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• **A14 Animal wrongs and animal rights: why nonhuman primate research is essential for children's eye health.** *Lawrence Tychem*

PERSPECTIVE

• **237 Virtual ophthalmology: telemedicine in a COVID-19 era.** *Sophia Mirza Saleem, Louis R. Pasquale, Paul A. Sidoti, and James C. Tsai*

The COVID-19 pandemic has motivated the field of ophthalmology to adopt live telehealth visits. This transformation has been as rapid as the pandemic itself. The process change is guided by providing safe patient-centered care and implementation strategies are suggested. We also describe a prototypical ophthalmology telehealth visit cycle and provide guidance on documentation, billing, and compliance issues, although these matters are in a state of flux.

ORIGINAL ARTICLES

• **1 Conjunctival biopsy site in mucous membrane pemphigoid.** *Giulia Coco, Vito Romano, Nardine Menassa, Davide Borroni, Katja Iselin, Daniel Finn, Gustavo S. Figueiredo, Filofteia Tacea, Elizabeth Anne Field, Sajjad Ahmad, and Stephen B. Kaye*

The direct immunofluorescence (DIF) test is considered the gold standard for diagnosing mucous membrane pemphigoid; however, it has low sensitivity in conjunctival samples and there is no agreement on which area of the ocular surface should be selected for biopsy. Comparing 3 different conjunctival locations (lesional, perilesional, and nonaffected), this study has revealed that taking the sample from perilesional areas increases the sensitivity of

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the DIF test, supporting the recommendation of choosing this area for sampling.

- **7 Patient-reported burden of dry eye disease in the United States: Results of an online cross-sectional survey.** *Reza Dana, Juliette Meunier, Jessica T. Markowitz, Corey Joseph, and Csaba Siffel*

In the United States, dry eye disease (DED) is a common ocular disease; however, the evidence on burden associated with this disease is limited. The aim of this cross-sectional study was to evaluate vision-related quality of life, ocular symptoms, general health status, and work productivity in individuals with and without DED. The results suggest that there is a substantial burden of DED on functional vision, general health status, and productivity.

- **18 Predictors of lost to follow-up in patients being treated for proliferative diabetic retinopathy.** *Michael Green, Thomas Tien, and Steven Ness*

The management of proliferative diabetic retinopathy (PDR) requires frequent in-office treatments, making adherence to follow-up appointments critical to visual outcomes. This retrospective cohort study of a safety net hospital population found a high rate of lost to follow-up in patients being treated for PDR and identified patient characteristics associated with poor adherence to regular follow-up. Identifying patients at high risk for lost to follow-up may be helpful in choosing treatment modality and appropriate patient counseling.

- **28 Clinical assessment of scleral canal area in glaucoma using spectral-domain optical coherence tomography.** *Yu Sawada, Makoto Araie, Hitomi Shibata, Katsuyuki Murata, Makoto Ishikawa, Takeshi Yoshitomi, and Takeshi Iwase*
This article reported that the anterior scleral canal area was significantly larger in the eyes with glaucoma compared to the fellow normal eyes in patients with unilateral glaucoma. It was significantly larger in the eyes with

worse visual field defect than those with better visual field defect in patients with bilateral glaucoma. These findings suggest that the anterior scleral canal area may be a useful parameter in the treatment and prevention of glaucoma.

- **37 Detection of progression with 10-2 standard automated perimetry: Development and validation of an event-based algorithm.** *Carlos Gustavo De Moraes, Jayter Silva Paula, Dana M. Blumberg, George A. Cioffi, Lama A. Al-Aswad, Christopher A. Girkin, Robert N. Weinreb, Linda M. Zangwill, Robert Ritch, Remo Susanna, Donald C. Hood, and Jeffrey M. Liebmann*

Current algorithms do not include a reference database of 10-2 visual field tests that could be used to monitor progressive functional loss in the macula of glaucomatous patients. In this study, the authors proposed and validated a pointwise event-based algorithm able to detect visual field progression with 10-2 standard automated perimetry.

- **44 Evaluation of long-term visual field function in patients undergoing glaucoma drainage device implantation.** *Qian Liu, Murtaza Saifee, Yinxi Yu, Gui-Shuang Ying, Shuning Li, Hua Zhong, Steven J. Gedde, and Ying Han*

This study examines the change in global and regional Humphrey VF functions after glaucoma drainage device implantation over a 3-year follow-up period. Overall, glaucoma drainage device surgery is effective for stabilizing VF function. The superior hemifield is affected more than other regions. The number of preoperative glaucoma medications is associated with mild VF changes measured by the Collaborative Initial Glaucoma Treatment Study score on total deviation probability.

- **55 Accuracy of Swept-Source Optical Coherence Tomography and Ultrasound Biomicroscopy for Evaluation of Posterior Lens Capsule in Traumatic Cataract.** *Seyed Ali Tabatabaei, Mohammad Soleimani, Hamed Etesali, and Morteza Naderan*

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This article discusses the efficacy of swept-source optical coherence tomography and ultrasound biomicroscopy in the assessment of posterior capsule integrity in traumatic cataract. Swept-source optical coherence tomography is a relatively new modality and no previous study has been published evaluating the above topic in the literature. Swept-source optical coherence tomography is an efficient and user-friendly method for the diagnosis of posterior capsule rupture in traumatic cataract.

- **59 Quantitative Analysis of Anterior Chamber Inflammation Using the Novel CASIA2 Optical Coherence Tomography.** Mingzhi Lu, Xiaoran Wang, Lei Lei, Yang Deng, Tinglong Yang, Ye Dai, Yonghao Li, Xiaoliang Gan, Yixin Hu, Hui Chen, Meng Li, Lishi Su, Jin Yuan, and Wei Chi

This study demonstrates that quantification of anterior chamber cell number, flare, and keratic precipitates using the CASIA2 device is a promising strategy for objective assessment of anterior chamber inflammation and auxiliary diagnosis of uveitis involving the anterior segment. Furthermore, it makes findings more reasonable and convincing by assessing 3 anterior segment optical coherence tomography-derived inflammatory indices to quantify anterior chamber inflammation rather than relying only on anterior chamber cell counts.

- **69 The clinical features and genetic spectrum of a large cohort of Chinese patients with vitelliform macular dystrophies.** Yi Xuan, Youjia Zhang, Yuan Zong, Min Wang, Lei Li, Xiaofeng Ye, Wei Liu, Junyi Chen, Xinghuai Sun, Yongjin Zhang, and Yuhong Chen

This study provided the clinical and genetic characteristics of a large cohort of 134 unrelated Chinese patients with vitelliform macular dystrophies. Novel mutations in the *BEST1* gene were detected. The clinical appearances and the ocular parameters were analyzed among different groups of patients with different genotypes. The results

expanded both the genotype and phenotype of vitelliform macular dystrophies in Chinese population. The assessment of angle-closure risk is a necessary consideration for all types of *BEST1*-related vitelliform macular dystrophies.

- **80 Crossover to photodynamic therapy or micropulse laser after failure of primary treatment of chronic central serous chorioretinopathy: The REPLACE trial.** Thomas J. van Rijnssen, Elon H.C. van Dijk, Paula Scholz, Myrte B. Breukink, Greet Dijkman, Petrus J.H. Peters, Roula Tsonaka, Robert E. MacLaren, Susan M. Downes, Sascha Fauser, Camiel J.F. Boon, and Carel B. Hoyng

In this prospective multicenter treatment study, chronic central serous chorioretinopathy patients with persistent subretinal fluid after either 1 or 2 half-dose photodynamic therapy or high-density subthreshold micropulse laser treatments received crossover treatment. The results of this study show that a crossover to half-dose photodynamic therapy is beneficial with regard to resolution of subretinal fluid and improvement of retinal sensitivity. Crossover treatment to high-density subthreshold micropulse laser did not yield significant improvements.

- **90 A Comparative Study of Total Corneal Power Using a Ray Tracing Method Obtained From 3 Different Scheimpflug Camera Devices.** Chao Pan, Weina Tan, Giacomo Savini, Yanjun Hua, Xiuhong Ye, Wenjin Xu, Jinjin Yu, Qinmei Wang, and Jinhai Huang

Ray-traced corneal power values obtained using 3 Scheimpflug camera devices were similar, indicating that they could be used interchangeably in daily clinical practice, although the dual Scheimpflug camera device displays a slightly larger value compared with 2 single Scheimpflug camera devices, Pentacam and Sirius. Compared with a conventional automated keratometer or a Placido-based topographer, the 3 Scheimpflug camera devices were satisfactory in agreement.

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- **99 Conjunctival Vascular Adaptation Related to Ocular Comfort in Habitual Contact Lens Wearers.** *Qi Chen, Hong Jiang, and Jianhua Wang*

Twenty-seven subjects were enrolled. Microvasculature and microcirculation on the temporal bulbar conjunctiva were imaged at baseline, 0.5 hours, and 6 hours after wearing contact lenses on both eyes. The relationship between the ocular comfort and conjunctival vascular responses in habitual contact lens wearers was detected in the current study. This is the first study to reveal the relation between ocular comfort and conjunctival vascular responses in habitual contact lens wearers.

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- **110 Intraocular pressure following prerandomization glaucoma medication washout in the HORIZON and COMPASS trials.** *Thomas V. Johnson and Henry D. Jampel*
- The HORIZON and COMPASS trials comparing cataract surgery alone to cataract surgery plus minimally invasive glaucoma surgery measured intraocular pressure (IOP) before and after medication washout, prior to surgical randomization. These data were analyzed to determine how the extent of postwashout IOP rise is affected by number of medications washed out, different drug classes, and specific eye drops. A generalized linear model identified associations between postwashout IOP rise and central corneal thickness as well as history of selective laser trabeculoplasty.

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- **121 Pre-perimetric open angle glaucoma with young age of onset: natural clinical course and risk factors for progression.** *Eunoo Bak, Yong Woo Kim, Ahnul Ha, Young Kook Kim, Ki Ho Park, and Jin Wook Jeoung*
- Young age onset pre-perimetric open angle glaucoma presents a slow disease course, even without treatment. To predict progression, structural parameters of temporal raphe sign, visible lamina pore, and functional parameter of greater pattern standard deviation should be considered.

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- **132 Corneal epithelial thickness measured using anterior segment optical coherence tomography as a diagnostic parameter for limbal stem cell deficiency.** *Qingfeng Liang, Qihua Le, Daniel W. Cordova, Chi-Hong Tseng, and Sophie X. Deng*

Epithelial thinning is present in eyes with limbal stem cell deficiency. The current study has validated the use of anterior segment optical coherence tomography in the measurement of epithelial thickness in limbal stem cell deficiency. The central corneal epithelial thickness could serve as the first confirmatory diagnostic test when there is clinical suspicion of limbal stem cell deficiency.

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- **140 Efficacy for Differentiating Nonglaucomatous Versus Glaucomatous Optic Neuropathy Using Deep Learning Systems.** *Hee Kyung Yang, Young Jae Kim, Jae Yun Sung, Dong Hyun Kim, Kwang Gi Kim, and Jeong-Min Hwang*

This study presented that artificial intelligence-based deep learning algorithms for detecting optic disc diseases could show excellent performance in differentiating nonglaucomatous and glaucomatous optic neuropathy on color fundus photographs, necessitating further research for clinical application.

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- **147 Globe axial length growth at age 10.5 years in the Infant Aphakia Treatment Study.** *M. Edward Wilson, Rupal H. Trivedi, David R. Weakley, Jr, George A. Cotsonis, and Scott R. Lambert, for the Infant Aphakia Treatment Study Group*

Axial length growth at age 10.5 years in the Infant Aphakia Treatment Study is evaluated. Eyes with glaucoma or poor visual acuity often grew longer than the fellow eye. Eyes operated for cataract surgery grew similarly in the intraocular lens and contact lens

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groups and also kept pace with the growth of the fellow eyes.

- **156 Hepatic ultrasonography compared with computed tomography and magnetic resonance imaging at diagnosis of metastatic uveal melanoma.** *Elina S. Rantala, Erno Peltola, Hanne Helminen, Micaela Hernberg, and Tero T. Kivelä*

In this consecutive cohort of 215 patients with primary uveal melanoma, hepatic ultrasonography was diagnostic of metastases in 95% of patients. The findings also suggest that subsequent magnetic resonance imaging is a more sensitive staging modality than computed tomography in detecting hepatic metastases from uveal melanoma. Ultrasonography should be followed by magnetic resonance imaging in case of any new hepatic lesion.

- **165 Randomized trial of monthly versus as-needed intravitreal ranibizumab for radiation retinopathy-related macular edema: 1-Year outcomes.** *Amy C. Scheffler, Dwain Fuller, Rajiv Anand, Timothy Fuller, Chelsey Moore, Jose Munoz, and Ryan S. Kim, on behalf of the RRR Study Group*

The authors present 1-year data of a randomized clinical trial comparing the efficacy of monthly ranibizumab injections versus monthly ranibizumab plus targeted panretinal photocoagulation (TRP) or as-needed ranibizumab plus TRP for the management of radiation-induced cystoid macular edema. Best-corrected visual acuity of the monthly group at 1 year was significantly better than that of the other 2 cohorts, while 83% of the subjects retained visual acuity of 20/200 or better after treatment.

- **174 Safety and Efficacy of Colored Iris Reconstruction Lens Implantation.** *Hongxing Wang, JooYeon Jung, Shawn R. Lin, Michael D. Olson, and Kevin M. Miller*

Colored iris reconstruction lens implantation significantly improved visual function in eyes with large iris defects 3 years postoperatively and beyond. Adverse events, complications, and late declines in visual acuity were relatively common, however.

- **186 The Effect of Axial Length on Extraocular Muscle Leverage.** *Robert A. Clark and Joseph L. Demer*

High-resolution magnetic resonance imaging in adults having a wide range of axial length shows that regardless of globe length, the eye rotates about a point nasal and anterior to its geometric center, giving the lateral rectus more leverage than the medial rectus muscle. This eccentricity may diminish the effect of tendon repositioning in moderate to highly myopic patients, predicting reductions in per-millimeter dose/response of muscle recession surgery in eyes with greater axial length.

- **193 Schlemm canal and trabecular meshwork features in highly myopic eyes with early intraocular pressure elevation after cataract surgery.** *Jiao Qi, Wenwen He, Qiang Lu, Keke Zhang, Yi Lu, and Xiangjia Zhu*

Highly myopic cataract eyes with smaller Schlemm canal vertical diameter and thinner trabecular meshwork are more susceptible to early transient intraocular pressure elevation after cataract surgery. Preoperative anterior segment optical coherence tomography assessment of Schlemm canal and trabecular meshwork may contribute to the identification of high-risk patients and timely postoperative intraocular pressure management.

- **201 Automated diagnosis of diabetic retinopathy using clinical biomarkers, optical coherence tomography, and optical coherence tomography angiography.** *Harpal Singh Sandhu, Mohammed Elmogy, Ahmed Taher Sharafeldien, Mohamed Elsharkawy, Nabila El-Adawy, Ahmed Eltanboly, Ahmed Shalaby, Robert Keynton, and Ayman El-Baz*

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A machine learning system was created for automated diagnosis of nonproliferative diabetic retinopathy using multiple modes of data, including optical coherence tomography, optical coherence tomography angiography, and easily obtainable clinical and demographic data. Combining the 2 imaging modalities improved the system's performance over either one alone, as did the addition of clinical and demographic data to imaging data, increasing sensitivity to 100%, specificity to 94%, and area under the curve to 0.96.

• **207 Psychosocial predictors of glaucoma medication adherence among the Support, Educate, Empower (SEE) personalized glaucoma coaching pilot study participants.**

Mariam Salman, Chris Andrews, Michele Heisler, Deborah Darnley-Fisch, and Paula Anne Newman-Casey

In a pilot study of a personalized glaucoma coaching program, baseline psychosocial predictors of adherence were assessed prior to monitoring glaucoma medication adherence electronically over 3 months. Glaucoma-related distress, income, and education all predicted lower glaucoma medication adherence, demonstrating a risk profile for those patients who may benefit from additional glaucoma self-management support.

• **219 Faster Sensitivity Loss Around Dense Scotomas than for overall macular sensitivity in Stargardt Disease: Progstar Report No. 14.** *Etienne M. Schönbach, Rupert W. Strauss, Mohamed A. Ibrahim, Jessica L. Janes, David G. Birch, Artur V. Cideciyan, Janet S. Sunness, Beatriz Muñoz, Michael S. Ip, Srinivas R. Sadda, and Hendrik P.N. Scholl, on behalf of the ProgStar Study Group*

This international, multicenter, prospective natural history study of molecularly confirmed cases of Stargardt disease type 1 introduces a novel automated approach to quantifying progression of functional loss selectively at the leading disease front. This approach was validated relative to manual grading and demonstrated faster progression,

which will allow clinical trials of shorter duration or smaller cohorts or both.

• **226 Aurolab aqueous drainage implant with and without scleral patch graft in refractory adult and pediatric glaucomas: a comparative study.** *George Varghese Puthuran, Paul Palmberg, Hiruni Kaushalya Wijesinghe, Kumar Saurabh Srivastav, Subbaiah Ramasamy Krishnadas, and Alan Lee Robin*

Implantation of the Aurolab Aqueous Drainage Implant tube through a needle-generated scleral tunnel without a donor scleral patch graft was as safe and effective as the conventional technique of implantation using the patch graft.

CORRESPONDENCE

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- **283 Comment on progression of retinopathy secondary to maternally inherited diabetes and deafness: Evaluation of predicting parameters.** *Josef Finsterer, Fulvio A. Scorza, and Carla A. Scorza* • **284 Reply to Comment on: Progression of retinopathy secondary to maternally inherited diabetes and deafness – evaluation of predicting parameters.** *Philipp L. Müller and Adnan Tufail* • **285 Comment on: Acute retinal necrosis: virological features using quantitative polymerase chain reaction, therapeutic management, and clinical outcomes.** *Kenneth J. Taubenslag and Stephen J. Kim* • **285 Reply to comment on: Acute retinal necrosis: virological features using quantitative polymerase chain reaction.** *Emilie Frobert, Meriem Hafidi, and Helene Janin-Magnificat* • **286 Comment on: Retinal and corneal neurodegeneration and its association to systemic signs of peripheral neuropathy in type 2 diabetes.** *Brijesh Takkar and Aastha Takkar* • **287 Reply to Comment on: Retinal and corneal neurodegeneration and its association to systemic signs of peripheral neuropathy in Type 2 Diabetes.** *Julia Hafner,*

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• **243 A comparison of trabeculectomy surgery outcomes with mitomycin-C applied by intra-Tenon injection versus sponge.** Michele C. Lim, Betty Hom, Mitchell R. Watnik, James D. Brandt, Allison R. Altman, Tania Paul, and Melissa G. Tong

A retrospective, comparative case study suggests that the application of MMC by injection was similar to application by sponge in lowering IOP in patients with glaucoma and the safety of both techniques appears to be comparable. For late complications (>1 month post-surgery), the MMC sponge group had a significantly greater proportion of cases

with tense, vascularized, or encapsulated blebs. Limbus-based conjunctival incision had longer time to failure for post-operative IOP control versus fornix-based incision.

• **257 Role of deep learning—quantified hyperreflective foci for the prediction of geographic atrophy progression.** Ursula Schmidt-Erfurth, Hrvoje Bogunovic, Christoph Grechenig, Patricia Bui, Maria Fabianska, Sebastian Waldstein, and Gregor S. Reiter

Hyperreflective foci (HRF) are a morphological hallmark in geographic atrophy (GA). Deep learning was used to localize and quantify HRF during the progression of GA in SD-OCT images. Increased HRF accumulation was identified within the junctional zone of GA lesions and correlated positively with focal progression as well as de novo lesion development. AI-based analysis of pathognomonic biomarkers offers a reliable tool for monitoring of disease activity in GA.

• **271 Static and dynamic factors associated with extended depth of focus in monofocal intraocular lenses.** Karolinne Maia Rocha, Larissa Gouvea, George Oral Waring IV, and Jorge Haddad

Corneal profile and type of IOL implanted were the most important factors influencing near vision functionality with contemporary aspheric monofocal IOLs.

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