickness after treatment. The post-treatment report will facilitate long-term management of this patient (bottom).** *(Images courtesy of Dr Jean-Christophe Ramel)*

Case presentations

CASE 1:

A 79-year-old male with 1yr h/o macular oedema secondary to a superior retinal vein occlusion OD, visual acuity 20/30. He had benefited from multiple injections of anti-VEGF and corticosteroids, but perifoveolar oedema persisted.

On ICG, we found a venous macroaneurysm close to the fovea that would not have been accessible to treatment by standard slit-lamp procedures due to foveal proximity. Instead, we were able to occlude the lesion using Navilas.

His results at 3 months post-treatment show retreat of macular oedema on OCT and a visual acuity of 20/20 (Figure 1).

The use of overlays to visualise what has been treated previously is clinically valuable for long-term management.

Among the many possible applications of this new laser, the treatment of macroaneurysms with the non-contact objective is one of the most attractive, both in terms of implementation and anatomical/functional results.

CASE 2:

An 82-year-old female with a h/o diabetes and macular oedema refractory to multiple intravitreal injections, 20/400.

There was a visible parafoveal macroaneurysm in the fundus and on angiography.

She was treated with Navilas and at 5 months showed diminished oedema on OCT, visual acuity 20/50 (Figure 2).

CASE 3:

An 84-year-old female with an arterial macroaneurysm, chronic oedema and dry exudates, 20/1000.

She was treated using the Navilas non-contact lens protocol.

Her results at 1 month post-treatment showed decreased retinal thickness, 20/200 (Figure 3).

Concluding thoughts

Macular oedema is a disabling pathological accumulation of fluid in the macula and is common in developed countries among diabetic and aging patients.

Current treatments with photocoagulation using the slit lamp are efficacious, but the Navilas endorses automated focusing and eye-tracking software that greatly enhance the precision and ease of treatment.

In short, Navilas augments clinicians' competence in treating patients by improving the safety, speed and precision of photocoagulation treatment.

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