

References

- 1 Uparkar M, Kaul S. Laser barrage anterior to ridge in threshold ROP-caveat. *Eye (Lond)* 2013; **27**(8): 994.
- 2 Ells AL, Gole GA, Lloyd Hildebrand P, Ingram A, Wilson CM, Geoff Williams R. Posterior to the ridge laser treatment for severe stage 3 retinopathy of prematurity. *Eye (Lond)* 2013; **27**(4): 525–530.
- 3 Lepore D, Molle F, Pagliara MM, Baldascino A, Angora C, Sammartino M *et al.* Atlas of fluorescein angiographic findings in eyes undergoing laser for retinopathy of prematurity. *Ophthalmology* 2011; **118**(1): 168–175.

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Sir,
Human histopathology of PASCAL laser burns

We present the first human histopathological and immunohistochemical correlation after laser injury with semi-automated pattern scanning retinal photocoagulation (PASCAL).

Case report

A 66-year-old male with a history of type 2 diabetes, coronary artery disease, congestive heart failure, and chronic kidney disease was admitted for abdominal pain and hypoxia. The patient had a history of proliferative diabetic retinopathy (PDR) and vitreous hemorrhage, for which he underwent conventional panretinal photocoagulation (PRP) 2 years prior in the left eye. Five months prior the patient had PDR with subhyaloid hemorrhage of the right eye and underwent PASCAL (Topcon, Santa Clara, CA) PRP with 912 spots, 200 micron, 20 ms pulse duration, and power from 400 to 850 mW. The patient underwent PASCAL PRP fill-in with 595 spots 4 months later in the right eye with visual acuities of 20/30 OD and 20/150 OS.

The patient had necrotizing *Nocardia pneumonia*, expired, and underwent autopsy. Gross examination of the right retina showed well-aligned 3 × 3 laser grids. H&E sections of the right eye PASCAL lesions showed outer nuclear layer (ONL) loss, but with a preserved inner nuclear layer (INL; Figure 1). An acellular matrix and pigmented cells fill the ONL defect. PAS stain shows an irregular ONL with a break in the ELM (Figure 2). Immunohistochemistry with GFAP demonstrates staining of short vertical segments that extend from the INL to ONL, likely representing activated Müller cell

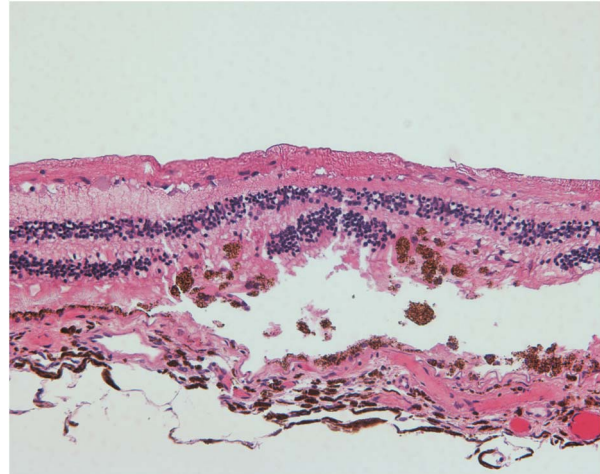


Figure 1 Hematoxylin and eosin (H&E) × 10 magnification section of PASCAL laser shows regions of outer nuclear layer loss filled with an acellular matrix and migrating pigmented cells within the outer retinal layers. There is disorganization of the choriocapillaris layer and areas of retinal pigment epithelial (RPE) atrophy and hyperplasia adjacent to these regions. The inner nuclear layer, ganglion cell layer, and nerve fiber layer appear preserved.

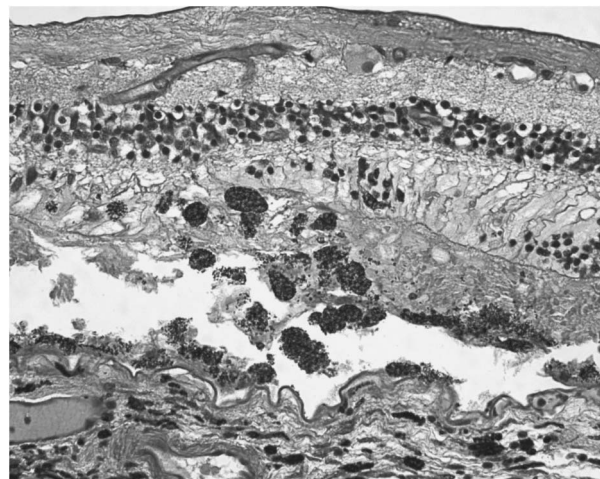


Figure 2 Periodic acid-Schiff (PAS) stain shows an irregular outer nuclear layer with a break in the external limiting membrane (ELM) with the migration of pigmented cells anterior to the ELM.

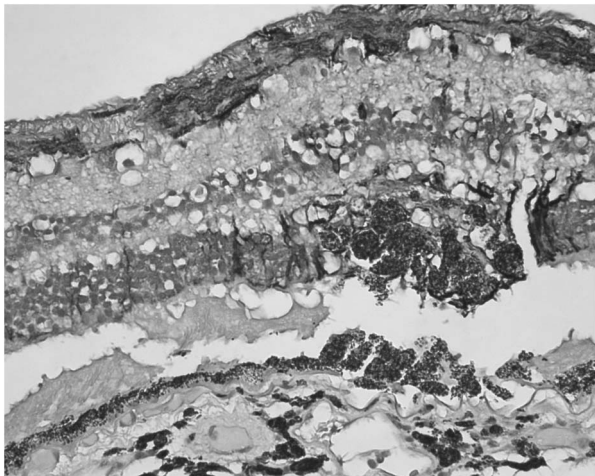


Figure 3 Immunohistochemistry $\times 20$ magnification with glial fibrillary acidic protein (GFAP), which stains intermediate filaments of astrocyte processes and activated Müller cells. There is subretinal fluid, suggesting these are likely the 1-month lesions. There are short vertical segments that stain positive for GFAP and extend from the INL to ONL, likely representing activated Müller cell processes or astrocyte gliosis.

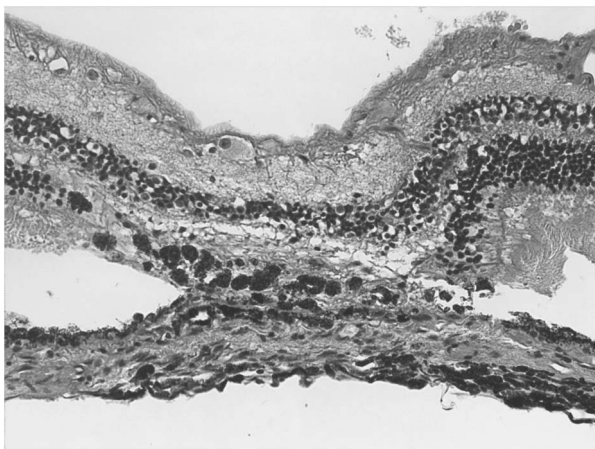


Figure 4 Hematoxylin and eosin (H&E) $\times 20$ magnification section of conventional laser in the left eye shows inner retinal damage with mild thinning of the inner nuclear layer from 5–7 cells thick normally to 2–5 cells thick and numerous migrating pigmented cells within the outer retinal layers.

processes or astrocyte gliosis (Figure 3). H&E sections of the left eye conventional laser showed inner retinal damage with dropout and thinning of the INL in some of the burns, inner retinal damage, and RPE hypertrophy (Figure 4).

Comment

PASCAL allows for well-aligned arrays of 4–56 burns applied in less than a second using a short-pulse duration scanning laser.¹ PASCAL laser lesions have been well characterized in rabbits.² Human PASCAL

burns have been analyzed with autofluorescence³ and adaptive optics.⁴ Human SD-OCT shows damage confined to the outer retina and RPE.⁵

This case reports the first human pathology of PASCAL laser burns. Whereas conventional photocoagulation sometimes results in INL and ONL loss, in this case we find that damage is more limited to the outer retina with PASCAL 20 ms laser lesions. PASCAL laser lesions result in histological preservation of INL and GCL, a break in external limiting membrane with pigmented cell invasion, and GFAP staining vertically adjacent to burns.

Conflict of interest

Dr Blumenkranz is party to a Stanford University patent on patterned scanning laser photocoagulation licensed to OptiMedica, now Topcon, with an associated equity and royalty interest and serves as a consultant to OptiMedica, now Topcon. None of the other authors has a conflict of interest with the submission. An IRB waiver was granted. All research was performed in accordance with the Declaration of Helsinki and all local, regional, and national law.

References

- 1 Blumenkranz MS, Yellachich D, Andersen DE, Wiltberger MW, Mordaunt D, Marcellino GR *et al*. Semiautomated patterned scanning laser for retinal photocoagulation. *Retina* 2006; **26**(3): 370–376.
- 2 Paulus YM, Jain A, Gariano RF, Stanzel BF, Marmor M, Blumenkranz MS *et al*. Healing of retinal photocoagulation lesions. *Invest Ophthalmol Vis Sci* 2008; **49**(12): 5540–5545.
- 3 Muqit MM, Gray JC, Marcellino GR, Henson DB, Young LB, Patton N *et al*. *In vivo* laser-tissue interactions and healing responses from 20 vs 100-millisecond pulse Pascal photocoagulation burns. *Arch Ophthalmol* 2010; **128**(4): 448–455.
- 4 Han DP, Croskrey JA, Dubis AM, Schroeder B, Rha J, Carroll J. Adaptive optics and spectral-domain optical coherence tomography of human photoreceptor structure after short Pascal macular grid and panretinal laser photocoagulation. *Arch Ophthalmol* 2012; **130**(4): 518–521.
- 5 Kriechbaum K, Bolz M, Deak GG, Prager S, Scholda C, Schmidt-Erfurth U. High-resolution imaging of the human retina *in vivo* after scatter photocoagulation treatment using a semiautomated laser system. *Ophthalmology* 2010; **117**(3): 545–551.

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