Navigated Laser Photocoagulation - a Cutting Edge in Retinal Photocoagulation

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More than 25 years ago, the Early Treatment Diabetic Retinopathy Study (ETDRS) showed that laser photocoagulation reduced the 3-year risk of losing three lines or more of visual acuity from 24% in the control group as opposed to 12% in the laser group in the management of diabetic macular edema (DME)\(^1,2\). Today, ophthalmologists continue to follow modified ETDRS guidelines using slit-lamp delivery of relatively long-pulse duration laser light. Role of anti-VEGF drugs appears to be increasing in the management of fovea-involving diabetic macular edema. However, the long-term results of a recent diabetic retinopathy clinical research network study have recently shown that addition of laser treatment helps to reduce the number of injections and maintains visual gains\(^3\). Laser is still the treatment of choice in extrafoveal DME\(^4\).

Conventional slit-lamp delivery laser systems are in use for more than 40 years. Conventional slit-lamp delivery laser system has many limitations such as need of contact lens, uncontrolled eye movements and necessity of local anesthesia. Other complications associated with laser photocoagulation include scar enlargement leading to foveal damage, peripheral field loss, decreased color and night vision and choroidal neovascularization\(^5,7\).

Advances in laser application technology such as pattern scan laser (PASCAL, OptiMedica, Santa Clara, California) improved laser application in clinical practice\(^8,9\). PASCAL is a semi-automated system that delivers 532 nm frequency-doubled solid-state laser. Navilas\(^\circledR\) system is a fundus camera-based laser system, as opposed to the conventional slit lamp-based laser systems\(^10\).

Laser treatment on Navilas\(^\circledR\) system includes four steps: image acquisition, planning, treatment and documentation.

**Image acquisition**

On the Navilas\(^\circledR\) system device, color fundus photography, fluorescein angiography and infrared photography of 35 or 50 degrees of field of retina can be performed using mydriatic or non-mydriatic camera. Navilas\(^\circledR\) system obtains real-time high-resolution images with eye tracking at a rate of 25 images per second.

**Planning**

The major advantage of Navilas\(^\circledR\) system is “computer based planning”. The clinician marks the desired targets, as well as any “no treatment zone”, on the computer screen image using either a touch screen or the mouse (Figure 1). Target areas can be marked as single laser spot or grid or pattern, ranging in

![Figure 1: Screen shot of the Navilas\(^\circledR\) system shows laser plan for an eye with diabetic macular edema. Yellow circles (arrow-head) show “no treatment zone” and planned laser spots to individual microaneurysm are seen as multiple small circles (arrow). Left panel shows various laser patterns and parameters](image-url)
size from 50 μm to 1000 μm with a pulse duration ranging from 10 mSec to 1000mSec. Accuracy of the navigated laser treatment has been reported to be 92% compared to 72% that of the conventional laser\textsuperscript{14}. Planning on the computer screen by trainees under supervision makes Navilas\textregistered system an excellent teaching tool and ensures patient safety as well.

Navilas\textregistered system allows multimodal image integration for treatment planning. Various images such as fundus autofluorescence, optical coherence tomography (OCT) retinal thickness maps, and indocyanine green angiography (ICG) images can be imported and utilized for treatment planning.

**Treatment**

The treatment plan is then registered to the live fundus image (infrared or color) of the retina, facilitating more precise positioning of laser spots. The clinician performs 532nm laser photocoagulation on the intended targets while watching the live video on screen. Treatment is performed in infrared mode, which is more comfortable for the patient than the bright white slitlamp light. Treatment is performed on upright images, so it avoids any confusion as encountered in conventional laser treatment due to inverted image. The treatment does not require use of contact lens or topical anaesthesia, increasing comfort for both, clinician and patient\textsuperscript{12}. Clinician can toggle between the color fundus view and infrared view to determine the intensity of each burn and adjust the power as necessary. In case of any sudden movement of the eye, the registration is failed and the laser treatment stops immediately. The advantage of eye tracking during treatment makes Navilas\textregistered system a safe and time-efficient treatment\textsuperscript{13}. The precise placement of the laser allows lower total energy delivery, with the potential for less collateral damage\textsuperscript{14}.

**Documentation**

Unlike the hand made drawings for the documentation as in conventional laser systems, the Navilas\textregistered system provides digital documentation of the entire procedure, including images of each laser spot, and the laser parameters used at each location. This accurate information helps for follow up of subjects especially when repeat treatment is required (Figure 2).

Panretinal photocoagulation with Navilas\textregistered system: Wide-angle contact lens for panretinal photocoagulation using Navilas\textregistered system provides a wider view almost up to ora serrata (Figure 3). Being a fundus camera based laser system; Navilas\textregistered system provides a uniform circular, equally intense and focused peripheral burns. Use of navigated laser during panretinal photocoagulation improves the safety.

Advantages of Navilas\textregistered system over conventional laser system include:

- Combination of color fundus photography, fluorescein angiography and laser photocoagulation on the same device
- Computer-based Laser Treatment Planning
- Faster procedure
- Availability of various laser patterns
- Safety/Eye-tracking
- Better accuracy
- Multimodal image integration
- Increased patient comfort
- Treatment ease for the physician
- Efficient panretinal photocoagulation
- Documentation
- Improved training

Limitations of Navilas\textregistered system: There is no stereoscopic view, which could provide a subjective measure of retinal thickness,
as the live fundus image is displayed on a screen. However, OCT maps representing objective values have been routinely imported into the Navilas® system for treatment planning. Navilas® system provides fluorescein angiography, but does not have an ICG capability. For ICG-based treatment planning and exact targeting of choroidal structures, external ICG images are to be imported into the system. Being a novel technique, a learning curve needs to be observed. However, it was shown that novice laser operators can reach similar accuracy and speed compared to experienced retinal physicians within less than 10 performed treatments.

In conclusion, Navilas® system uses a novel digitalized approach to retinal laser, based on live fundus imaging, treatment planning and target-assisted administration of laser. It has several advantages over conventional laser systems such as improved patient/physician comfort, improved accuracy, excellent documentation and enhanced training. Navilas® system revolutionizes laser photocoagulation treatment and indicates the beginning of new era in vitreo-retinal disorders.

References


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