News in Review

COMMENTARY AND PERSPECTIVES

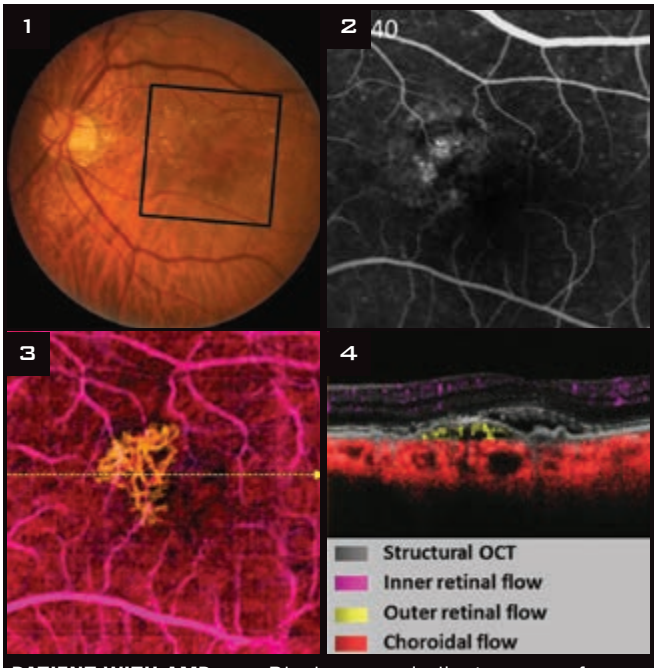
New Views of Retina With OCT Angiography

Fourier-domain optical coherence tomography (FD-OCT), the technology that already provides unprecedented views of the eye's inner microstructures, is wowing ophthalmic researchers again—this time as a fast, noninvasive, 3-D alternative to fluorescein angiography (FA). Thanks to a special processing algorithm developed for existing high-speed OCT devices, OCT angiography can produce images of capillary-level blood flow in the retina and choroid in a few seconds, a team of Oregon researchers reported this spring.[1]

No dye required. "It's a lot faster and more user-friendly than fluorescein angiography," said David Huang, MD, PhD, study investigator and Peterson Professor of Ophthalmology at the Casey Eye Institute of Oregon Health & Science University, in Portland.

"Unlike fluorescein angiography, OCT angiography uses the motion of blood cells as contrast. So there is no dye injection, and you don't have to take images at precise seconds over 10 minutes. There is no dye leakage and staining to obscure the boundary of pathologies. And, whereas with fluorescein you can only capture early transit in one eye, with OCT you can take your time and scan the other eye, too," he said.

New algorithm overcomes problems. The use of OCT for angiography has been studied since 2006, but early techniques required many repeat scans at the same location, a process too slow to be clinically practical, Dr. Huang said. "Also, people were not separating circulations in different layers, so a pathology like choroidal neovascularization could be obscured by retinal and choroidal vascular networks," he said.



PATIENT WITH AMD. (1) Black square indicates area of angiograms. (2) Late-stage fluorescein angiography showing an occult CNV. (3) Composite en face color-coded OCT angiogram with CNV flow highlighted in yellow. The CNV area was 0.96 mm^2. Dashed line indicates the position of the OCT cross-section. (4) Cross-sectional color OCT angiogram; CNV is predominantly under the RPE. (Color key applies to both Figs. 3 and 4.)

JIA Y ET AL. PROC NATL ACAD SCI U S A. 2015;112(18):E2395-E2402

In their study, Dr. Huang and colleagues reported solving these problems with a split-spectrum amplitude-decorrelation angiography algorithm (SSADA). It can detect speckle variation in narrow spectral channels to optimize the detection of motion, he said. SSADA can produce a high-quality angiogram by repeating scans only once at each location. So the entire macula (6 × 6 mm) can be captured in 3 seconds with a new-generation commercial OCT system, Dr. Huang said.

Separate layers revealed. "Using en face visualization of separate layers in the retina and choroid, the algorithm can clearly visualize retinal and choroidal capillary networks and quantify capillary dropout, as well as measure retinal and choroidal neovascularization in normally avascular layers," Dr. Huang said. "These clean images of pathology have gotten people really excited."

The group has also had success identifying retinal pathology that is too early to see clinically, he added. "We have a diabetic case where there was a tiny dot of leakage that looked like a microaneurysm on FA, and it turned out on OCT angiography to be in the vitreous. So it is actually an early tuft of neovascularization."

Limitations. According to the authors, the limitations of this technology include projection of the retinal flow signal onto deeper layers, such as the retinal pigment epithelium and choroid, and a relatively small field of view unless several scans are montaged.

Availability. Interest in OCT angiography mushroomed over the last year as angiography-enabled OCT systems entered commercial use internationally, Dr. Huang said. European and Asian sales of the 70-kHz Avanti system (Optovue), containing the Oregon group's SSADA software, began in late 2014. Competitors also have begun adding other versions of angiography software to their OCT devices, he said.

—Linda Roach

1 Jia Y et al. *Proc Natl Acad Sci U S A.* 2015;112(18):E2395-E2402.

Relevant financial disclosures—Dr. Huang: *Carl Zeiss Meditech: P; Optovue: O,P,S.*

Pediatric Trauma Research

Steep Rise in Kids' Eye Injuries From Air Guns

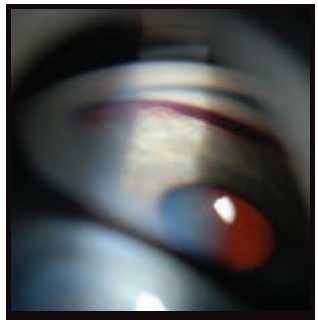
The work of "a curious and industrious medical student" uncovered startling statistics on pediatric eye injuries caused by nonpowder guns, said Douglas Fredrick, MD, Vice Chair for Clinical Affairs and clinical professor of ophthalmology at Stanford University Medical School. The student, Rachel Lee, was surprised by the extent of ocular trauma suffered by a boy who had been injured by a "benign-sounding" airsoft gun. That prompted Ms. Lee to analyze data (2002-2012) in the U.S. Consumer Product Safety Commission's National Electronic Injury Surveillance System and to coauthor an epidemiologic study with Dr. Fredrick.[1]

Traumatic toys. Nonpowder guns include paintball guns; BB and pellet guns, which fire metal spheres or pellets; and the increasingly popular airsoft guns, which are replicas of real firearms and shoot lightweight, 6-mm plastic bullets. All of these are capable of inflicting eye trauma, ranging from hyphema and corneal abrasion to more severe injuries such as lens dislocation, retinal detachment, and globe rupture.

The authors reported that about 3,160 children were treated in 2012 in U.S. emergency departments for eye injuries from these guns; and, since 2010, rates of hospital admissions for air gun eye injuries have increased by more than 600%. In fact, these guns are responsible for the majority of pediatric eye injuries that require hospital admission. What's more, there may be lasting visual consequences for many young patients: About 28% of documented airsoft- or BB gun–related cases had VA worse than 20/50 after initial treatment.

The ophthalmologist's role. Dr. Fredrick said that any physician who works with children "must look at the health of the whole child, not only the child's eyes." He added, "Just as we should advocate against smoking, drug and alcohol use, and other harmful behaviors, we should discourage the use of dangerous toys, like these guns." Parents who choose to let their children play with these toys must be responsible for making sure that the kids are closely supervised and always wear eye protection.

Noting that there are no federal laws regulating nonpowder guns and that a majority of states allow minors to purchase and possess these guns, Dr. Fredrick suggested that ophthalmologists work with local pediatricians to educate their legislators about these toys' potential for harm. "Anything that protects the health of our patients is worth getting involved in," he said. *—Peggy Denny*



TRAUMA FROM TOY GUN. Goniophoto shows bleeding into the trabecular meshwork and chamber angle after a BB gun injury.

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1 Lee R, Fredrick D. *J AAPOS.* 2015;19(2):163-168.

Relevant financial disclosures—Dr. Fredrick: *None.*

Cataract Surgery

Excessive Preop Testing

For years, the Academy and other organizations such as the Royal College of Ophthalmologists have been advising doctors to stop ordering routine laboratory testing before cataract surgery. Yet evidence-based guidelines have failed to alter individual physician behavior, according to a recent study headed by Catherine L. Chen, MD, MPH, an anesthesiologist at the University of California, San Francisco.[1]

Dr. Chen's study shows that over half of the patients in a random cohort of more than 440,000 Medicare beneficiaries undergoing cataract surgery in 2011 had 1 or more routine preoperative test in the month before surgery—even though routine testing has not been shown to improve outcomes.

Other findings from the preop month include:

- Nearly 800,000 tests were ordered at a cost of $16.1 million.
- 13% of patients had 1 preop test; 13% had 5 or more.
- In the preop month, testing costs were $4.8 million (42%) higher than the mean monthly costs in the previous 11 months.
- $28.3 million was spent on 308,397 office visits; this was $12.4 million more than the mean monthly costs in the prior 11 months.

Surprise finding. The researchers had hypothesized that the patients undergoing routine testing were older and sicker. But, in fact, a healthier subset of patients accounted for much of the testing. Some 90,000 patients who had not been sick enough to require *any* testing in the prior year had an average of 3 to 4 routine tests in the month before surgery. Dr. Chen said that there was nothing to account for the additional tests except for the patients' upcoming cataract surgery.

Physician driven. Digging deeper, she found that the individual cataract surgeon was the strongest predictor of the amount of testing. For example, among those who operated on 5 or more patients in 2011, 36% ordered tests for at least three-fourths of their patients, while 8% did so for all their patients.

Resistance to change. Some doctors keep ordering tests because "that's the way things have always been done," Dr. Chen said. Other factors may include concern for the safety of a mostly older patient population, assumptions about other physicians' expectations, and medicolegal fears, she said.

Rx for excessive testing. "Clearly, it is not enough just to disseminate guidelines," she said. She proposed that "high-testing" physicians be given feedback about their behavior so they can make appropriate changes. She hopes that this could avert a potential Medicare crackdown on reimbursement for preop testing and thus "avoid adding another layer of bureaucracy for the circumstance in which a patient truly does need a lab test or EKG prior to surgery because of a new symptom."

—Miriam Karmel

1 Chen CL et al. *N Engl J Med.* 2015;372(16):1530-1538.

Relevant financial disclosures—Dr. Chen: *Foundation for Anesthesia Education and Research: S.*

Femtosecond Techniques

The Ideal Capsulotomy?

If a femtosecond laser capsulotomy were as close to perfect as technologically possible, what would be its size and location on the capsular bag? Ideally, it would be 5.25 mm wide and centered on the optical axis of the crystalline lens, concluded Mark Packer, MD, FACS, CPI, and colleagues in a recent publication.[1] Dr. Packer is associate clinical professor of ophthalmology at Oregon Health & Sciences University, in Portland.

The authors postulate that this configuration would:

- Place the capsulotomy edge on the thickest part of the bag, to minimize the risk of capsular tears
- Ensure that the capsulotomy and the IOL are concentric, thus allowing the capsule rim to overlap the IOL evenly for 360 degrees, to prevent posterior capsular opacification
- Optimally and stably position the IOL in the bag, to possibly achieve a more predictable refractive outcome

Methods and results. To reach their biomechanical conclusions, the research group built an apparatus to test the strength and elasticity of 49 porcine capsular bags that had been incised with either a 5.0-mm manual continuous curvilinear capsulorrhexis (CCC) or a laser capsulotomy of between 4.0 and 5.5 mm.

In the CCC eyes, the anterior capsular rims broke with significantly less mean force ($p < .05$), and their mean elongation at breaking point was significantly smaller ($p < .0001$) than in the laser eyes. Although the researchers found that a 5.5-mm capsulotomy would be even stronger, they chose 5.25 mm as an ideal size so as to place the laser capsulotomy in the histologically thickest region of the capsule, Dr. Packer said.

—Linda Roach

1 Packer M et al. *Br J Ophthalmol.* March 31, 2015. [Epub ahead of print.]

Relevant financial disclosures—Dr. Packer: *Alcon: C; Bausch + Lomb: C; Lensar: C,O.*

For the financial disclosure key, *see page 8.* ***For full disclosures,*** *including category descriptions, view this News in Review at www.eyenet.org.*