News in Review

THIS MONTH, NEWS IN REVIEW HIGHLIGHTS SELECTED papers from the original papers sessions at AAO 2019. Each was chosen by the session chairs because it presents important news or illustrates a trend in the field. Only four subspecialties are included here; papers sessions will also be held in six other fields. For more information, see the Mobile Meeting Guide at aao.org/mobile.

TOPO MAP. *Data from 9,185 cataract surgeries were used with off-the-shelf hardware and free software to develop an AI-based formula.*

CATARACT

IOL Formulas: Using AI to Improve Accuracy

RESEARCHERS IN BOSTON AND LOS Angeles have developed an artificial intelligence (AI) neural network to calculate IOL power. The predictive ability of this approach significantly improved on the accuracy of several existing IOL formulas in mean error, mean absolute error, and target accuracy.

While most traditional formulas are based on large datasets, "they are generally engineered by humans or built using regression analysis," said lead author Shawn R. Lin, MD, MBA, at the University of California, Los Angeles. And although several existing formulas are AI-based, their technology is licensed to biometry companies, so their methods are not well publicized, he said. "We wanted to show that this type of research can be done with off-the-shelf hardware and free software."

Built on past results. For this retrospective cohort study, researchers used billing data to identify 9,185 cataract surgeries performed by 96 surgeons at Massachusetts Eye and Ear between 2016 and 2018. The formula is based on a subset of selected cases.

Data from those cases were fed into a software program, Google TensorFlow, to develop and train a neural network capable of predicting IOL power. In addition to postoperative refraction, the parameters included axial length, keratometry, anterior chamber depth, lens thickness, white to white, age, and sex.

Outsmarting existing models. The AI algorithm yielded significantly better results than the other IOL formulas it was compared to, including the Barrett Universal II, Hoffer Q, Holladay 1, and SRK/T.

Using the AI formula, 85% of eyes were within 0.50 D of target, and 97% were within 1.00 D of target. With the Barrett Universal II formula, the next closest in performance, 80% of eyes were within 0.50 D, and 95% were within 1.00 D.

Calculating the outliers. The predictive power can only get better with the inclusion of more eyes to the database, said Dr. Lin. He plans to start a multicenter data collection effort to expand the dataset to introduce variation across patient populations, geography, and technologies. Additional validation with data from more eyes will ensure that the formula works at the extremes of patient biometry measurements. "These are scenarios where all formulas have difficulty," he said.

Gearing up for prime time. Once this AI model is ready for clinical practice, surgeons will be able to input a patient's information and the formula will calculate the correct IOL power, Dr. Lin said. For now, he is using the formula alongside other existing formulas for each of his patients. "Comparing the

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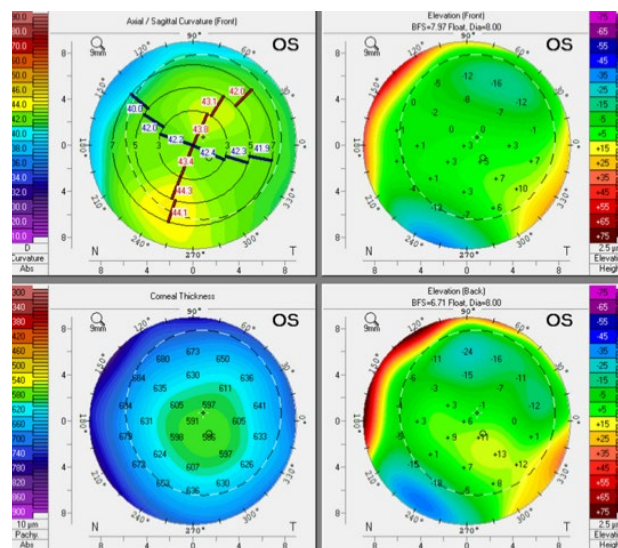
An AI-Based Approach to Predicting IOL Power. Presented during the first cataract original papers session. **When:** Sunday, Oct. 13, 3:30-5:30 p.m. **Where:** South 152. **Access:** Free.

Shawn R. Lin, MD, MBA

post-op results allows me to continuously improve the formula."

Dr. Lin plans to share this model and methodology with the research community as soon as possible. "I believe there is value in sharing our techniques so that we can spur others to do research in this field. Ultimately, I hope to improve cataract surgery outcomes for patients everywhere."

—*Miriam Karmel*

Relevant financial disclosures—Dr. Lin: None.

CORNEA
Neurotization for Neurotrophic Keratopathy

BRITISH RESEARCHERS SET OUT TO evaluate corneal neurotization in patients with neurotrophic keratopathy. They found that the surgical procedure restores trophic and sensory functions of neurotrophic corneas.

"Restoration of corneal sensation contributes to improved corneal function and structural health," said Samer Hamada, MD, at Queen Victoria Hospital in East Grinstead, England, and Eye Clinic London. "This helps prevent complications of neurotrophic keratopathy."

Patient selection. For this prospective study, 11 patients with neurotrophic keratopathy of various degrees underwent sural nerve transplantation surgery between February 2016 and April 2018 at Queen Victoria Hospital. A multidisciplinary team of cornea, oculoplastic, and plastic surgeons was involved.

The patients selected for this procedure had significant ocular morbidity secondary to irreversible neurotrophic keratopathy, and they had already undergone failed conventional medical or surgical treatments.

Methods. Outcome measures included visual acuity (VA) and evalu-

NOVEL TX. Corneal neurotization is a new option for restoring sensation and improving vision in patients with neurotrophic keratopathy.

ation of ocular surface (OS) staining, tear production, tear film breakup time (TFBT), osmolarity, and corneal sensation. Structural outcomes were assessed for changes in corneal nerve density and morphology by in vivo confocal microscopy.

Both functional and structural outcomes were measured preoperatively and postoperatively at the early (1-3 months), intermediate (3-6 months), and late (9 or more months) stages. Objective evidence for worsening keratopathy included reduced VA, TFBT, tear meniscus height, tear film quality and osmolarity, corneal thickness, and increased corneal and conjunctival staining.

Results. At last follow-up, VA had stabilized and improved in 10 patients. In addition, OS staining improved in 10 patients, tear quantity and quality improved in nine, tear film osmolarity was reduced in eight, and corneal sensation improved in seven. No complications were recorded intra- or postoperatively, and three patients had general improvement in sub-basal corneal nerve length and density. No patients had ulcers after the procedure.

Patient feedback. Six patients filled out questionnaires before and after surgery. One reported poor post-op vision; the remainder graded it to be

fair to good. Reading improved in four patients from being extremely or moderately difficult preoperatively to experiencing no or mild difficulty following the procedure. The other two patients reported no changes.

—*Arthur Stone*

Relevant financial disclosures—Dr. Hamada: None.

GLAUCOMA
VF Outcomes in the TVT Study

IN FINDINGS FROM THE TUBE VERSUS Trabeculectomy (TVT) Study, visual field (VF) outcomes appear to be comparable between the two treatment arms. "Similar rates of visual field progression were observed after both tube shunt implantation and trabeculectomy," said Swarup Swaminathan, MD, at Bascom Palmer Eye Institute in Miami.

Patients with a history of diabetes, elevated intraocular pressure (IOP), or worse VFs at baseline were at higher risk for VF progression, he added.

Study overview. This multicenter randomized trial was designed to describe and compare VF outcomes in two groups of patients: Those who underwent tube shunt surgery with the 350-mm² Baerveldt glaucoma implant and those who underwent trabeculectomy with mitomycin C (0.4 mg/mL for two minutes).

The analysis involved 122 patients (122 eyes) with previous cataract and/ or glaucoma surgery. Patients were evenly split between the two treatment groups.

Evaluating VFs. Participants were examined at multiple time points for up to five years following surgery. Each examination included measurements of visual acuity (VA) and IOP. VF measurements were included if the false-positive rate was less than or equal to 20% and the false-negative rate was less than or equal to 35%. VFs were excluded if VA was less than or equal to 20/400, or if the patient lost 2 or more Snellen lines from baseline due to any etiology other than glaucoma. Longitudinal linear mixed-effects models with

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Functional and Structural Changes Following Corneal Neurotization in the Management of Neurotrophic Keratopathy. Presented during the cornea and external disease original papers session. **When:** Monday, Oct. 14, 2:00-4:30 p.m. **Where:** South 10. **Access:** Free.

best linear unbiased predictions were applied to estimate rates of change in mean deviation (MD).

Results. For this cohort analysis, a total of 436 VFs were evaluated, with an average of 3.6 VFs per eye. The rate of MD change was –0.60 dB/year in the tube group and –0.38 dB/year in the trabeculectomy group (p = 0.34). Although elevated IOP at baseline was identified as a risk factor for VF progression, there was no significant association between IOP control and VF progression.   —*Arthur Stone*

Relevant financial disclosures: Dr. Swaminathan —None.

PEDIATRICS

IRIS Measures Meet Amblyopia

RESEARCHERS HAVE USED REPORT- ing measures developed for the Academy's Intelligent Research in Sight (IRIS) Registry to assess treatment outcomes at Boston Children's Hospital (BCH) for children with amblyopia.

The relevant IRIS Registry measure —Amblyopia Interocular Acuity—was published as IRIS7 in 2015 and relabelled as IRIS50 in 2019, after undergoing some changes to its specifications. The researchers found that their amblyopia treatment was successful in 71% of eligible patients by IRIS7 and in 81% of eligible patients by IRIS50, for a statistical significance of p = .006, said lead author Talia Shoshany, BS.

"We are the first to report our success by IRIS50 and compare with IRIS7 outcomes," said Ms. Shoshany, at Harvard Medical School in Boston. "To date, only one other group has evaluated its success by IRIS7," finding a 46% success rate.[1]

Study specifics. For this study, the researchers drew from the amblyopia outcomes database at BCH, which currently includes information on more than 2,000 patients.

Question of inclusion. The researchers evaluated all patients who were treated at BCH for amblyopia from 2010 to 2015. However, only 12% of the children met the measure's inclusion criteria for analysis, Ms. Shoshany noted. That is, they had newly been diagnosed with amblyopia, were between the ages of 3 and 7, had an interocular difference (IOD) that was greater than .29 logMAR (or 3 Snellen lines), and had no deprivation amblyopia.

In discussing the criteria, Ms. Shoshany noted that under IRIS7, a successful treatment is that which results in an IOD of less than .23 logMAR (approximately 2 lines) at 12-18 months. In comparison, she said, IRIS50 "added visual acuity (VA) of 20/30 or better and improvement in VA of 2 lines or more" at three to 12 months.

Predictors of success. "Multivariable logistic regression was used to evaluate whether specific variables were independently predictive of success," Ms. Shoshany said. Using IRIS7, baseline IOD and insurance status were predictive of success, but the other variables —presenting age, type of amblyopia, family history of amblyopia, initial VA, stereopsis, and type of treatment (e.g., glasses, patching, atropine, or surgery) —were not.

In contrast, under IRIS50, none of these variables was predictive of success.

Bottom line. "We believe IRIS50 is a better tool for measuring treatment success, as it takes improvement into account rather than just final VA outcomes," Ms. Shoshany said. "This captures patients with denser amblyopia at baseline" and tracks their improvement, "even if they didn't reach perfection."

With regard to the question of

TRACKING OUTCOMES. *The newer IRIS50 measure captures patients with denser amblyopia at baseline and tracks their overall improvement.*

inclusion, she said, the IRIS criteria "exclude a large proportion of patients we treat for amblyopia at BCH," such as those who are outside the age range, have previously been treated elsewhere, or do not meet IOD specifications (i.e., those with bilateral amblyopia or those with 2 lines of IOD who are still considered amblyopic). Additional criteria should be established to allow practices to evaluate outcomes in this broader range of patients that the BCH researchers captured in their database, she concluded.   —*Jean Shaw*

1 West CE et al. *J AAPOS.* 2015;20:e10.
Relevant financial disclosures: Ms. Shoshany— None.

Amblyopia Treatment Outcomes Using AAO IRIS7 and IRIS50 Criteria. Presented during the pediatric ophthalmology and strabisumus original papers session. **When:** Tuesday, Oct. 15, 8:30-10:00 a.m. **Where:** South 152. **Access:** Free.

POSTERS AT THE MEETING

For a look at cutting-edge research, visit the Scientific Poster Theater. **When:** For times, check the Mobile Meeting Guide at aao. org/mobile. **Where:** South, Exhibition Level. **Access:** Free.

Visual Field Outcomes in the Tube Versus Trabeculectomy Study. Presented during the glaucoma original papers session. **When:** Monday, Oct. 14, 2:00-5:15 p.m. **Where:** South 152. **Access:** Free.

See the financial disclosure key, page 10. **For full disclosures,** including category descriptions, view this News in Review at aao.org/eyenet.