

Clinical Experience With a High-speed Multispot Laser

The PASCAL produces multiple laser spots simultaneously, reducing treatment times and improving patient comfort.

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Photocoagulation of the retina with argon laser has been the standard treatment for a range of retinal pathologies for decades. Panretinal photocoagulation (PRP) has been shown to stop the spread of retinal vessels in diabetic retinopathy.^{1,2} Focal laser can be used to treat a range of pathologies including microaneurysms and other types of focal leakage, and grid photocoagulation effectively treats more diffuse leakage. Even in the era of vascular endothelial growth factor inhibitors, PRP and laser grid photocoagulation remain the gold standard of therapy for diabetics with vision-threatening retinopathy.³

Until recently, these laser procedures have been performed one burn at a time, with the patient seated at the slit lamp. In the case of grid treatments and PRP, the sessions can be lengthy and taxing for both patient and surgeon.

Recently, a multispot modality for retinal photocoagulation has been introduced.^{4,5} The PASCAL (Pattern Scan Laser; Optimedica, Santa Clara, CA) delivers multiple uniform laser burns simultaneously in a variety of patterns. This diode-pumped 532-nm solid state laser uses proprietary software to create square arrays, arcs and grids with variable spot sizes and variable distance between spots, all controlled by the user through an intuitive touch-screen interface.

The PASCAL can be used to treat proliferative and nonproliferative diabetic retinopathy, choroidal neovascularization, branch and central retinal vein occlusion, age-related macular degeneration, lattice degeneration, and retinal tears and detachments.

In my clinical experience to date, the ability of the PASCAL to deliver multiple laser spots improves the

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precision of grid pattern delivery, increases safety, and reduces patient discomfort compared with conventional one-spot-at-a-time laser photocoagulation. This paper outlines the experience with the PASCAL in our center to date, including clinical impressions, preliminary clinical evaluations, and experimental test results.

THE LASER

The slit-lamp-mounted PASCAL is capable of delivering up to 2,000 mW of power in pulse durations of 10 to 1,000 msec. The user can select spot sizes of 60, 100, 200 or 400 μm diameter at the corneal plane. The laser's software produces square arrays with two, three, four, or five spots on a side for treating proliferative diabetic retinopathy (PDR); triple arcs for treating PDR, lattice degeneration or retinal tears; a modified grid for treating diabetic macular edema; a circular pattern for treating peripheral holes; and single spots for performing conventional focal treatment. The user can further adjust the patterns by increasing or decreasing the spacing between spots.

The choice of patterns allows the surgeon to fit the treatment to the area of the retina being treated; for instance, the arcs are particularly suited for treating in the periphery, and the square arrays in the midperiphery.

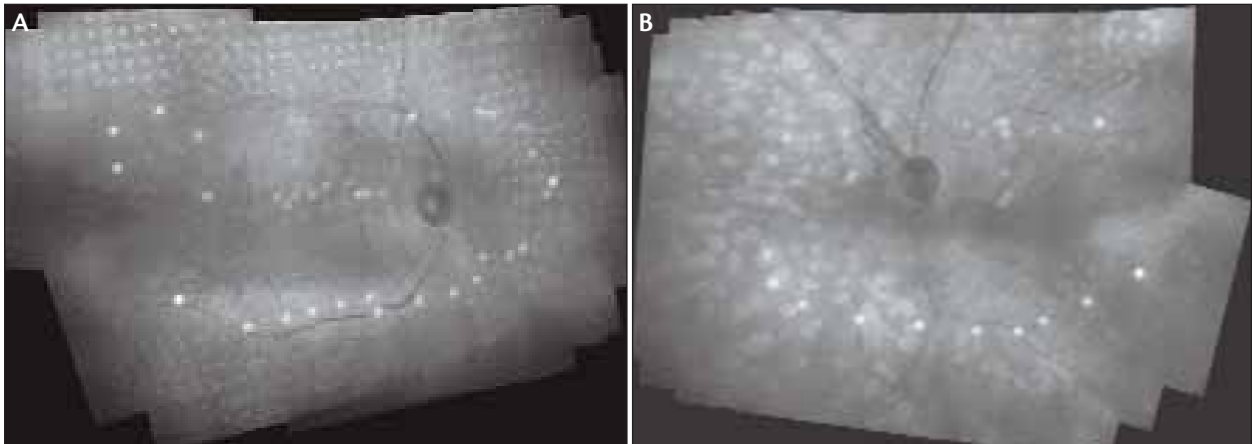


Figure 1. Infrared photos 3 months after PRP: (A) PASCAL; (B) standard argon laser.

The PASCAL's 532-nm beam creates burns with effects similar to argon green laser photocoagulation, causing regression of new vessels and preventing further vascular proliferation. However, the spots are delivered faster, with a duration of 10 to 20 msec at each spot, as opposed to 150 to 200 msec with conventional laser. Therefore the fluence (energy X time duration/spot size) is only a quarter of that delivered by conventional laser (PASCAL, 30 J/cm² vs. conventional, 127 J/cm²).

It might be thought that treatment effect would be diminished because of the reduction in fluence, but investigators have not found this to be the case.^{6,7} When we compared eyes with similar pathology in two patients, one treated with conventional single-spot laser and the other with PASCAL, we observed similar vessel regression in both eyes but less burn in the PASCAL-treated eye.

We have observed several clinical advantages with use of the PASCAL. The ability to deliver multispot patterns increases efficiency and reduces treatment time. This seems to reduce discomfort for the patient and fatigue for both patient and surgeon. Patients who have previously been treated with conventional laser notice the difference and always request PASCAL when given the choice at subsequent treatments.

Among other advantages, with the use of arrays PRP can be performed in a single sitting, or at least in a reduced number of sittings. And the interspacing between laser spots is much more even than with conventional laser, assuring uniform application to all treated areas and a better visual result for the patient.

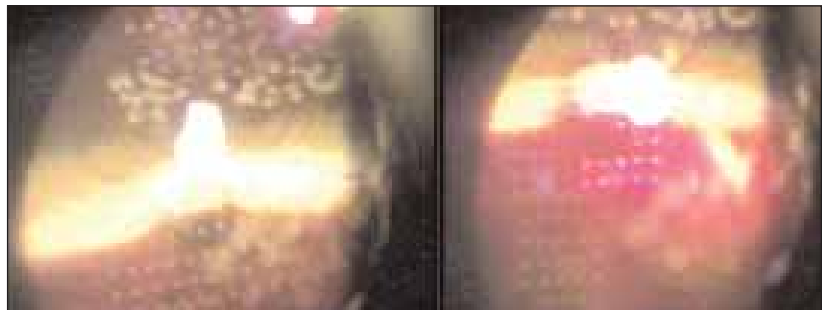


Figure 2. Rabbit retinas treated superiorly with conventional argon laser and inferiorly with PASCAL.

The greatest advantage of the multispot laser, however, is the reduction of fluence, which decreases collateral damage to surrounding tissue compared with conventional laser.

The PASCAL is easy to use even in the extreme periphery with the Mainster lens. Peripheral tears can be treated efficiently using the circular and semicircular grids with interchangeable spacing with just a few shots.

TEST RESULTS

We have evaluated the PASCAL in the clinic and the laboratory, and we have also sought subjective reactions from patients through post-laser questionnaires.

In patients treated in one eye with PASCAL and the contralateral eye with conventional laser, we compared visual field loss from a previously established baseline. Eyes treated with PASCAL consistently had 3 to 4 dB less field loss than eyes treated with conventional laser. These value differences did not reach statistical significance, but consistent difference was seen in all comparisons. Figure 1 shows infrared photographs of two eyes at 3 months after treatment with PASCAL (A) and conventional argon PRP (B). The irregular placement and interspacing and

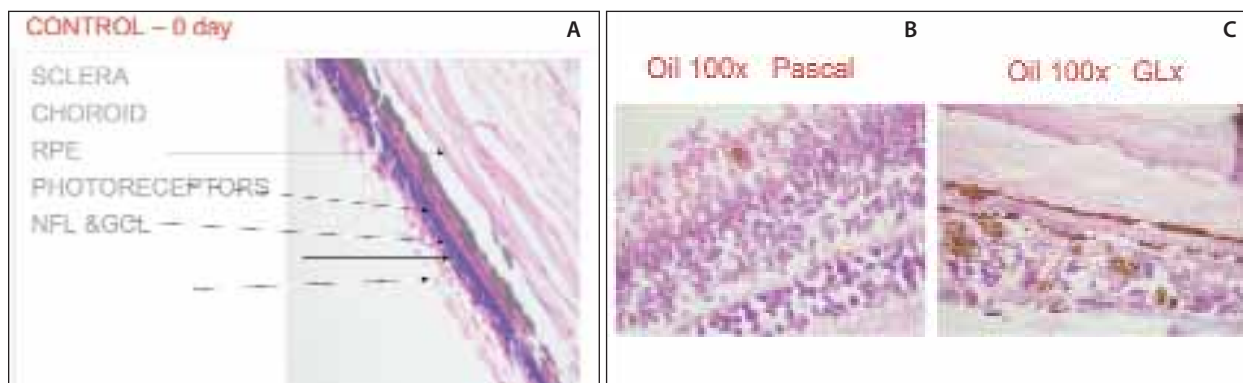


Figure 3. Histology of rabbit eyes: (A) Control eye at day 0; (B) PASCAL-treated rabbit eye at 1 month shows minimal disruption around laser burn; (C) argon-treated eye shows more destruction around treatment area.

the larger size of the conventional argon burns in comparison to those with PASCAL are evident.

In rabbits we have compared the burns delivered with standard argon laser compared with PASCAL using the same amount of power. We treated half of the fundus with PASCAL, half with argon (Figure 2). Histopathology was performed at 0 and 15 days and at 1 month to evaluate collateral tissue damage. In Figure 3B, small blisters can be seen in the PASCAL-treated tissue, with minimal disruption to the rest of the layers, while in Figure 3C with argon laser treatment, the elevation and destruction of the receptors around the treatment area is much greater.

We have also been collecting patient-satisfaction questionnaires and comments from our patients after laser treatment. Patients state a preference for PASCAL over conventional laser. Conventional laser was tiring and painful. Patients after PASCAL treatment express much less discomfort. There is a “wow” effect in patients who have previously undergone standard argon treatment. They cannot believe the treatment is over so soon because it seemed so fast and painless compared with their previous experience.

CONCLUSIONS

The indications for use of PASCAL are the same as for conventional laser. In that way, nothing has changed in our use of laser for retinal pathologies. However, with the ability to perform faster treatments in fewer sessions, with less patient discomfort and fatigue, a lot has changed in the way we deliver care for our patients. We can now in many cases offer treatment on the same day, even including PRP, without bringing patients back for another visit. Patients are happier because their treatment burden is reduced, and that makes surgeon and staff happier as well.

It would seem that multipot laser technology offers a

significant advance in treatment of retinal pathologies. Moreover, the additional benefit of less collateral damage to retinal tissue should provide lasting long-term functional benefits to patients and should go a long way in redefining new strategies in terms of power, software and hardware technology to formulate safer macular laser applications.

Still, much study is needed to assess the benefits and drawbacks of this new technology in comparison with the gold standard of conventional single-spot laser. I look forward to the months and years ahead as we learn more about the capabilities and indications for the use of multipot lasers in retinal care. ■

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