Wills Eye Resident Series: Distorted vision in an older patient. *P. 71*

REVIEW® of OPHTHALMOLOGY

January 2021

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The **FIRST AND ONLY FDA APPROVED SHORT-TERM**
(up to two weeks) Rx treatment for the signs and symptoms of Dry Eye Disease

IN THE BATTLEGROUND OF DRY EYE...

When Dry Eye Flares strike, fight back first with fast.

INDICATION

EYSUVIS is a corticosteroid indicated for the short-term (up to two weeks) treatment of the signs and symptoms of dry eye disease.

IMPORTANT SAFETY INFORMATION

Contraindication:

EYSUVIS, as with other ophthalmic corticosteroids, is contraindicated in most viral diseases of the cornea and conjunctiva including epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, and varicella, and also in mycobacterial infection of the eye and fungal diseases of ocular structures.

Warnings and Precautions:

Delayed Healing and Corneal Perforation: Topical corticosteroids have been known to delay healing and cause corneal and scleral thinning. Use of topical corticosteroids in the presence of thin corneal or scleral tissue may lead to perforation. The initial prescription and each renewal of the medication order should be made by a physician only after examination of the patient with the aid of magnification, such as slit lamp biomicroscopy, and, where appropriate, fluorescein staining.

Intraocular Pressure (IOP) Increase: Prolonged use of corticosteroids may result in glaucoma with damage to the optic nerve, as well as defects in visual acuity and fields of vision. Corticosteroids should be used with caution in the presence of glaucoma. Renewal of the medication order should be made by a physician only after examination of the patient and evaluation of the IOP

Cataracts: Use of corticosteroids may result in posterior subcapsular cataract formation.

Bacterial Infections: Use of corticosteroids may suppress the host response and thus increase the hazard of secondary ocular infections. In acute purulent conditions, corticosteroids may mask infection or enhance existing infection

Viral Infections: Use of a corticosteroid medication in the treatment of patients with a history of herpes simplex requires great caution. Use of ocular corticosteroids may prolong the course and may exacerbate the severity of many viral infections of the eye (including herpes simplex).

Fungal Infections: Fungal infections of the cornea are particularly prone to develop coincidentally with long-term local corticosteroid application. Fungus invasion must be considered in any persistent corneal ulceration where a corticosteroid has been used or is in use.

Adverse Reactions:

The most common adverse drug reaction following the use of EYSUVIS for two weeks was instillation site pain, which was reported in 5% of patients.

Please see Brief Summary of Prescribing Information for EYSUVIS on the next page.

EYSUVIS™
(loteprednol etabonate ophthalmic suspension) 0.25%
THE FAST FLARE FIGHTER

kala PHARMACEUTICALS

US-EYS-2000157 www.EYSUVIS.com

EYSUVIS (loteprednol etabonate ophthalmic suspension) 0.25%, for topical ophthalmic use

BRIEF SUMMARY OF FULL PRESCRIBING INFORMATION

INDICATIONS AND USAGE

EYSUVIS is a corticosteroid indicated for the short-term (up to two weeks) treatment of the signs and symptoms of dry eye disease.

CONTRAINDICATIONS

EYSUVIS, as with other ophthalmic corticosteroids, is contraindicated in most viral diseases of the cornea and conjunctiva including epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, and varicella, and also in mycobacterial infection of the eye and fungal diseases of ocular structures.

WARNINGS AND PRECAUTIONS

Delayed Healing and Corneal Perforation—Topical corticosteroids have been known to delay healing and cause corneal and scleral thinning. Use of topical corticosteroids in the presence of thin corneal or scleral tissue may lead to perforation. The initial prescription and each renewal of the medication order should be made by a physician only after examination of the patient with the aid of magnification, such as slit lamp biomicroscopy, and, where appropriate, fluorescein staining.

Intraocular Pressure (IOP) Increase—Prolonged use of corticosteroids may result in glaucoma with damage to the optic nerve, as well as defects in visual acuity and fields of vision. Corticosteroids should be used with caution in the presence of glaucoma. Renewal of the medication order should be made by a physician only after examination of the patient and evaluation of the IOP.

Cataracts—Use of corticosteroids may result in posterior subcapsular cataract formation.

Bacterial Infections—Use of corticosteroids may suppress the host response and thus increase the hazard of secondary ocular infections. In acute purulent conditions of the eye, corticosteroids may mask infection or enhance existing infection.

Viral Infections—Use of corticosteroid medication in the treatment of patients with a history of herpes simplex requires great caution. Use of ocular corticosteroids may prolong the course and may exacerbate the severity of many viral infections of the eye (including herpes simplex).

Fungal Infections—Fungal infections of the cornea are particularly prone to develop coincidentally with long-term local corticosteroid application. Fungus invasion must be considered in any persistent corneal ulceration where a corticosteroid has been used or is in use. Fungal cultures should be taken when appropriate.

Risk of Contamination—Do not to allow the dropper tip to touch any surface, as this may contaminate the suspension.

Contact Lens Wear—The preservative in EYSUVIS may be absorbed by soft contact lenses. Contact lenses should be removed prior to instillation of EYSUVIS and may be reinserted 15 minutes following administration.

ADVERSE REACTIONS

Adverse reactions associated with ophthalmic corticosteroids include elevated intraocular pressure, which may be associated with infrequent optic nerve damage, visual acuity and field defects, posterior subcapsular cataract formation, delayed wound healing and secondary ocular infection from pathogens including herpes simplex, and perforation of the globe where there is thinning of the cornea or sclera.

Clinical Trials Experience—Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in the clinical trials of a drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in practice.

The most common adverse reaction observed in clinical trials with EYSUVIS was instillation site pain, which was reported in 5% of patients.

USE IN SPECIFIC POPULATIONS

Pregnancy—Risk Summary: There are no adequate and well controlled studies with loteprednol etabonate in pregnant women. Loteprednol etabonate produced teratogenicity at clinically relevant doses in the rabbit and rat when administered orally during pregnancy. Loteprednol etabonate produced malformations when administered orally to pregnant rabbits at doses 1.4 times the recommended human ophthalmic dose (RHOD) and to pregnant rats at doses 34 times the RHOD. In pregnant rats receiving oral doses of loteprednol etabonate during the period equivalent to the last trimester of pregnancy through lactation in humans, survival of offspring was reduced at doses 3.4 times the RHOD. Maternal toxicity was observed in rats at doses 347 times the RHOD, and a maternal no observed adverse effect level (NOAEL) was established at 34 times the RHOD.

The background risk in the U.S. general population of major birth defects is 2 to 4%, and of miscarriage is 15 to 20%, of clinically recognized pregnancies.

Data—*Animal Data:* Embryofetal studies were conducted in pregnant rabbits administered loteprednol etabonate by oral gavage on gestation days 6 to 18, to target the period of organogenesis. Loteprednol etabonate produced fetal malformations at 0.1 mg/kg (1.4 times the recommended human ophthalmic dose (RHOD) based on body surface area, assuming 100% absorption). Spina bifida (including meningocele) was observed at 0.1 mg/kg, and exencephaly and craniofacial malformations were observed at 0.4 mg/kg (5.6 times the RHOD). At 3 mg/kg (41 times the RHOD), loteprednol etabonate was associated with increased incidences of abnormal left common carotid artery, limb flexures, umbilical hernia, scoliosis, and delayed ossification. Abortion and embryofetal lethality (resorption) occurred at 6 mg/kg (83 times the RHOD). A NOAEL for developmental toxicity was not established in this study. The NOAEL for maternal toxicity in rabbits was 3 mg/kg/day.

Embryofetal studies were conducted in pregnant rats administered loteprednol etabonate by oral gavage on gestation days 6 to 15, to target the period of organogenesis. Loteprednol etabonate produced fetal malformations, including absent innominate artery at 5 mg/kg (34 times the RHOD); and cleft palate, agnathia, cardiovascular defects, umbilical hernia, decreased fetal body weight and decreased skeletal ossification at 50 mg/kg (347 times the RHOD). Embryofetal lethality (resorption) was observed at 100 mg/kg (695 times the RHOD). The NOAEL for developmental toxicity in rats was 0.5 mg/kg (3.4 times the RHOD). Loteprednol etabonate was maternally toxic (reduced body weight gain) at 50 mg/kg/day. The NOAEL for maternal toxicity was 5 mg/kg.

A peri-/postnatal study was conducted in rats administered loteprednol etabonate by oral gavage from gestation day 15 (start of fetal period) to postnatal day 21 (the end of lactation period). At 0.5 mg/kg (3.4 times the clinical dose), reduced survival was observed in live-born offspring. Doses ≥ 5 mg/kg (34 times the RHOD) caused umbilical hernia/incomplete gastrointestinal tract. Doses ≥ 50 mg/kg (347 times the RHOD) produced maternal toxicity (reduced body weight gain, death), decreased number of live-born offspring, decreased birth weight, and delays in postnatal development. A developmental NOAEL was not established in this study. The NOAEL for maternal toxicity was 5 mg/kg.

Lactation—There are no data on the presence of loteprednol etabonate in human milk, the effects on the breastfed infant, or the effects on milk production. The developmental and health benefits of breastfeeding should be considered, along with the mother's clinical need for EYSUVIS and any potential adverse effects on the breastfed infant from EYSUVIS.

Pediatric Use—Safety and effectiveness in pediatric patients have not been established.

Geriatric Use—No overall differences in safety and effectiveness have been observed between elderly and younger adult patients.

NONCLINICAL TOXICOLOGY

Carcinogenesis, Mutagenesis, Impairment of Fertility—Long-term animal studies have not been conducted to evaluate the carcinogenic potential of loteprednol etabonate. Loteprednol etabonate was not genotoxic *in vitro* in the Ames test, the mouse lymphoma thymidine kinase (tk) assay, in a chromosome aberration test in human lymphocytes, or *in vivo* in the single dose mouse micronucleus assay. Treatment of male and female rats with 25 mg/kg/day of loteprednol etabonate (174 times the RHOD based on body surface area, assuming 100% absorption) prior to and during mating caused pre-implantation loss and decreased the number of live fetuses/live births. The NOAEL for fertility in rats was 5 mg/kg/day (34 times the RHOD).

For a copy of the Full Prescribing Information, please visit www.EYSUVIS.com.

Manufactured for:
Kala Pharmaceuticals, Inc.
Watertown, MA 02472

Part # 2026R02

October 2020
Kala®

US-EYS-2000115

NEWS

RevOpth
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JANUARY 2021

Study Supports Reversal of Vision Loss from Glaucoma

Scientists at Harvard Medical School have completed a proof-of-concept study showing that it's possible to reverse both age-related vision loss and eye damage similar to that caused by glaucoma, in mice, using epigenetic reprogramming.

This new approach is based on a recent theory about the cause of the gradual functional failure we associate with aging. The hypothesis is that this failure is caused by deterioration of the epigenome, a system that activates specific genes in our DNA, causing cells to serve specific purposes. The epigenome appears to accomplish this by methylation—attaching methyl groups to the DNA. Early in life the epigenome triggers patterns of methylation that activate the appropriate genes, but as the epigenome deteriorates, the wrong genes are activated—or the right ones fail to activate—leading to signs and symptoms associated with diseases of aging.

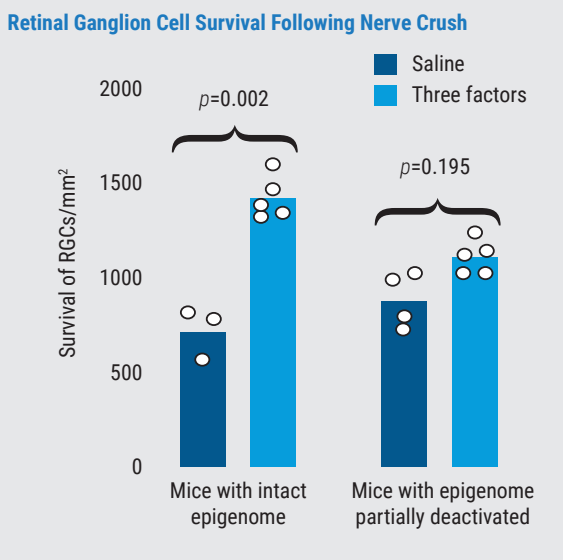
In this study, described in the early December 2020 edition of *Nature*, the researchers theorized that if a virus could be used to deliver genes into cells that would replace faulty methylation patterns with the original, early-life methylation patterns, the dysfunction of the cells might be reversed. This would then cause healthy cell function to resume. The effect could be thought of as a reversal of the aging process.

The lead study author, Yuancheng Lu, PhD, based this work on the Nobel-Prize-winning work of Japanese stem cell researcher Shinya Yamanaka. Yamanaka identified four transcription factors (genes) that can be used to erase epigenetic markers, returning them to their primitive embryonic state. Studies found that the result of applying all four factors caused too much regression, so Dr. Lu and colleagues hypothesized that omitting one of the four factors would reset the early-life epigenome safely. They were able to achieve this result in petri dishes, so the next step was to see if it would work as well *in vivo*.

Partnering with Harvard's professor of genetics David Sinclair, PhD, and Zhigang He, PhD, a professor of neurology and ophthalmology at Boston Children's Hospital, Dr. Lu conducted a series of experiments:

- First, they used an adeno-associated virus to deliver the gene combination to retinal ganglion cells of adult mice with optic nerve injury. The result was a two-fold increase in surviving retinal cells and a five-fold increase in nerve regrowth. *(Graph, left.)*
- Following the success of that experiment, the team partnered with colleagues at Schepens Eye Research Institute (part of Massachusetts Eye and Ear) and the treatment was applied to mice that had lost vision after being subjected to a model of glaucoma. The treatment led to increased nerve cell electrical activity and an increase in visual acuity.
- Next, they treated mice whose vision had diminished due to normal aging. After treatment, optic nerve cells regained the electrical signaling seen in young mice, and testing showed that the mice

(Continued on p. 14)



Retinal ganglion cell survival following crush injury in mice was significantly enhanced by the application of three transcription factors that reset the epigenome to its original state, returning cells to an earlier, more functional state (left bars). Deactivating some of the encoding genes that would be "repaired" by the three factors undercut their impact significantly (right bars).[1]

iLink™
CROSS-LINKING PROCEDURE

Using Photrexa® Viscous (riboflavin 5'-phosphate in 20% dextran ophthalmic solution), Photrexa® (riboflavin 5'-phosphate ophthalmic solution), and the KXL® system, the iLink™ corneal cross-linking procedure from Glaukos is the only FDA-approved therapeutic treatment for patients with progressive keratoconus and corneal ectasia following refractive surgery.*[1]

GET THERE IN TIME

iLink™ is the only FDA-approved cross-linking procedure that slows or halts progressive keratoconus to help you preserve vision.

Now from GLAUKOS
LEARN MORE AT **GLAUKOS.COM**

INDICATIONS

Photrexa® Viscous (riboflavin 5'-phosphate in 20% dextran ophthalmic solution) and Photrexa® (riboflavin 5'-phosphate ophthalmic solution) are indicated for use with the KXL System in corneal collagen cross-linking for the treatment of progressive keratoconus and corneal ectasia following refractive surgery. Corneal collagen cross-linking should not be performed on pregnant women.

IMPORTANT SAFETY INFORMATION

Ulcerative keratitis can occur. Patients should be monitored for resolution of epithelial defects.

The most common ocular adverse reaction was corneal opacity (haze). Other ocular side effects include punctate keratitis, corneal striae, dry eye, corneal epithelium defect, eye pain, light sensitivity, reduced visual acuity, and blurred vision.

These are not all of the side effects of the corneal collagen cross-linking treatment. For more information, go to www.livingwithkeratoconus.com to obtain the FDA-approved product labeling.

You are encouraged to report all side effects to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.

*Photrexa® Viscous and Photrexa® are manufactured for Avedro. The KXL System is manufactured by Avedro. Avedro is a wholly owned subsidiary of Glaukos Corporation.

REFERENCE: 1. Photrexa [package insert] Waltham, MA: Glaukos, Inc. 2016.

MA-01953A

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Clinical advice you can trust

CONTRIBUTORS

ADVISORY BOARD

BUSINESS OFFICES
19 CAMPUS BOULEVARD, SUITE 101
NEWTOWN SQUARE, PA 19073
SUBSCRIPTION INQUIRIES (877) 529-1746
(USA ONLY); OUTSIDE USA, CALL (847) 763-9630

BUSINESS STAFF
PUBLISHER
MICHAEL HOSTER
(610) 492-1028 MHOSTER@JOBSON.COM

EXECUTIVE DIRECTOR
JAMES HENNE
(610) 492-1017 JHENNE@JOBSON.COM

REGIONAL SALES MANAGER
MICHELE BARRETT
(610) 492-1014 MBARRETT@JOBSON.COM

REGIONAL SALES MANAGER
JONATHAN DARDINE
(610) 492-1030 JDARDINE@JOBSON.COM

CLASSIFIED ADVERTISING
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PRODUCTION MANAGER
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KAREN LALLONE
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CIRCULATION
PO BOX 71, CONGERS, NY 10920-0071
(877) 529-1746
OUTSIDE USA: (845) 267-3065

SENIOR CIRCULATION MANAGER
HAMILTON MAHER
(212) 219-7870 hmaher@jhihealth.com

CEO, INFORMATION GROUP SERVICES
MARC FERRARA

SENIOR VICE PRESIDENT, OPERATIONS
JEFF LEVITZ

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VICE PRESIDENT, CIRCULATION
JARED SONNERS

395 Hudson Street, 3rd Floor,
New York, NY 10014

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ONCE-DAILY
rhopressa®
(netarsudil ophthalmic solution) 0.02%

BRIEF SUMMARY
Consult the full Prescribing Information for complete product information.

INDICATIONS AND USAGE
Rhopressa® (netarsudil ophthalmic solution) 0.02% is indicated for the reduction of elevated intraocular pressure (IOP) in patients with open-angle glaucoma or ocular hypertension.

DOSAGE AND ADMINISTRATION
The recommended dosage is one drop in the affected eye(s) once daily in the evening.

If one dose is missed, treatment should continue with the next dose in the evening. Twice a day dosing is not well tolerated and is not recommended. If Rhopressa® is to be used concomitantly with other topical ophthalmic drug products to lower IOP, administer each drug product at least 5 minutes apart.

WARNINGS AND PRECAUTIONS
Bacterial Keratitis
There have been reports of bacterial keratitis associated with the use of multiple-dose containers of topical ophthalmic products. These containers had been previously contaminated by patients who, in most cases, had a concurrent corneal disease or a disruption of the ocular epithelial surface.

Use with Contact Lenses
Rhopressa® contains benzalkonium chloride, which may be absorbed by soft contact lenses. Contact lenses should be removed prior to instillation of Rhopressa® and may be reinserted 15 minutes following its administration.

ADVERSE REACTIONS
Clinical Trials Experience
Because clinical studies are conducted under widely varying conditions, adverse reaction rates observed in the clinical studies of a drug cannot be directly compared to rates in the clinical studies of another drug and may not reflect the rates observed in practice.

The most common ocular adverse reaction observed in controlled clinical studies with Rhopressa® dosed once daily was conjunctival hyperemia which was reported in 53% of patients. Six percent of patients discontinued therapy due to conjunctival hyperemia. Other common (approximately 20%) ocular adverse reactions reported were: corneal verticillata, instillation site pain, and conjunctival hemorrhage. Instillation site erythema, corneal staining, blurred vision, increased lacrimation, erythema of eyelid, and reduced visual acuity were reported in 5-10% of patients.

Corneal Verticillata
Corneal verticillata occurred in approximately 20% of the patients in controlled clinical studies. The corneal verticillata seen in Rhopressa®-treated patients were first noted at 4 weeks of daily dosing. This reaction did not result in any apparent visual functional changes in patients. Most corneal verticillata resolved upon discontinuation of treatment.

For additional information, please refer to full Prescribing Information at Rhopressa.com.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch or call 1-800-1088.

U.S. Patent Nos.: 8,450,344; 8,394,826; 9,096,569; 9,415,043; 9,931,336

ONCE-DAILY
rocklatan®
(netarsudil and latanoprost ophthalmic solution) 0.02%/0.005%

BRIEF SUMMARY
Consult the full Prescribing Information for complete product information.

INDICATIONS AND USAGE
Rocklatan® (netarsudil and latanoprost ophthalmic solution) 0.02%/0.005% is indicated for the reduction of elevated intraocular pressure (IOP) in patients with open-angle glaucoma or ocular hypertension.

DOSAGE AND ADMINISTRATION
The recommended dosage is one drop in the affected eye(s) once daily in the evening.

If one dose is missed, treatment should continue with the next dose in the evening. The dosage of Rocklatan® should not exceed once daily. Rocklatan® may be used concomitantly with other topical ophthalmic drug products to lower IOP. If more than one topical ophthalmic drug is being used, the drugs should be administered at least five (5) minutes apart.

CONTRAINDICATIONS
None.

WARNINGS AND PRECAUTIONS
Pigmentation
Rocklatan® contains latanoprost which has been reported to cause changes to pigmented tissues. The most frequently reported changes have been increased pigmentation of the iris, periorbital tissue (eyelid), and eyelashes. Pigmentation is expected to increase as long as latanoprost is administered.

The pigmentation change is due to increased melanin content in the melanocytes rather than to an increase in the number of melanocytes. After discontinuation, pigmentation of the iris is likely to be permanent, while pigmentation of the periorbital tissue and eyelash changes have been reported to be reversible in some patients. Beyond 5 years the effects of increased pigmentation are not known.

Iris color change may not be noticeable for several months to years. Typically, the brown pigmentation around the pupil spreads concentrically towards the periphery of the iris and the entire iris or parts of the iris become more brownish. Neither nevi nor freckles of the iris appear to be affected by treatment. While treatment with Rocklatan® can be continued in patients who develop noticeably increased iris pigmentation, these patients should be examined regularly.

Eyelash Changes
Rocklatan® contains latanoprost which may gradually change eyelashes and vellus hair in the treated eye; these changes include increased length, thickness, pigmentation, the number of lashes or hairs, and misdirected growth of eyelashes. Eyelash changes are usually reversible upon discontinuation of treatment.

Intraocular Inflammation
Rocklatan® contains latanoprost which should be used with caution in patients with a history of intraocular inflammation (iritis/uveitis) and should generally not be used in patients with active intraocular inflammation because it may exacerbate inflammation.

Macular Edema
Macular edema, including cystoid macular edema, has been reported during treatment with latanoprost. Rocklatan® should be used with caution in aphakic patients, in pseudophakic patients with a torn posterior lens capsule, or in patients with known risk factors for macular edema.

Herpetic Keratitis
Reactivation of herpes simplex keratitis has been reported during treatment with latanoprost. Rocklatan® should be used with caution in patients with a history of herpetic keratitis. Rocklatan® should be avoided in cases of active herpes simplex keratitis because it may exacerbate inflammation.

Bacterial Keratitis
There have been reports of bacterial keratitis associated with the use of multiple-dose containers of topical ophthalmic products. These containers had been inadvertently contaminated by patients who, in most cases, had a concurrent corneal disease or a disruption of the ocular epithelial surface.

Use with Contact Lenses
Contact lenses should be removed prior to the administration of Rocklatan® and may be reinserted 15 minutes after administration.

ADVERSE REACTIONS
Clinical Trials Experience
Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in the clinical trials of a drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in clinical practice.

Rocklatan®
The most common ocular adverse reaction observed in controlled clinical studies with Rocklatan® was conjunctival hyperemia which was reported in 59% of patients. Five percent of patients discontinued therapy due to conjunctival hyperemia. Other common ocular adverse reactions reported were instillation site pain (20%), corneal verticillata (15%), and conjunctival hemorrhage (11%). Eye pruritus, visual acuity reduced, increased lacrimation, instillation site discomfort, and blurred vision were reported in 5-8% of patients.

Other adverse reactions that have been reported with the individual components and not listed above include:

Netarsudil 0.02%
Instillation site erythema, corneal staining, increased lacrimation and erythema of eyelid.

Latanoprost 0.005%
Foreign body sensation, punctate keratitis, burning and stinging, itching, increased pigmentation of the iris, excessive tearing, eyelid discomfort, dry eye, eye pain, eyelid margin crusting, erythema of the eyelid, upper respiratory tract infection/nasopharyngitis/influenza, photophobia, eyelid edema, myalgia/arthralgia/back pain, and rash/allergic reactions.

DRUG INTERACTIONS
In vitro drug interaction studies have shown that precipitation can occur when eye drops containing thimerosal are mixed with Rocklatan®. If such drugs are used, they should be administered at least five (5) minutes apart.

The combined use of two or more prostaglandins or prostaglandin analogs including latanoprost ophthalmic solution 0.005% is not recommended. It has been shown that administration of these prostaglandin drug products more than once daily may decrease the IOP lowering effect or cause paradoxical elevations in IOP.

For additional information, refer to the full Prescribing Information at Rocklatan.com.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch or call 1-800-FDA-1088.

U.S. Patent Nos.: 8,450,344; 8,394,826; 9,096,569; 9,415,043; 9,931,336; 9,993,470; 10,174,017; 10,532,993; 10,588,901; 10,174,017

Manufactured for: Aerie Pharmaceuticals, Inc., Irvine, CA 92614, U.S.A.

References: 1. Rhopressa® (netarsudil ophthalmic solution) 0.02% Prescribing Information. Aerie Pharmaceuticals, Inc., 2019. **2.** Data on file. Aerie Pharmaceuticals, Inc. **3.** Rocklatan® (netarsudil and latanoprost ophthalmic solution) 0.02%/0.005% Prescribing Information. Aerie Pharmaceuticals, Inc., 2020. **4.** Asrani S, Bacharach J, Holland E, et al. Fixed-dose combination of netarsudil and latanoprost in ocular hypertension and open-angle glaucoma: pooled efficacy/safety analysis of phase 3 MERCURY-1 AND -2. *Adv Ther.* 2020;37(4):1620-1631.

Power and Simplicity of ROCK Inhibition

Consistent IOP reduction, whether added to a PGA monotherapy or to a combination of therapies[1,2]

Only Rocklatan® demonstrated superior efficacy over latanoprost in registration trials at all time points[3,4]

IMPORTANT SAFETY INFORMATION FOR RHOPRESSA®

WARNINGS AND PRECAUTIONS

Bacterial Keratitis: There have been reports of bacterial keratitis associated with the use of multiple-dose containers of topical ophthalmic products. These containers had been previously contaminated by patients who, in most cases, had a concurrent corneal disease or a disruption of the ocular epithelial surface.

Contact Lenses: Contact lenses should be removed prior to instillation of Rhopressa® and may be reinserted 15 minutes following its administration.

IMPORTANT SAFETY INFORMATION FOR ROCKLATAN®

CONTRAINDICATIONS

None.

WARNINGS AND PRECAUTIONS

- Pigmentation changes
- Eyelash changes
- Intraocular inflammation
- Macular edema
- Herpetic keratitis
- Bacterial keratitis
- Contact lens wear

ONCE-DAILY rhopressa® (netarsudil ophthalmic solution) 0.02%

ONCE-DAILY rocklatan® (netarsudil and latanoprost ophthalmic solution) 0.02%/0.005%

Visit DISCOVaerieLive.com to learn more about these innovative IOP-lowering treatments

Please refer to Brief Summary on the reverse side.

IOP, intraocular pressure; PGA, prostaglandin analog.

FEATURES

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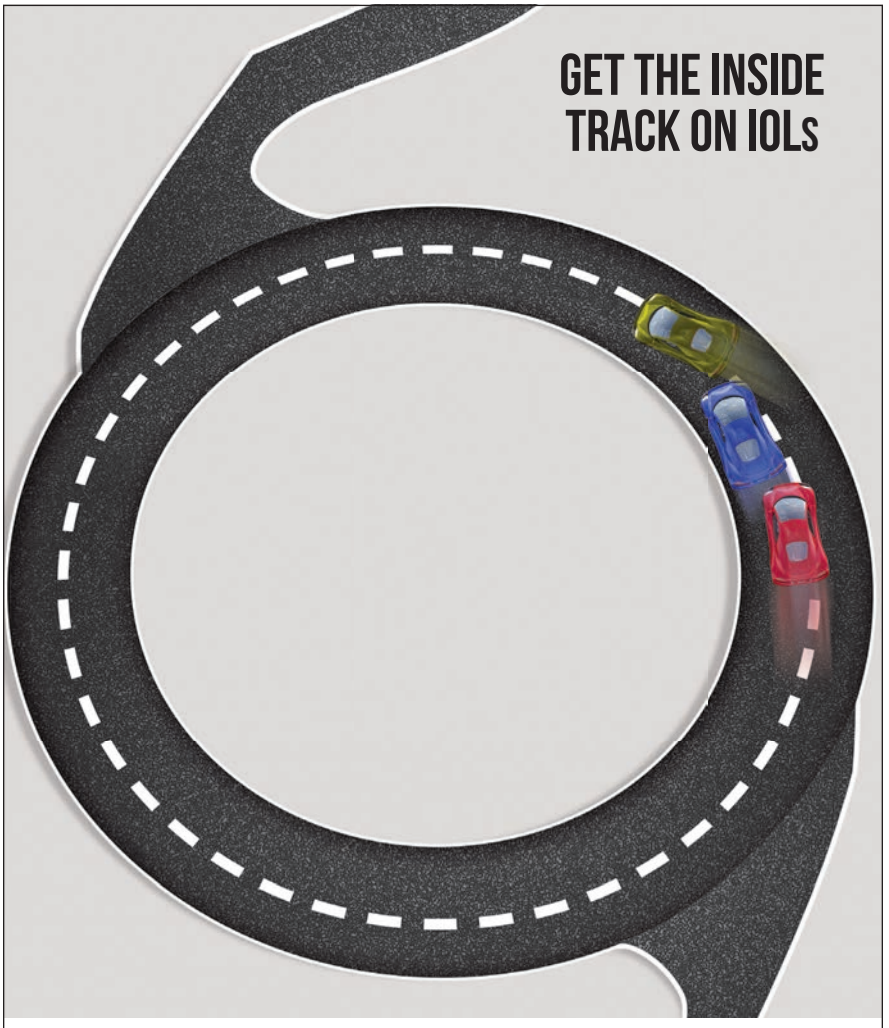

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Getting Great Outcomes With Torics
Surgeons share strategies for making sure these patients end up with the best possible vision. ***Christopher Kent, Senior Editor***

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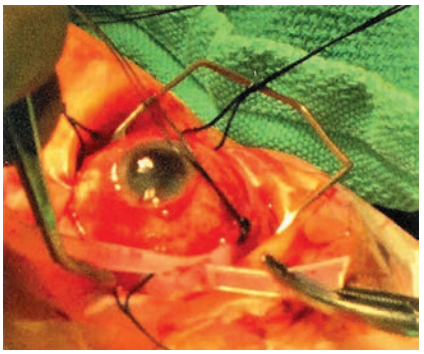
Survey: New IOLs Turn Surgeons' Heads
On this year's IOL survey, the new PanOptix Trifocal and Tecnis Toric II both made a splash. ***Walter Bethke, Editor in Chief***



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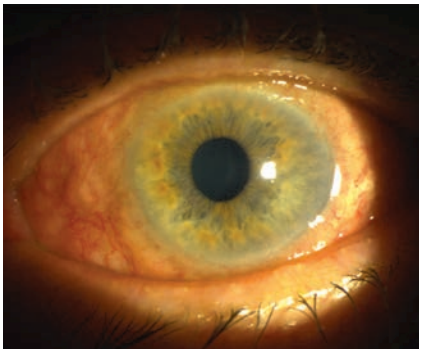

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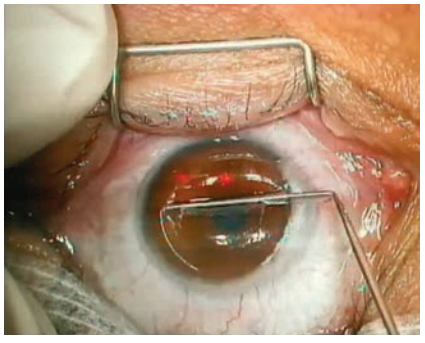

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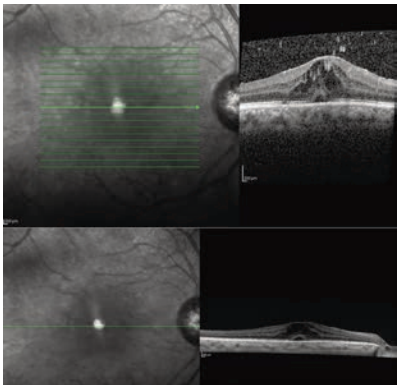

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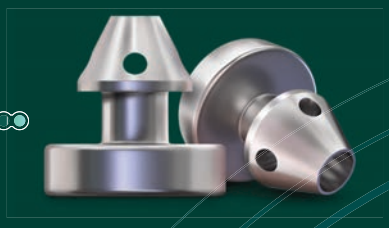

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1. Samuelson TW, Sarkisian SR, Lubeck DM, et al. Prospective, randomized, controlled pivotal trial of an ab interno implanted trabecular micro-bypass in primary open-angle glaucoma and cataract. *Ophthalmology.* Jun 2019;126(6):811-821.

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WALTER C. BETHKE, EDITOR IN CHIEF

EDITOR'S PAGE

Here's to Our Old Year's Resolution

2020 was like getting hit by a truck, except in this case the truck hits you every day for nine months.

Amid the massive tragedy of lives lost and families shattered by the virus, there was the almost incalculable damage done to employees who were laid off or furloughed; businesses and medical practices that had to close, sometimes permanently, after decades of successfully serving their customers and patients; and students who had to try to cobble together what often amounted to a substandard education on a tiny screen in their bedrooms.

In short, it was a nightmare.

Never in our recent—or even not-so-recent—history, have we collectively looked forward to the conclusion of a year the way we've looked forward to the end of 2020.

Though 2020 is behind us, we're still not entirely out of the woods, as COVID-19 continues to plague the world, even as new vaccines slowly chip away at its grip.

However, even though some problems remain, we can still find some relief in bidding farewell to a miserable year, and turn our thoughts to the new year and what it represents in terms of renewal, rebirth and hope.

In that vein, let *Review* be among the first to show you something new in 2021: Our newly redesigned magazine.

Make no mistake, the articles and departments still feature the same practical, helpful insights you've come to rely on. Now, however, they'll just be presented in a fresh, new way. I hope you can page through the new-look *Review* and, if possible, let us know what you think.

This month's articles, too, maintain the theme of novelty.

Even though toric intraocular lenses have been around for a while, as the expert surgeons we spoke to for our feature on torics (p. 32) explain, there's always something new you can learn about them and put to use in your practice for even better results in 2021.

Likewise, your colleagues who weighed in on their preferences for intraocular lenses in our survey report (p. 40) highlighted several of the new lens options that might hold the potential for improved outcomes in the coming year, as surgery centers attempt to return to some semblance of normalcy following the upheaval wrought by the pandemic.

In closing, I hope you and yours enjoyed a safe, happy holiday season. The staff of *Review of Ophthalmology* wish you a healthy, prosperous New Year.

Here's to new beginnings.

—Walter Bethke
Editor in Chief

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A Note from Our Publisher, Michael Hoster

Dear Doctors,

While the first few months of the new year may, in fact, seem a great deal like the previous several months of the old year—we have, if nothing else, a renewed sense of hope and optimism that 2021 will mark a stark turning point in humanity's battle against the COVID-19 pandemic.

Fortunately, during the past 10 months, we've all continued to experience precious moments of accomplishment, reward and joy—even if these instances frequently have been dotted with a Mark McGwire-sized asterisk. Perhaps a son or daughter graduated from college. (*just two family members were permitted to attend.) Or, you purchased a new home. (*you had to tour the house virtually.) The same is true for me. In July, I was humbled and honored to be named publisher of the Review Group, following the retirement of my predecessor, mentor and friend, Jim Henne. (*during one of the most turbulent times our industry has ever faced.)

Throughout this period of enormous uncertainty, however, we've remained steadfastly committed to the development of novel, practical content intended to help you successfully navigate these trying times. And, I couldn't be more proud of our efforts.

Along similar lines, I'm pleased to announce that ***Review*** has undergone its most comprehensive graphic redesign in the past 20 years. You'll notice a bold re-imagining of our logo on the cover, and a modern aesthetic layout for feature articles and recurring columns. It's all part of our tireless efforts to provide you with clinical advice you can trust—which also happens to be our new tagline.

A special thanks to Editorial Director, Jack Persico; Editor-in-Chief, Walt Bethke; Art Director, Jared Araujo; and Senior Designer Matt Egger for their exceptional creative talents and vigorous discipline in making this redesign possible!

Study Supports Reversal of Vision Loss from Glaucoma

(Continued from p. 4)

had regained their youthful vision.

So far, treating mice for a year with the combination gene therapy has shown no negative side effects. The researchers say that if their findings are confirmed, they hope to initiate trials in humans within two years.

Asked how many treatments might be required to restore vision—assuming the approach continues to be confirmed as safe and effective—co-author Bruce Ksander, PhD, says that remains to be determined. "We're currently determining how long the increase in visual function is sustained following a four-week expression of the OSK genes in retinal ganglion cells," he explains. "However, since this gene therapy uses a doxycycline inducible vector, it would be possible to induce a second expression of the OSK genes by delivering doxycycline to the retina. Therefore, we may achieve long-term effects on visual function by periodic reactivation of the vector."

Dr. Ksander notes that this epigenetic repair approach will probably have limitations. "We predict that OSK gene therapy is reprogramming retinal ganglion cells that have lost function but have not yet undergone apoptosis," he says. "Therefore, the 'window of opportunity' for treatment would be determined by how long dysfunctional retinal ganglion cells survive before dying by apoptosis.

"I hope that with the addition of more pre-clinical studies, we'll be closer to translating this approach to the clinic to treat glaucoma patients," he adds. "I also hope that epigenetic reprogramming is shown to be effective in restoring function to other types of cells in the retina, such as photoreceptors, retinal pigment epithelial cells and Müller cells."

1. Lu Y, Brommer B, Tian X, et al. Reprogramming to recover youthful epigenetic information and restore vision. Nature 2020;588;124-29.

Evolving with Sub-Bowman's Keratomileusis

SBK is more than just a name. Expert surgeons, including the inventors of the technique, review its finer points.

BY SEAN MCKINNEY
SENIOR EDITOR

How would you define sub-Bowman's keratomileusis? As an anatomical description of thin-flap LASIK? Possibly. As any LASIK procedure a patient might undergo today? Not quite. A term for refractive surgery that's been around for more than 12 years? You could call it that. The correct answer, however, depends on who you ask.

"Everybody's correct on this, actually," declares Dan Durrie, MD, one of the creators of SBK. "In our practice we call it SBK because it represents the latest evolution of LASIK. But many surgeons have their own interpretations. What we like to keep in mind is that this procedure is not your grandmother's LASIK. If we offered a patient LASIK, the patient might think of a procedure performed on a loved one that created halos or other issues back in the 1990s. With today's advanced technologies and techniques, every procedure we perform is most definitely not that. We don't have a lot of those issues."

No matter what you call this procedure, Dr. Durrie and others recommend that you understand the latest strategies on flap thickness, flap diameter, ablation zones and how to incorporate thin-flap procedures into your refractive surgery offerings. To learn more, read on.

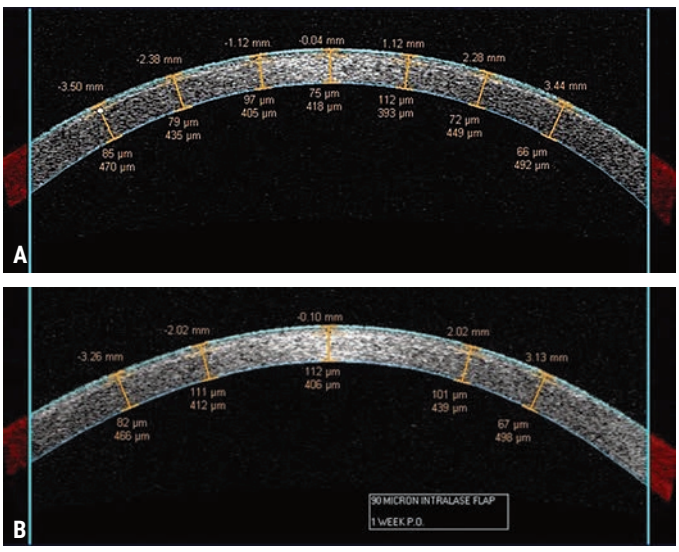
Why SBK?

Dr. Durrie and Houston surgeon Stephen Slade, MD, introduced SBK in 2008.[1] "There had been an issue with the early microkeratomes," he explains. "When we used the techniques available at the time for measuring flaps—with subtraction ultrasound and early OCT—we found a depth variation of 50 µm from patient to patient, even for the same surgeon when the surgeon was using the same microkeratome."

This variation, leaving some patients with flaps that were too thin, explained why some of them developed buttonholes, he notes. "So we solved that problem by going deeper, exceeding the 50-µm range of variation," he says. "In the cornea, however, that presented problems because it cut more nerves and fibers, creating dry eye and other issues. Plus, we were adding more thickness to the flap, leaving us with less to rely on below the flap for use by the excimer laser to do the procedure."

Dr. Durrie and his colleagues were able to switch to their thinnest flap ever after the introduction of the femtosecond laser by IntraLase. "We found the variation among flaps was only plus-or-minus 4-µm. With such a magnitude of difference from 50 µm, we realized we didn't have to cut as deeply because the risk of having too thin of a flap and creating a buttonhole was dramatically reduced by the precision of the femtosecond laser. So that's when the term sub-Bowman's keratomileusis, or SBK, came into play, to differentiate a procedure that came to be known by

Stephen Slade, MD



Figures 1-A and 1-B. The precision and advanced capabilities of today's diagnostic testing technologies only add to the impact of SBK today, letting surgeons individualize treatments and closely follow patients, as shown in these anterior OCT images.

This article has no commercial sponsorship.

Dr. Chayet is considered a pioneer in refractive and cataract surgery, and is Medical Director of the Codet Vision Institute in Tijuana, Mexico. He is a clinical investigator for RxSight, LensGen, ForSight Vision6.

Dan Durrie, MD

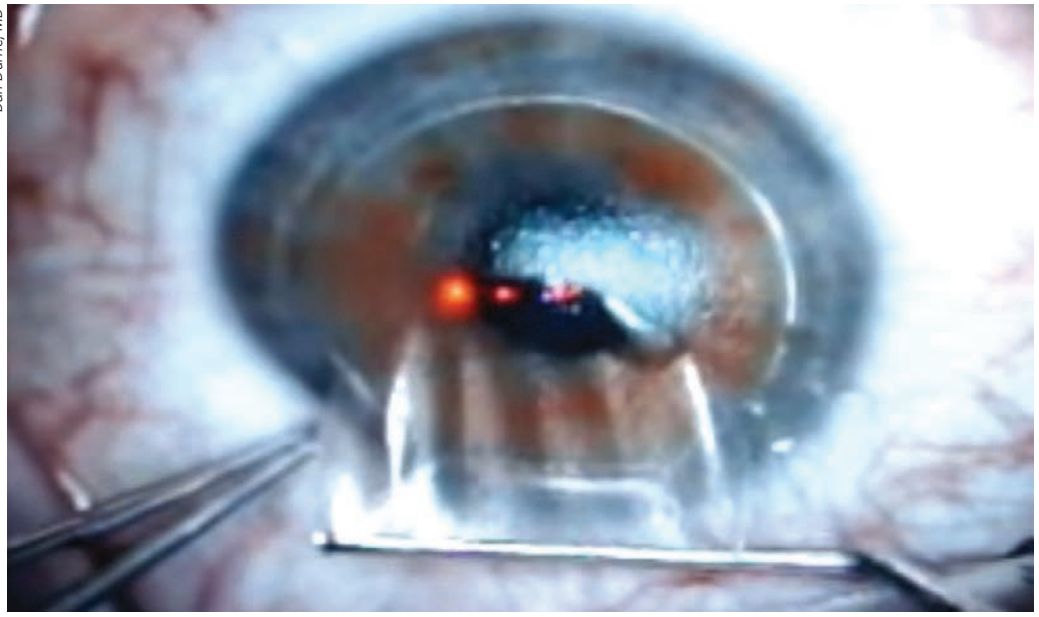


Figure 2. As shown in this 2008 photo, Dan Durrie, MD, and Stephen Slade, MD, were able to use the IntraLase femtosecond laser to create a 100-µm corneal flap to introduce sub-Bowman's keratomileusis, minimizing postop dry eye and maintaining a stronger stromal bed.

many as thin-flap LASIK."

Soon, microkeratome manufacturers began making a more consistent blade, allowing surgeons to perform SBK with microkeratomes, if they had the right equipment, Dr. Durrie says. LASIK flaps went from 160 to 180 µm to 110 µm or lower. "The good news is that industry standards kicked up so that everyone started doing thin-flap LASIK surgery. That's why many surgeons now have a different way of referring to what started out as only SBK."

Today's SBK

Dr. Slade, who practices at Slade & Baker Vision in Houston, says he actually came up with the term sub-Bowman's keratomileusis while working with Dr. Durrie to describe a procedure that he says remains as vital and relevant today as when it was introduced. "We know that SBK reduces postop dry eye," he says. "It also increases the strength of the cornea. With this procedure, the patient heals more quickly. It's just less surgery, which is almost always a good thing."

Dr. Slade also agrees that SBK has evolved to encompass broader applications. "The important thing to understand is that what SBK really means is customizing a LASIK flap rather than just doing a standard flap," says Dr. Slade. "That means customizing the flap to the needs and cornea of the patient. In most cases, it's an attempt to get a thinner flap. But it's also typically a flap that's smaller in diameter and a flap that can even be shaped depending on the pattern of the ablation. The whole idea is to match the flap to the cornea and match it to what you're doing to the cornea with your laser."

For example, Dr. Durrie adds, SBK sometimes requires a thicker flap. "If the patient has a corneal scar, that would be an indication for a thicker flap," he notes. "We might use a depth of 130 µm, instead of 110 µm. We don't call a thicker flap anything different as far as the patient is concerned. Although we rarely use a thicker flap, we know that we can safely create one—again, because of the precision of the femtosecond laser."

Surgeons point out that the precision and advanced capabilities of today's diagnostic testing technologies only add to the impact of SBK today, letting surgeons individualize treatments and closely follow patients. Dr. Slade advises against getting trapped by the limitations of a one-size-fits-all LASIK measurement from yesteryear. "Before SBK, corneal flaps were the same for every patient—160 or 180 µm thick and 9 or 9.5 mm wide," he says. "We realized that this was just way too big and way too deep. The epithelium is 50 µm. So, with 50 µm of stroma, you get a 100-µm flap and you save tissue.

"The size of the flap should also more carefully match the ablation," he continues. "That varies, depending on your laser and what you set the diameter at. So you need to know your ablation pattern. What is it actually doing? For example, on a WaveLight FS200 laser (Alcon) on a spherical myope—e.g., -6 D—if you set it to 6.5 mm, then 6.5 mm is going to be the entire ablation zone, including the optical zone. There are no shots outside of 6.5 mm or 6.7 mm. So it doesn't make a lot of sense to do a 9-mm flap because you've wasted 1.5 mm on each side. Our routine diameter is 8 mm, but we'll go down to 7.5 or even 7 mm for a patient like that."

Taking this approach, he notes, you denervate less cornea, along with speeding up the healing process. "It's the same thing for PRK. We use smaller epithelium removals to match the ablation. Some lasers have a very wide ablation zone, but a small optical zone. They'll make shots out to 9 mm because they're trying to sort of taper and smooth, but the actual refractive change is at 6 mm. Well, then you need to look at the total ablation zone—9 mm in that example—and ask yourself: 'Do

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References: 1. Sawhney AS, Jarrett P, Bassett M, Blizzard C, inventors; Incept, LLC, assignee. Drug delivery through hydrogel plugs. US patent 8,409,606 B2. April 2, 2013.
2. DEXTENZA [package insert). Bedford. MA: Ocular Therapeutlx, Inc: 2019.

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we really need those shots? I mean, laser ablations were all designed for PRK, so they have very broad, gradual transition zones. But you don't need that for LASIK, or what we call SBK. So the whole point for SBK is to customize the metrics, the dimensions of the flap, for the cornea, and for the ablation pattern that your laser is creating."

Flap Size

Much of the discussion today about SBK, sometimes called thin-flap LASIK, centers on flap thickness. Most surgeons have settled on a depth of 110 µm for most cases, saying thinner flaps can be difficult to handle and are prone to wrinkling, striae and drying out. But there are notable exceptions.

"We use a 90-µm thickness for nearly all SBK cases we do in our practice," says Yunuen Bages-Rousselon, MD, who practices in San Pedro Garza García, Nuevo Leon, Mexico. "A flap this thin helps us maintain an appropriate percentage of tissue altered and a greater residual stromal bed. So it's our standard flap thickness for myopes and hyperopes. In some myopic astigmatism patients, we can go down to 85 or 80 µm. We use the Ziemer z8 femtosecond laser, which allows us to go that low."

Noting that she learned how to perform SBK during fellowship training, Dr. Bages-Rousselon says it's the only form of flap surgery she has ever done. "I think the benefits of femto-SBK, instead of using a microkeratome, are also important," she adds. "We achieve uniform flap thickness and diameter, and we have the capacity to alter side-cut angles. We can decrease the risk of epithelial ingrowth when we use the femtosecond laser."

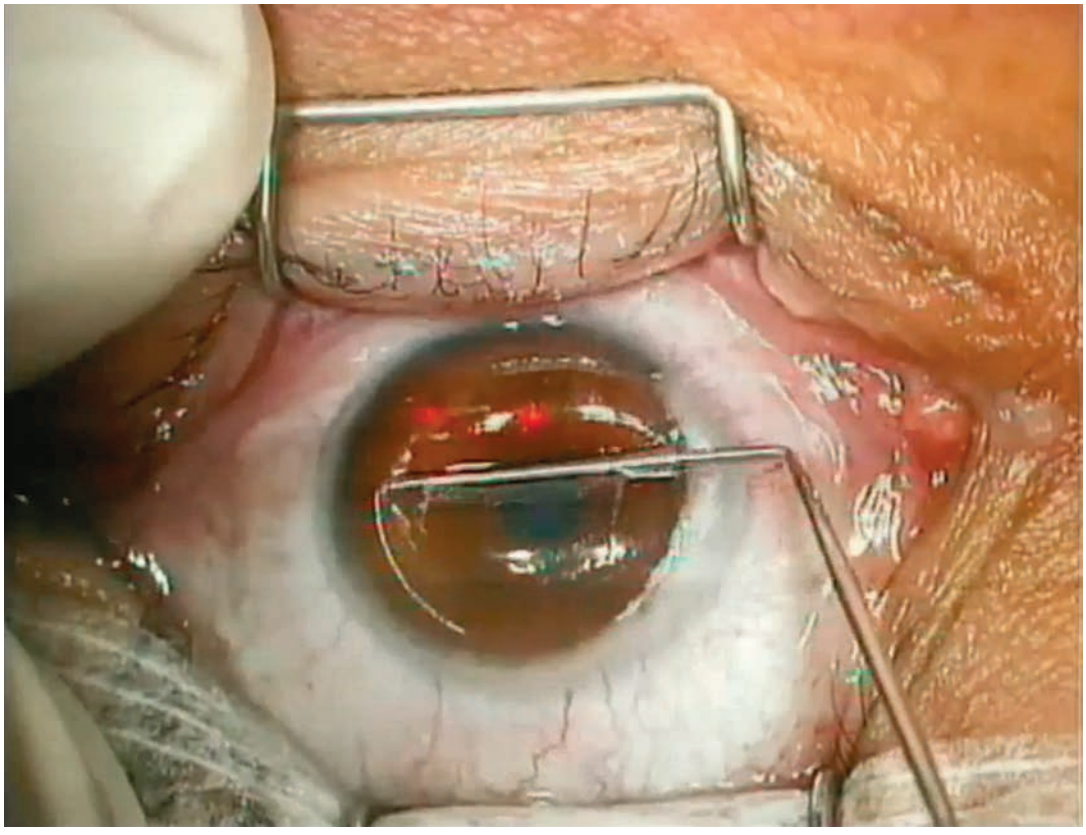
Dr. Bages-Rousselon exceeds the flap diameter limits observed by most surgeons today with her insistence on a diameter of 9.2 to 9.4 mm for all procedures. "I know most other surgeons would describe the advantage of making the flap smaller, but we make it that large to take advantage of the bigger flap to treat the refraction in these patients. This way, you can fit the treatment and transition zone adequately for myopes and hyperopes. We program ablation zones depending on pupil diameters, and PTA/residual stromal bed calculations."

Dr. Bages-Rousselon also programs the femtosecond laser to create a flap with an edge at 110 degrees, instead of a 90-degree edge that's perpendicular to the stromal bed. This allows her to use what she calls an an inverted edge on the flap, with an outward slanted slope that she says discourages the growth of postop epithelium. "When you have that downward slope, it's like a puzzle fitting together on the periphery, so it's really hard for the epithelium to grow," she says. "We continue to get very good outcomes."

William Culbertson, MD, Higgins Distinguished Professor of Ophthalmology at the Bascom Palmer Eye Institute in Miami, says a 120-µm flap, is his "sweet spot"

for most patients. He uses the IFS (Johnson & Johnson Vision) and WaveLight FS200 (Alcon) femtosecond lasers, but notes that B + L's Victus platform is also a good choice. "The idea of making a flap thinner without having buttonholes or tears is very valuable, but we don't think about this procedure as sub-Bowman keratomileusis," he says. "I was making thinner flaps and doing LASIK before SBK even came out."

He notes that he will vary his typical 120-µm flap as needed. "For instance, I can go down to 110 µm or 100 µm for a patient who has a high degree of nearsightedness. Why not do it if I can do it and achieve predictable results?"



Yunuen Bages-Rousselon, MD

Figure 3. Yunuen Bages-Rousselon, MD, who practices in Nuevo Leon, Mexico, lifts each SBK flap by thirds to make it easier to handle.

He continues: "I can tell you that I don't make intentional 90- or 80-µm flaps anymore, even though I know there are surgeons who do it regularly. If you make an 80-µm flap, the epithelium is now going to be 50 µm," he points out. "So you're left with only 30 µm of stroma. For years, we've all been trying to figure out how to make a flap thin and still get good results. A depth of 120 µm is where I've settled. I think it just gets a little less predictable in many cases when you go thinner than that."

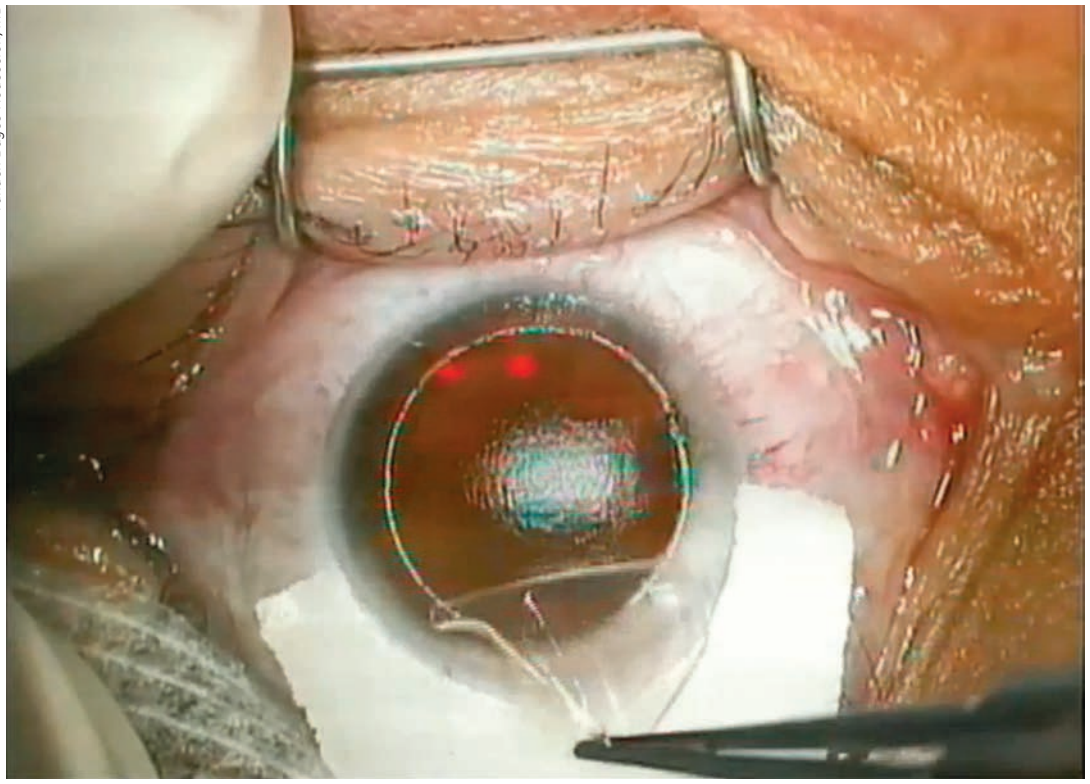
Dr. Slade also sees little benefit in flaps below 100 µm. "Well, you can do an 80 or 90 µm flap, but I don't see why," he says. "I think 100 is plenty. And 80 or 90 µm, sure, I have nothing against them, but I think 100 µm is fine."

However, Dr. Bages-Rousselon believes the thinner flaps—covering a broader range of corrections with one procedure—are worth her commitment of extra precautions and careful techniques. For example, to minimize the challenges of handling her thin flaps, she dissects the flap by thirds, using a "three-pass-underpass" technique pioneered by Amar Agarwal, MS, FRCS, FRCOphth, and colleagues.[2] "After dissecting the flap by thirds, you lift it and fold it back to rest it over a dampened LASIK drain sponge that's been cut in half," she explains. "The sponge keeps the flap moistened with BSS solution and also keeps the flap stable and prevents desiccation. This way, we don't see any striae or have any challenges handling it and laying it back down after ablation. It fits right into place."

One challenge to be aware of when creating very thin flaps is that you need to maintain hinge thickness, she notes. "This can sometimes be an issue as you center the cut zone," she says. If the hinge isn't thick enough, she adds, it risks going up under the cornea. "So we make sure the hinge on the flap is 0.4 to 0.5 mm so that the flap will be quite stable when you lift it." She also lifts thin flaps very carefully, mindful that they could be damaged by instrumentation.

All Options

Although SBK and thin-flap enthusiasts are fervent believers in their refractive surgery niche, most, if not all, have gravitated to more balanced offerings through the years. Even Dr. Bages-Rousselon will recommend PRK and implantable collamer lenses (but not SMILE) for patients who are not right for SBK, such as patients with inferior or superior corneal asymmetry, as long as they have normal posterior cornea elevations, or patients with corneas that are thinner than 500 µm. Dr. Culbertson is partial to SMILE as an alternative so he can retain the strength of



Yunuen Bages-Rousselon, MD

Figure 4. By folding her SBK flap on a LASIK drain sponge that's been cut in half, Yunuen Bages-Rousselon, MD, and her colleagues in Nuevo Leon, Mexico, keep flaps as shallow as 80 µm moistened with BSS solution, maintaining flap stability and preventing desiccation.

the anterior cornea. He also favors PRK to preserve residual corneal stroma when preserving corneal nerves isn't as much of a priority. Dr. Slade recommends PRK or ICL. Dr. Durrie says his practice offers SBK as one of eight possible procedures. Beside SBK, the list includes regular LASIK, PRK, ICL, SMILE, clear lens exchange, refractive cataract surgery and corneal cross-linking.

"Not one recommendation meets the needs of all patients," says Dr. Culbertson. "One consideration is if there is vulnerability because of what the patient does for a living or the sport he plays, such as a skydiving or playing football or basketball. After undergoing SMILE, the patient is much less vulnerable to a direct blow that would damage a flap."

Some surgeons might choose PRK if they don't favor SMILE as a safer alternative for these active patients, he notes. "So there are options," adds Dr. Culbertson. "It depends on what the doctor has in his armamentarium. As far as SBK and the LASIK evolution are concerned, I like to think of it as a story about several concerns we've had going on through the years. It's a story of what we needed to do to minimize ectasia. It's a story about bringing dry eye under control after refractive surgery. And, at the same time, it's a story of emerging technology that is much more precise but expensive these days. A lot of the terms used today were basically commercial terms to differentiate LASIK with a femtosecond laser from LASIK with a microkeratome. But it keeps evolving."

Choosing Patients Wisely

In the refractive surgery arena, the one constant is change, surgeons say. The progress of techniques and technologies will continue to drive everything from patient selection to positioning procedures for the success of patients and practices, according to Dr. Durrie.

"Our patient selection process begins by determining if the patient is even a candidate for any kind of refractive surgery," he says. "We can zero in on which procedure is the best for each individual patient, or even the individual eye of each patient, because we sometimes do a different procedure for the right eye than the left, depending on the status of the corneas. It's great to have a broad selection of procedures. And we always say, 'If you don't do a procedure that's the best one for a particular patient, refer the patient to a surgeon who does the procedure.' We want what is ideal for that patient. Pick the right patients for the right technology, and you'll get great results. This is a simple and effective strategy. Make the selection of the procedure and the technology fit each patient. That's the way most people look at it nowadays."

1. Durrie DS, Slade SG, Marshall J. Wavefront-guided excimer laser ablation using photorefractive keratectomy and sub-Bowman's keratomileusis: a contralateral eye study. J Refract Surg 2008;24:1:S77-84.
2. Prakash G, Agarwal A, Kumar DA. The three-pass-underpass technique: A graded flap dissection technique for thin femtosecond sub-Bowman keratomileusis flaps. Eye Contact Lens 2010;36:6:324-9.

DISCLOSURES

Drs. Durrie and Slade are consultants for Johnson & Johnson Vision and Alcon. Dr. Culbertson is a consultant for Johnson & Johnson Vision. Dr. Bages-Rousselon reports no relationships with companies related to any of the products mentioned in this article.

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Keep in Touch (Virtually) With Your Patients

The new normal demands new solutions. Here's an overview of five tools that can help your practice transition and grow.

BY CHRISTINE LEONARD
ASSOCIATE EDITOR

Many practices have started reaching for technological solutions such as patient relationship management platforms to accommodate the new care paradigm brought on by the pandemic. These tools can help practices communicate more effectively with patients, minimize cancellations and recoup lost revenue. Here, we'll take a look at the importance of PRM and see how technological tools can help streamline your practice.

Closing the Gaps

Patient relationship management is the health-care equivalent of customer relationship management in other business settings, say practice management consultants Corinne Wohl, MHSA, COE, of C. Wohl & Associates, and John Pinto of J. Pinto & Associates. "The term is new, but the concept is old," Ms. Wohl says. "It's already embedded in your practice at a higher or lower level of competency. Any practice management software that you now use for appointments and billing is, for better or worse, part of your PRM array, as is your website and its embedded patient portal. Ditto for you as the surgeon, and each of your staff members. Taken together, these all result in each patient's experience as they take an eye-care journey with you, but, along with your electronic health record system, frame your quality and continuity of care."

Patient recall has only become more difficult in the COVID-19 era. According to Mr. Pinto, this area is one of the most common PRM gaps they see in practices, and one that PRM software is designed to address. "In the average practice we find continuity-of-care gaps that not only degrade patients' outcomes (and their opinion of the doctor) but impede practice economics," Mr. Pinto says.

PRM software automates many of the minute tasks of patient-provider communication, freeing up staff members to focus more on direct patient care. But while the software may streamline some administrative tasks, Ms. Wohl and Mr. Pinto say it's not a magic solution.

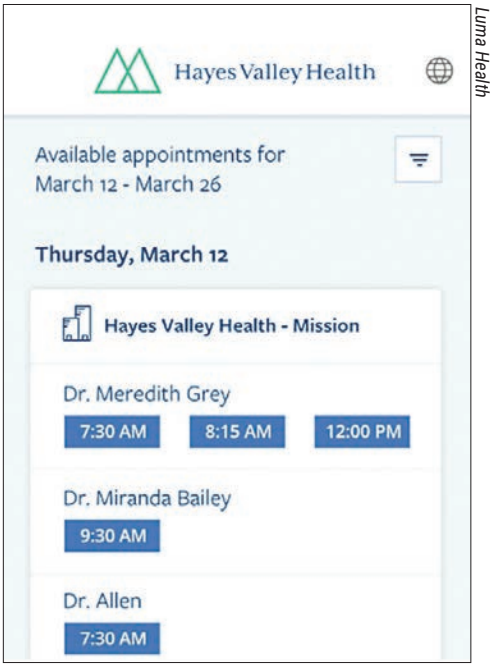
"Most gaps in patient care have nothing to do with the PM/EHR/PRM software tools a clinic uses," Ms. Wohl says. "Most gaps are human ones: poor doctor-patient communication; insufficient attention to detail by staff. Unfortunately, as fees fall and costs rise, these gaps are widening, as doctors and staff alike pedal faster to keep up financially viable volumes—and of course, doing so in the midst of a pandemic just exacerbates the challenge. More than just focusing on software, physician-owners and administrators need to collaborate to continuously improve each patient's experience."

There's a wide array of PRM tools available to choose from. Here's a brief rundown of five of these tools and some of the features they offer.

Luma Health

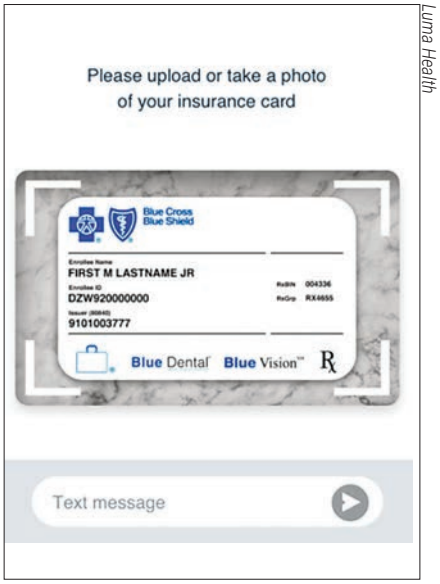
According to Luma Health's COVID-19 data report, the pandemic drove a 108-percent increase in appointment cancellations across its 12-million-patient database between March and April 2020. These cancellations were both patient- and provider-initiated. Many resulted in rescheduled telehealth visits.

Luma Health's HIPAA-compliant,



Luma Health

Dr. Colvard is a surgeon at the Colvard-Kandavel Eye Center in Los Angeles and a clinical professor of ophthalmology at the Keck School of Medicine of the University of Southern California.
Dr. Charles is the founder of the Charles Retina Institute in Germantown, TN.



Luma Health

total patient engagement platform provides interactive patient communication and online scheduling, acquisition and retention tools, appointment reminders, mobile patient intake trackers and a telehealth platform. The company says it's designed to reduce staff member stress and give patients control over their scheduling. Here are some features Luma Health offers:

• ***Smart waitlist.*** This feature automatically offers canceled appointment slots to the next patient waiting for that specific appointment type, provider and location.

• ***Referral capture and conversion.*** Automated text messages prompt referred patients to schedule appointments.

• ***Patient recall.*** This tool automatically contacts existing patients and prompts them to schedule recommended follow-up appointments.

• ***Multilingual messaging.*** Luma Health offers more than 20 languages for patient engagement.

• ***Mobile patient intake.*** This feature allows for contactless check-in and collection of patient data. Patients can upload photos of insurance cards and driver's licenses, fill out COVID-19 screening forms and "wait in line" with a virtual waiting room.

• ***User-friendly telehealth.*** There's no need for patients to download apps or create portal accounts for their telehealth visit. Patients can also invite up to two additional guests to help them during their virtual appointment.

Luma Health is compatible with more than 70 EHRs and PM systems, such as Epic, Centricity, Allscripts, NextGen, eClinicalWorks and more. The platform also provides data analytics for tracking communication effectiveness, patient engagement and patient satisfaction. For information or to request a custom demo, visit lumahealth.io.

SolutionReach

SolutionReach is an all-in-one patient relationship management tool that can help you grow your practice and meet the needs of the new normal, the company says. Its platform is designed to help healthcare providers deliver better care and increase revenue by strengthening patient relationships. Here are some of its features:

• ***Newsletter templates.*** SolutionReach provides newsletter templates that can be customized and personalized for patients. The company says these are powerful patient education tools, since many patients forget what their providers tell them. The company suggests using the newsletters for conveying disease information, noting the importance of taking medications as prescribed or communicating office events such as closures or COVID-19 protocol updates.

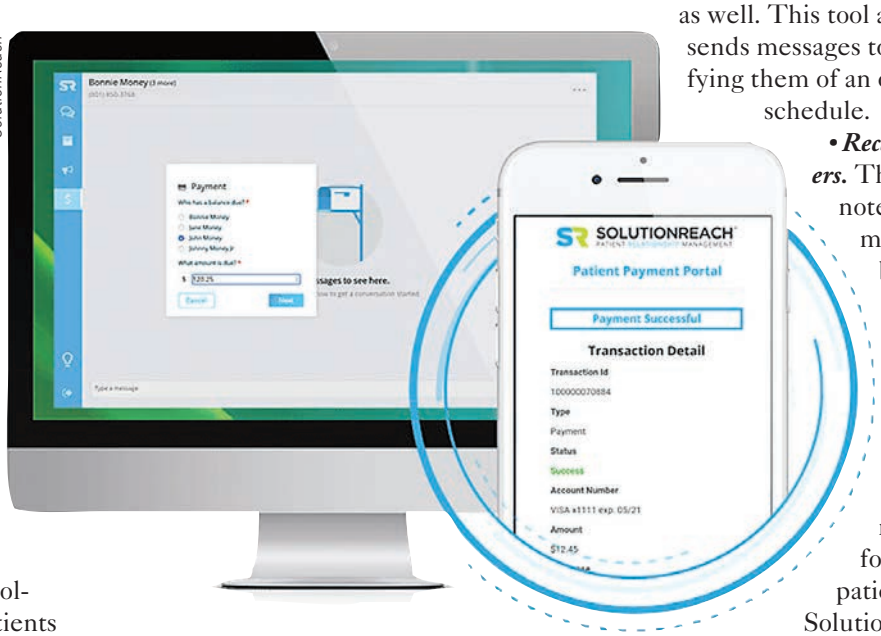
• ***Cost-saving tools for patients.*** This platform helps patients adhere to their insurance plans and choose the most appropriate, in-network options.

• ***Contactless check-ins.*** SolutionReach's digital approach to patient engagement minimizes risk with non-contact patient tools, the company says.

• ***Marketing support.*** SolutionReach provides marketing tools to make email campaigns easy, says the company. With this tool, users can create individual messages or a series of messages, also known as "drip campaigns," to reach patients and inform them of important events or changes.

• ***ASAP wait list.*** Patients often complain about wait times not only in the office, but for appointments as well. This tool automatically sends messages to patients, notifying them of an opening in the schedule.

• ***Recall reminders.*** The company notes that it's much easier to bring existing patients back than it is to get new patients. This tool offers flexible, customizable reminders for automatic patient messaging. SolutionReach says



SolutionReach

EYLEA®
(aflibercept) Injection
For Intravitreal Injection

START EARLIER WITH EYLEA IN DR

SIGNIFICANT REDUCTION IN DR SEVERITY IN PANORAMA[1,2]

PANORAMA is the first phase 3 anti-VEGF trial specifically designed to study patients with moderately severe to severe NPDR without DME.

PANORAMA study design: Multicenter, double-masked, controlled clinical study in which patients with moderately severe to severe NPDR (ETDRS-DRSS: 47 or 53) without CI-DME (N=402; age range: 25-85 years, with a mean of 56 years) were randomized to receive 1 of 2 EYLEA dosing regimens or sham. Protocol-specified visits occurred every 28±7 days for the first 5 visits, then every 8 weeks (56±7 days). Between week 52 and week 96, patients randomized to one of the EYLEA arms received a different dosing regimen.[2]

IMPORTANT SAFETY INFORMATION AND INDICATIONS

CONTRAINDICATIONS

- EYLEA is contraindicated in patients with ocular or periocular infections, active intraocular inflammation, or known hypersensitivity to aflibercept or to any of the excipients in EYLEA.

WARNINGS AND PRECAUTIONS

- Intravitreal injections, including those with EYLEA, have been associated with endophthalmitis and retinal detachments. Proper aseptic injection technique must always be used when administering EYLEA. Patients should be instructed to report any symptoms suggestive of endophthalmitis or retinal detachment without delay and should be managed appropriately. Intraocular inflammation has been reported with the use of EYLEA.
- Acute increases in intraocular pressure have been seen within 60 minutes of intravitreal injection, including with EYLEA. Sustained increases in intraocular pressure have also been reported after repeated intravitreal dosing with VEGF inhibitors. Intraocular pressure and the perfusion of the optic nerve head should be monitored and managed appropriately.

REGENERON

777 Old Saw Mill River Road, Tarrytown, NY 10591

MORE PATIENTS ACHIEVED A ≥2-STEP IMPROVEMENT IN ETDRS-DRSS WITH EYLEA VS SHAM[1]

Proportion of Patients Achieving a ≥2-Step Improvement in ETDRS-DRSS* Score From Baseline[1,2,†]

Primary Endpoint			Exploratory Endpoint‡
Week 24	Week 52		Week 100
EYLEA Q8 and Q16 (n=269)	EYLEA Q8 (n=134)	EYLEA Q16 (n=135)	EYLEA Q16 (n=135)
58%	**80%**	**65%**	**62%**
vs 6% in the sham group (n=133)	vs 15% in the sham group (n=133)	vs 15% in the sham group (n=133)	vs 13% in the sham group (n=133)

P<0.01 vs sham at Week 24 and Week 52. Nominal *P*<0.01 vs sham at Week 100.

*Early Treatment Diabetic Retinopathy Study–Diabetic Retinopathy Severity Scale (ETDRS-DRSS): an established grading scale for measuring the severity of DR.

†Full analysis set.

‡The results of these exploratory endpoints require cautious interpretation, as a multiplicity adjustment has not been applied. Results are descriptive only.

anti-VEGF = anti–vascular endothelial growth factor; CI-DME = central-involved DME; DME = Diabetic Macular Edema; DR = Diabetic Retinopathy; DRSS = Diabetic Retinopathy Severity Scale; NPDR = nonproliferative diabetic retinopathy; Q8 = every 8 weeks; Q16 = every 16 weeks.

SEE MORE DATA TODAY AT HCP.EYLEA.US

WARNINGS AND PRECAUTIONS (cont'd)

- There is a potential risk of arterial thromboembolic events (ATEs) following intravitreal use of VEGF inhibitors, including EYLEA. ATEs are defined as nonfatal stroke, nonfatal myocardial infarction, or vascular death (including deaths of unknown cause). The incidence of reported thromboembolic events in wet AMD studies during the first year was 1.8% (32 out of 1824) in the combined group of patients treated with EYLEA compared with 1.5% (9 out of 595) in patients treated with ranibizumab; through 96 weeks, the incidence was 3.3% (60 out of 1824) in the EYLEA group compared with 3.2% (19 out of 595) in the ranibizumab group. The incidence in the DME studies from baseline to week 52 was 3.3% (19 out of 578) in the combined group of patients treated with EYLEA compared with 2.8% (8 out of 287) in the control group; from baseline to week 100, the incidence was 6.4% (37 out of 578) in the combined group of patients treated with EYLEA compared with 4.2% (12 out of 287) in the control group. There were no reported thromboembolic events in the patients treated with EYLEA in the first six months of the RVO studies.

ADVERSE REACTIONS

- Serious adverse reactions related to the injection procedure have occurred in <0.1% of intravitreal injections with EYLEA including endophthalmitis and retinal detachment.
- The most common adverse reactions (≥5%) reported in patients receiving EYLEA were conjunctival hemorrhage, eye pain, cataract, vitreous detachment, vitreous floaters, and intraocular pressure increased.

INDICATIONS

EYLEA® (aflibercept) Injection 2 mg (0.05 mL) is indicated for the treatment of patients with Neovascular (Wet) Age-related Macular Degeneration (AMD), Macular Edema following Retinal Vein Occlusion (RVO), Diabetic Macular Edema (DME), and Diabetic Retinopathy (DR).

References: 1. Wykoff CC. A phase 3, double-masked, randomized study of the efficacy and safety of aflibercept in patients with moderately severe to severe NPDR: week 100 results. Data presented at: Angiogenesis, Exudation, and Degeneration Annual Meeting; February 8, 2020; Miami, FL. **2.** EYLEA® (aflibercept) Injection full U.S. Prescribing Information. Regeneron Pharmaceuticals, Inc. August 2019.

Please see Brief Summary of Prescribing Information on the following page.

10/2020
EYL20.09.0078

EYLEA® (aflibercept) Injection
For Intravitreal Injection

BRIEF SUMMARY—Please see the EYLEA full Prescribing Information available on HCP.EYLEA.US for additional product information.

1 INDICATIONS AND USAGE
EYLEA is a vascular endothelial growth factor (VEGF) inhibitor indicated for the treatment of patients with:

Neovascular (Wet) Age-Related Macular Degeneration (AMD), Macular Edema Following Retinal Vein Occlusion (RVO), Diabetic Macular Edema (DME), Diabetic Retinopathy (DR).

4 CONTRAINDICATIONS

4.1 Ocular or Periocular Infections
EYLEA is contraindicated in patients with ocular or periocular infections.

4.2 Active Intraocular Inflammation
EYLEA is contraindicated in patients with active intraocular inflammation.

4.3 Hypersensitivity
EYLEA is contraindicated in patients with known hypersensitivity to aflibercept or any of the excipients in EYLEA. Hypersensitivity reactions may manifest as rash, pruritus, urticaria, severe anaphylactic/anaphylactoid reactions, or severe intraocular inflammation.

5 WARNINGS AND PRECAUTIONS

5.1 Endophthalmitis and Retinal Detachments
Intravitreal injections, including those with EYLEA, have been associated with endophthalmitis and retinal detachments [*see Adverse Reactions (6.1)*]. Proper aseptic injection technique must always be used when administering EYLEA. Patients should be instructed to report any symptoms suggestive of endophthalmitis or retinal detachment without delay and should be managed appropriately [*see Patient Counseling Information (17)*].

5.2 Increase in Intraocular Pressure
Acute increases in intraocular pressure have been seen within 60 minutes of intravitreal injection, including with EYLEA [*see Adverse Reactions (6.1)*]. Sustained increases in intraocular pressure have also been reported after repeated intravitreal dosing with vascular endothelial growth factor (VEGF) inhibitors. Intraocular pressure and the perfusion of the optic nerve head should be monitored and managed appropriately.

5.3 Thromboembolic Events
There is a potential risk of arterial thromboembolic events (ATEs) following intravitreal use of VEGF inhibitors, including EYLEA. ATEs are defined as nonfatal stroke, nonfatal myocardial infarction, or vascular death (including deaths of unknown cause). The incidence of reported thromboembolic events in wet AMD studies during the first year was 1.8% (32 out of 1824) in the combined group of patients treated with EYLEA compared with 1.5% (9 out of 595) in patients treated with ranibizumab; through 96 weeks, the incidence was 3.3% (60 out of 1824) in the EYLEA group compared with 3.2% (19 out of 595) in the ranibizumab group. The incidence in the DME studies from baseline to week 52 was 3.3% (19 out of 578) in the combined group of patients treated with EYLEA compared with 2.8% (8 out of 287) in the control group; from baseline to week 100, the incidence was 6.4% (37 out of 578) in the combined group of patients treated with EYLEA compared with 4.2% (12 out of 287) in the control group. There were no reported thromboembolic events in the patients treated with EYLEA in the first six months of the RVO studies.

6 ADVERSE REACTIONS
The following potentially serious adverse reactions are described elsewhere in the labeling:
- Hypersensitivity [*see Contraindications (4.3)*]
- Endophthalmitis and retinal detachments [*see Warnings and Precautions (5.1)*]
- Increase in intraocular pressure [*see Warnings and Precautions (5.2)*]
- Thromboembolic events [*see Warnings and Precautions (5.3)*]

6.1 Clinical Trials Experience
Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in the clinical trials of a drug cannot be directly compared to rates in other clinical trials of the same or another drug and may not reflect the rates observed in practice.
A total of 2980 patients treated with EYLEA constituted the safety population in eight phase 3 studies. Among those, 2379 patients were treated with the recommended dose of 2 mg. Serious adverse reactions related to the injection procedure have occurred in <0.1% of intravitreal injections with EYLEA including endophthalmitis and retinal detachment. The most common adverse reactions (≥5%) reported in patients receiving EYLEA were conjunctival hemorrhage, eye pain, cataract, vitreous detachment, vitreous floaters, and intraocular pressure increased.

Neovascular (Wet) Age-Related Macular Degeneration (AMD). The data described below reflect exposure to EYLEA in 1824 patients with wet AMD, including 1223 patients treated with the 2-mg dose, in 2 double-masked, controlled clinical studies (VIEW1 and VIEW2) for 24 months (with active control in year 1).
Safety data observed in the EYLEA group in a 52-week, double-masked, Phase 2 study were consistent with these results.

Table 1: Most Common Adverse Reactions (≥1%) in Wet AMD Studies

	Baseline to Week 52		Baseline to Week 96	
Adverse Reactions	**EYLEA (N=1824)**	**Active Control (ranibizumab) (N=595)**	**EYLEA (N=1824)**	**Control (ranibizumab) (N=595)**
Conjunctival hemorrhage	25%	28%	27%	30%
Eye pain	9%	9%	10%	10%
Cataract	7%	7%	13%	10%
Vitreous detachment	6%	6%	8%	8%
Vitreous floaters	6%	7%	8%	10%
Intraocular pressure increased	5%	7%	7%	11%
Ocular hyperemia	4%	8%	5%	10%
Corneal epithelium defect	4%	5%	5%	6%
Detachment of the retinal pigment epithelium	3%	3%	5%	5%
Injection site pain	3%	3%	3%	4%
Foreign body sensation in eyes	3%	4%	4%	4%
Lacrimation increased	3%	1%	4%	2%
Vision blurred	2%	2%	4%	3%
Intraocular inflammation	2%	3%	3%	4%
Retinal pigment epithelium tear	2%	1%	2%	2%
Injection site hemorrhage	1%	2%	2%	2%
Eyelid edema	1%	2%	2%	3%
Corneal edema	1%	1%	1%	1%
Retinal detachment	<1%	<1%	1%	1%

Less common serious adverse reactions reported in <1% of the patients treated with EYLEA were hypersensitivity, retinal tear, and endophthalmitis.

Macular Edema Following Retinal Vein Occlusion (RVO). The data described below reflect 6 months exposure to EYLEA with a monthly 2 mg dose in 218 patients following central retinal vein occlusion (CRVO) in 2 clinical studies (COPERNICUS and GALILEO) and 91 patients following branch retinal vein occlusion (BRVO) in one clinical study (VIBRANT).

Table 2: Most Common Adverse Reactions (≥1%) in RVO Studies

	CRVO		BRVO	
Adverse Reactions	**EYLEA (N=218)**	**Control (N=142)**	**EYLEA (N=91)**	**Control (N=92)**
Eye pain	13%	5%	4%	5%
Conjunctival hemorrhage	12%	11%	20%	4%
Intraocular pressure increased	8%	6%	2%	0%
Corneal epithelium defect	5%	4%	2%	0%
Vitreous floaters	5%	1%	1%	0%
Ocular hyperemia	5%	3%	2%	2%
Foreign body sensation in eyes	3%	5%	3%	0%
Vitreous detachment	3%	4%	2%	0%
Lacrimation increased	3%	4%	3%	0%
Injection site pain	3%	1%	1%	0%
Vision blurred	1%	<1%	1%	1%
Intraocular inflammation	1%	1%	0%	0%
Cataract	<1%	1%	5%	0%
Eyelid edema	<1%	1%	1%	0%

Less common adverse reactions reported in <1% of the patients treated with EYLEA in the CRVO studies were corneal edema, retinal tear, hypersensitivity, and endophthalmitis.

Diabetic Macular Edema (DME) and Diabetic Retinopathy (DR). The data described below reflect exposure to EYLEA in 578 patients with DME treated with the 2-mg dose in 2 double-masked, controlled clinical studies (VIVID and VISTA) from baseline to week 52 and from baseline to week 100.

Table 3: Most Common Adverse Reactions (≥1%) in DME Studies

	Baseline to Week 52		Baseline to Week 100	
Adverse Reactions	**EYLEA (N=578)**	**Control (N=287)**	**EYLEA (N=578)**	**Control (N=287)**
Conjunctival hemorrhage	28%	17%	31%	21%
Eye pain	9%	6%	11%	9%
Cataract	8%	9%	19%	17%
Vitreous floaters	6%	3%	8%	6%
Corneal epithelium defect	5%	3%	7%	5%
Intraocular pressure increased	5%	3%	9%	5%
Ocular hyperemia	5%	6%	5%	6%
Vitreous detachment	3%	3%	8%	6%
Foreign body sensation in eyes	3%	3%	3%	3%
Lacrimation increased	3%	2%	4%	2%
Vision blurred	2%	2%	3%	4%
Intraocular inflammation	2%	<1%	3%	1%
Injection site pain	2%	<1%	2%	<1%
Eyelid edema	<1%	1%	2%	1%

Less common adverse reactions reported in <1% of the patients treated with EYLEA were hypersensitivity, retinal detachment, retinal tear, corneal edema, and injection site hemorrhage.
Safety data observed in 269 patients with nonproliferative diabetic retinopathy (NPDR) through week 52 in the PANORAMA trial were consistent with those seen in the phase 3 VIVID and VISTA trials (see Table 3 above).

6.2 Immunogenicity
As with all therapeutic proteins, there is a potential for an immune response in patients treated with EYLEA. The immunogenicity of EYLEA was evaluated in serum samples. The immunogenicity data reflect the percentage of patients whose test results were considered positive for antibodies to EYLEA in immunoassays. The detection of an immune response is highly dependent on the sensitivity and specificity of the assays used, sample handling, timing of sample collection, concomitant medications, and underlying disease. For these reasons, comparison of the incidence of antibodies to EYLEA with the incidence of antibodies to other products may be misleading.
In the wet AMD, RVO, and DME studies, the pre-treatment incidence of immunoreactivity to EYLEA was approximately 1% to 3% across treatment groups. After dosing with EYLEA for 24-100 weeks, antibodies to EYLEA were detected in a similar percentage range of patients. There were no differences in efficacy or safety between patients with or without immunoreactivity.

8 USE IN SPECIFIC POPULATIONS

8.1 Pregnancy
Risk Summary
Adequate and well-controlled studies with EYLEA have not been conducted in pregnant women. Aflibercept produced adverse embryofetal effects in rabbits, including external, visceral, and skeletal malformations. A fetal No Observed Adverse Effect Level (NOAEL) was not identified. At the lowest dose shown to produce adverse embryofetal effects, systemic exposures (based on AUC for free aflibercept) were approximately 6 times higher than AUC values observed in humans after a single intravitreal treatment at the recommended clinical dose [*see Animal Data*].
Animal reproduction studies are not always predictive of human response, and it is not known whether EYLEA can cause fetal harm when administered to a pregnant woman. Based on the anti-VEGF mechanism of action for aflibercept, treatment with EYLEA may pose a risk to human embryofetal development. EYLEA should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.
All pregnancies have a background risk of birth defect, loss, or other adverse outcomes. The background risk of major birth defects and miscarriage for the indicated population is unknown. In the U.S. general population, the estimated background risk of major birth defects and miscarriage in clinically recognized pregnancies is 2-4% and 15-20%, respectively.

Data
Animal Data
In two embryofetal development studies, aflibercept produced adverse embryofetal effects when administered every three days during organogenesis to pregnant rabbits at intravenous doses ≥3 mg per kg, or every six days during organogenesis at subcutaneous doses ≥0.1 mg per kg.
Adverse embryofetal effects included increased incidences of postimplantation loss and fetal malformations, including anasarca, umbilical hernia, diaphragmatic hernia, gastroschisis, cleft palate, ectrodactyly, intestinal atresia, spina bifida, encephalomeningocele, heart and major vessel defects, and skeletal malformations (fused vertebrae, sternebrae, and ribs; supernumerary vertebral arches and ribs; and incomplete ossification). The maternal No Observed Adverse Effect Level (NOAEL) in these studies was 3 mg per kg. Aflibercept produced fetal malformations at all doses assessed in rabbits and the fetal NOAEL was not identified. At the lowest dose shown to produce adverse embryofetal effects in rabbits (0.1 mg per kg), systemic exposure (AUC) of free aflibercept was approximately 6 times higher than systemic exposure (AUC) observed in humans after a single intravitreal dose of 2 mg.

8.2 Lactation
Risk Summary
There is no information regarding the presence of aflibercept in human milk, the effects of the drug on the breastfed infant, or the effects of the drug on milk production/excretion. Because many drugs are excreted in human milk, and because the potential for absorption and harm to infant growth and development exists, EYLEA is not recommended during breastfeeding.
The developmental and health benefits of breastfeeding should be considered along with the mother's clinical need for EYLEA and any potential adverse effects on the breastfed child from EYLEA.

8.3 Females and Males of Reproductive Potential
Contraception
Females of reproductive potential are advised to use effective contraception prior to the initial dose, during treatment, and for at least 3 months after the last intravitreal injection of EYLEA.

Infertility
There are no data regarding the effects of EYLEA on human fertility. Aflibercept adversely affected female and male reproductive systems in cynomolgus monkeys when administered by intravenous injection at a dose approximately 1500 times higher than the systemic level observed humans with an intravitreal dose of 2 mg. A No Observed Adverse Effect Level (NOAEL) was not identified. These findings were reversible within 20 weeks after cessation of treatment.

8.4 Pediatric Use
The safety and effectiveness of EYLEA in pediatric patients have not been established.

8.5 Geriatric Use
In the clinical studies, approximately 76% (2049/2701) of patients randomized to treatment with EYLEA were ≥65 years of age and approximately 46% (1250/2701) were ≥75 years of age. No significant differences in efficacy or safety were seen with increasing age in these studies.

17 PATIENT COUNSELING INFORMATION
In the days following EYLEA administration, patients are at risk of developing endophthalmitis or retinal detachment. If the eye becomes red, sensitive to light, painful, or develops a change in vision, advise patients to seek immediate care from an ophthalmologist [*see Warnings and Precautions (5.1)*].
Patients may experience temporary visual disturbances after an intravitreal injection with EYLEA and the associated eye examinations [*see Adverse Reactions (6)*]. Advise patients not to drive or use machinery until visual function has recovered sufficiently.

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My Patient Messages

My Patient Messages' cloud-based platform provides automated patient relationship and practice management support. The company says its platform improves the scheduling and appointment-reminder experience and encourages patient-practice engagement. Features include:

• ***Appointment notifications.*** My Patient Messages notes that patients expect to receive immediate confirmation of appointment bookings and may become anxious with delays. This tool sends texts or emails shortly after the booking. Additionally, it provides a series of notifications using the patient's preferred contact method. Reminders are sent a week prior to the appointment, then two days before the visit and then finally on the day of the appointment. Practices can also create custom cancellation messages if circumstances change.

• ***Appointment generation.*** The platform offers patients online scheduling through email newsletters or social media pages. It also notifies patients to schedule follow-up appointments, identifies those who are overdue for an appointment and automatically prompts no-shows to reschedule.

• ***Practice marketing tools.*** This feature surveys your patients to identify those who are most likely to write positive public reviews and then directs them to well-known review sites such as Health Grades, Yelp, Google and Facebook. It also surveys patient experience and generates survey data and summary reports, with charts and graphs. My Patient Messages provides patient educational content through email broadcasts; on-hold messages, where you can also include office policies; and with ready-to-use social media posts and newsletter templates with vetted content from accredited organizations.

• ***Practice management tools.*** This tool flags scheduling gaps, high-probability no-shows and appointment requests. A waitlist management tool detects cancellations and fills vacancies. Additionally, My Patient Messages stores and manages patient data and records in one place, says the company. It also automatically collects and updates patient information.

My Patient Messages has three pricing plans: basic; professional; and enterprise. For information or to request a quote, visit mypatientmessages.com.

Inphonite

Inphonite is a streamlined automated appointment reminder tool. The company says it's fully customizable and saves practices time and money by automatically connecting with clients. Highlights include:

• ***Texting.*** This feature enables you to send SMS texts from your business number. The company says this helps clients recognize who's texting them.

• ***Surveys.*** Inphonite says their patient experience surveys help to improve client satisfaction and retention. Patients are automatically prompted to respond after their appointment.

• ***Appointment reminders.*** The platform sends automated voice, email and text reminders. This helps to reduce no-shows, the company says.

• ***Group notifications.*** With this feature, practices can quickly send updates to large groups of people about inclement weather, closings or emergencies.

• ***Privacy.*** Inphonite provides private messaging for sending portal information such as lab results or private messages from the doctor.

The mobile version features an interface that the company says is easy-to-use and includes instant messaging. It also allows users to view appointments and review reports. It's available for both Android and iOS. For information or to request a demo, visit inphonite.com.

NexHealth

NexHealth is a patient management and telehealth tool that includes messaging, appointment and recall reminders, email and texting campaigns, waitlists, reports and online booking. Other tools include:

• ***Telehealth.*** NexHealth's HIPAA-compliant platform is safe and secure, the company says. No log-ins or downloads are required and practices can integrate appointments with their PM software. It also includes a cloud-based waiting room. Patients receive a link that takes them to the virtual exam room.

• ***Payments.*** NexHealth says it makes it easy for patients to pay with text and email-based billing—no log-ins or passwords required. The platform also automatically sends patients payment statements and sends confirmation emails once payment has been received. Payments are automatically deposited into your bank account. NexHealth says that 80 percent of patients on their platform pay within 10 business days.

• ***Digital forms.*** This feature eliminates paperwork and security risks, the company says. It provides custom digital patient forms to collect information, including medical history, authorization and consent forms.

• ***Developer tools.*** NexHealth is compatible with a number of EHRs. The company says integration is seamless with their single-application programming interface, and says the API reduces production costs and cuts down on development time by reducing high-value tasks and bypassing manual EHR integration.

NexHealth has four pricing plans tailored to practices' specific needs: acquire; activate; retain; and complete. For information or to see a demo, visit nexhealth.com.

Surgical Approaches to Pterygium

Recurrence is your worst enemy. Here, a surgeon discusses ways to avoid it and what to do if the pterygium comes back.

BY JACK PARKER, MD, PHD
BIRMINGHAM, ALA.

It's best to approach pterygium surgery with the goal of reducing the chances of recurrence at all costs. While most pterygia are asymptomatic and regarded as garden variety lesions, they become serious problems if they recur after removal. These cases most certainly warrant a subspecialist evaluation. In this article, I'll discuss some surgical approaches to pterygium, with particular emphasis on recurrent pterygium.

At the Outset

When a patient presents with a pterygium, the first thing to decide is whether it's necessary to do anything at all. Many patients have only mild complaints related to dryness or irritation, and are often best observed or managed medically. Lubrication or topical NSAIDs may help relieve ocular inflammation and reduce the pterygium's appearance. Protecting the face and eyes from excessive UV exposure may also help, as pterygium is more prevalent in regions that receive strong ultraviolet radiation.

Only a small percentage of pterygium cases warrants surgical excision. Indications for surgery include obstruction of the visual axis, pterygium-induced irregular astigmatism, chronic eye irritation and cosmetic dissatisfaction.

If you do decide to surgically remove the pterygium, your next decision will be to determine how extensive a procedure is required. One day postoperatively, no matter which method you used to remove the pterygium, it's going to be gone. The question is: Is it going to come back? You want to do everything you can to make sure the answer is "no."

Surgical Strategy

There are many different ways to do a basic pterygium removal, and potentially hundreds of modifications of the surgical technique. The most common method of simple excision takes about five minutes but is associated with a much higher relative risk of the pterygium recurring. For this technique, you simply pry the scar tissue off the cornea and snip it off. It's effective for about 90 percent of cases, but that means you can expect approximately 10 percent of cases to recur (often with a vengeance).

As a medical adjuvant to the simple snip excision, one might also consider the adjunctive use of antimetabolites such as mitomycin-C on the surgical site. This isn't something that I usually do however, because mitomycin carries the risk of scleral melting. If you're concerned enough to pour chemotherapy on the surface of the eye to prevent the pterygium from coming back, then, rather than using the mitomycin technique, the optimal thing to do would be to try the PERFECT technique (*explained in detail below*).

Pterygium Excision

We often use a nerve blocker for pterygium excision. Retrobulbar anesthesia is typically most comfortable for the patient because it provides good levels of pain control during the procedure. Take care not to damage the underlying corneal tissue or remove stroma when prying the pterygium off the surface of the eye.

First, make an incision at the limbus where the pterygium begins to encroach over the cornea. Cut it free and peel it from the corneal surface using blunt dissection. Once the pterygium's been removed, we often polish the cornea with a diamond burr. When the cornea has been repaired, we turn our attention to the sclera and conjunctiva.

Dissect the conjunctiva free from Tenon's capsule. Remove all of Tenon's capsule where the pterygium was.

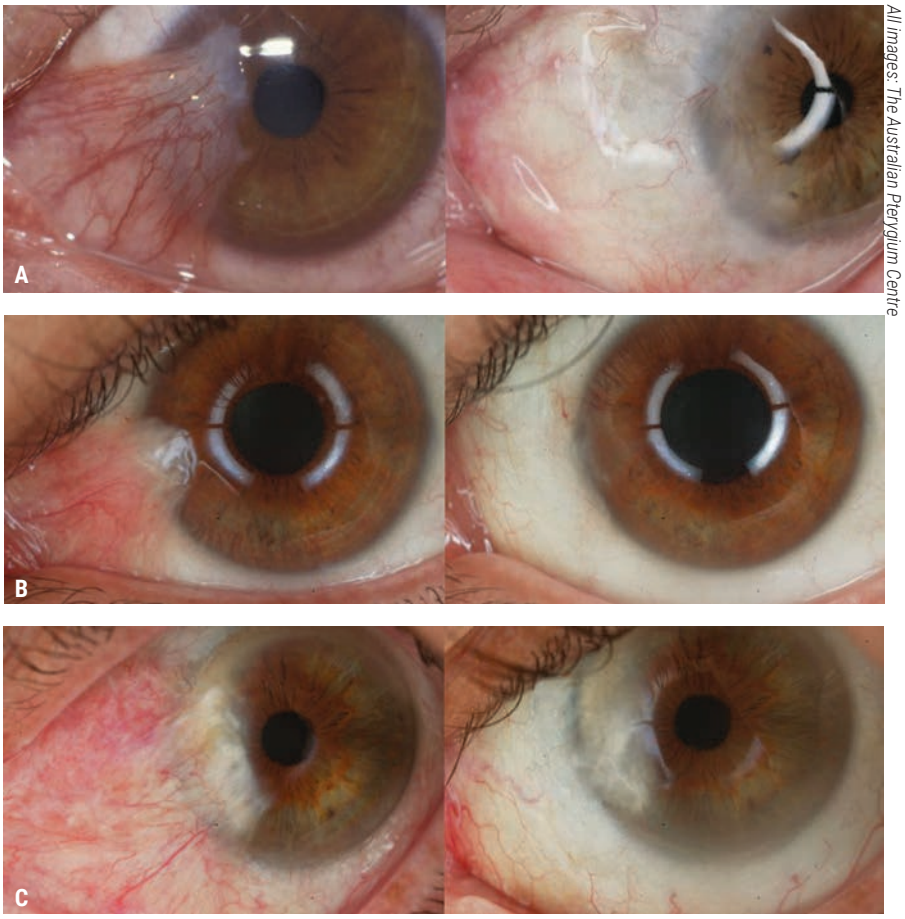
Once you remove the scar tissue from the nasal aspect of the cornea and globe, you must then decide what to put in the gap where the scar tissue used to be. You have a few options:

Option 1: Do nothing. You can just leave it bare and it'll re-epithelialize on its own. This has the highest risk of recurrence and induces the most patient discomfort, but it can be done.

Option 2: Cover the area with a bio-

This article has no commercial sponsorship.

Dr. John is a clinical associate professor at Loyola University at Chicago and is in private practice in Oak Brook, Tinley Park and Oak Lawn, Illinois. He has a small equity interest in, is consultant/advisor to, and has received lecture fees and grant support from Bio-Tissue and Tissue Tech. He can be reached at 708-429-2223; email: tjconference@gmail.com.



All images: The Australian Pterygium Centre

Figure 1. Pre- and postop eyes that underwent the PERFECT technique for (A) primary pterygium removal, (B) removal after a failed surgery and (C) removal after 10 failed surgeries. Your first opportunity to remove pterygium is your best opportunity. These patients didn't require subsequent pterygium excision.

logical material. Amniotic membrane, which can be placed and glued or sutured over the area of the defect, is a very effective method. We prefer to use glue, since it's fast and simple. Amniotic membrane makes patients more comfortable and contributes to the healing of the tissue. However, it's not quite as effective in discouraging recurrence as the third option.

Option 3: Rotational conjunctival autograft. This method might not be necessary in every case, but it's the least likely to lead to recurrence. It's also the technique I perform most often.

To perform a rotational conjunctival autograft, first measure the conjunctival epithelial defect and how much bare sclera you need to cover. Then, harvest the conjunctiva approximately 90 degrees or 3 to 4 clock hours away from the resected site, usually in the superior globe, with Wescott scissors. Dissect the conjunctiva free from the underlying Tenon's capsule to an extent that matches the surface area of the pterygium. Create a pedicle flap and rotate it down to cover the area. Glue or suture the flap to the bed with 8-0 vicryl. If using glue, aim for as little glue as possible. Postoperatively, prescribe topical antibiotic drops such as fluoroquinolone q.i.d. for a week, and a steroid drop such as prednisolone acetate q.i.d., tapered over one to three months.

In terms of graft stability, gluing and suturing will give you the most peace of mind. A third technique, autologous *in situ* blood coagulum, will also work if you don't have access to glue and you do have an extra 10 minutes to hold pressure on the site. The patient's natural bleeding in the area will coagulate and anchor the amniotic membrane; however, you can't be as sure as with glue or suture that the tissue will still be adherent after a day or a week. Besides, glue and suture are expensive, but the most expensive thing of all is time in the operating room—holding tissue down with your fingers for 10 minutes is quite expensive.

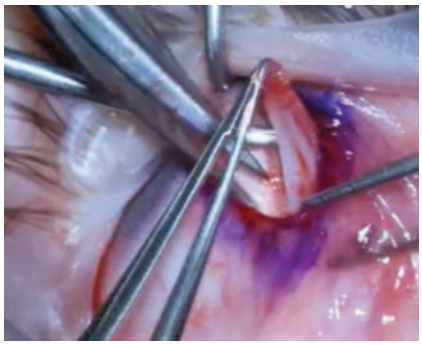


Figure 2. Removing Tenon's capsule. Adequate removal will result in visible bare sclera above and below the medial rectus muscle.

Recurrence (discussed below) is the most serious postop complication of pterygium excision. Additionally, you have to be concerned about scarring. When you're cutting on the eye you're generating scar tissue, so you need to be careful that you don't end up with a tangled, fibrous mess. This is entirely possible, especially with multiple surgeries.

Other complications you may encounter include scleral melt due to the use of mitomycin-C; fibrosis, especially around the extraocular muscle in that location; infection, which is rare; and ocular surface discomfort, which can last for weeks or even months. Typically, the steroids help ease discomfort, but we also encourage the use of lubricant drops. Keep these complications in mind when forming your surgical strategy.

Recurrence

Young people are generally at

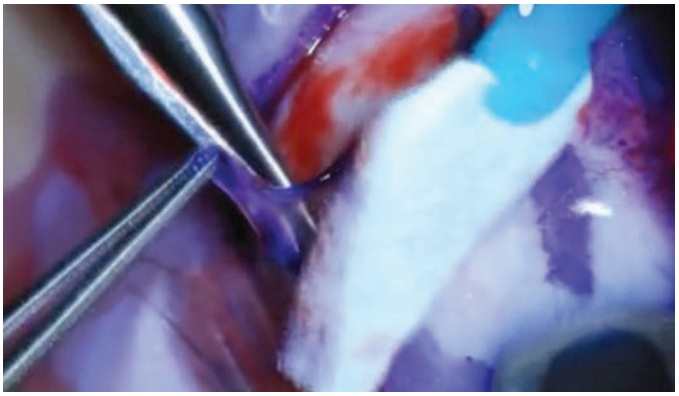


Figure 3. Graft retrieval. A successful autograft should be virtually transparent without any Tenon's layer.

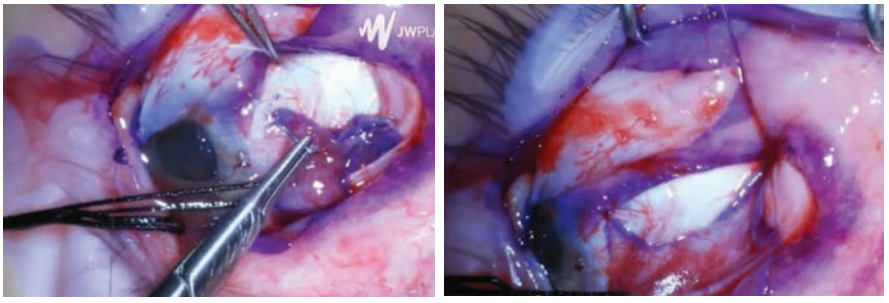


Figure 4. Suture the graft into place at the site of the former pterygium.

increased risk for recurrence, as are African Americans and Hispanics of all ages, who tend to have more inflammatory phenotypes. Additionally, patients with double pterygia (on both the nasal and temporal aspects of the cornea) and bilateral double pterygia are at extremely high risk for recurrence. In these patients, you need to take every possible precaution and be very careful if you do any surgery on them.

It's critical that these patients be watched carefully for recurrence. If you notice the area you've resected is starting to grow back, usually at a millimeter-by-millimeter pace, begin aggressive topical steroids immediately, since you want to do everything in your power to avoid a second surgery. If the eye is red and inflamed, that's the time for drops, not surgery.

However, if you lose the battle—whether you're inattentive, or the patient comes back years later, or was referred elsewhere and upon their return to you, the pterygium is growing over the visual axis—then it's time to consider reoperating.

In the event that the pterygium recurs, I recommend trying the PERFECT technique. This technique, which stands for Pterygium Extended Removal Followed by Extended Conjunctival Transplant, was pioneered by Australian ophthalmologist Lawrence Hirst, MBBS, MD, MPH, who runs The Australian Pterygium Centre. It has by far the lowest risk of recurrence, at just 0.1 percent (*Figure 1*). This method involves extensive removal of Tenon's capsule from the area of the pterygium and surrounding areas and is meant to be used on patients who have recurrent pterygium after previous surgical removal. This procedure has very good cosmetic outcomes, with most patients reporting being unable to tell which eye had surgery.

The PERFECT technique for pterygium consists of three components that each take about 15 to 20 minutes to perform. Following are the steps of the technique as described by Prof. Hirst in a video of the procedure.

First, mark and transect the pterygium. Strip it from the corneal surface. Try to avoid having any residual pterygium tissue. Next, separate Tenon's layer from the overlying conjunctiva and sclera, almost to the superior and inferior rectus muscles, and over the medial rectus muscle back to the caruncle (*Figure 2*). Adequate removal will result in visible bare sclera above and below the medial rectus muscle.

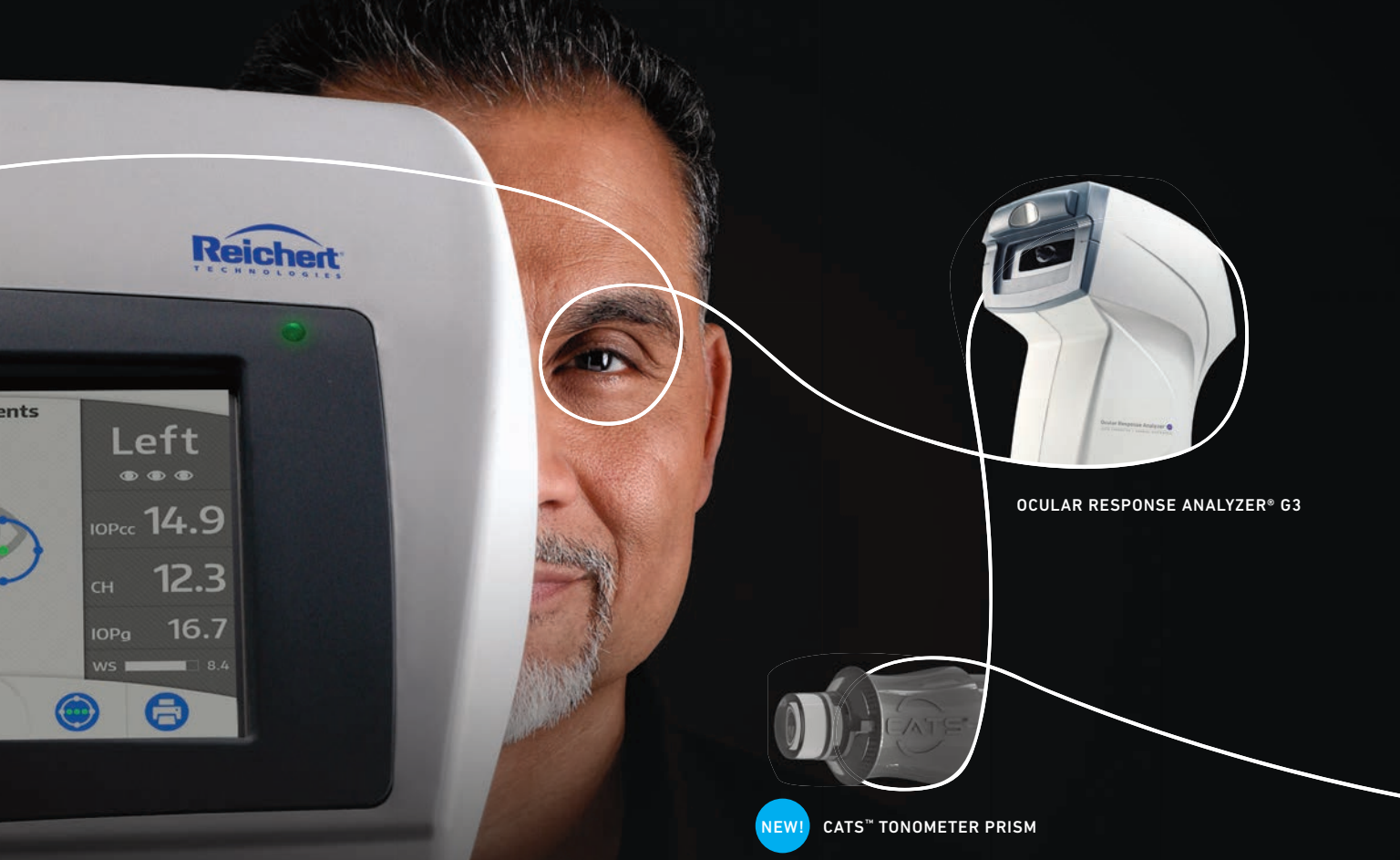
For the extended conjunctival transplant, mark the donor graft starting at the superior bulbar conjunctiva (*Figure 3*). The mark should extend almost to the superior fornix, and about 1 to 2 mm short of the limbus, and nasally, almost to the pterygium excision site. Leave a 5- to 7-mm bridge of conjunctiva and Tenon's layer. At the donor site, the conjunctiva to be grafted should be separated from Tenon's. A successful autograft should be virtually transparent, without any Tenon's layer carried over with the graft. This helps to ensure that the donor site will heal with minimal-to-no scarring. The conjunctival graft is then transferred to the site of the former pterygium and sutured into place (*Figure 4*). To view a video of this technique, visit youtu.be/ODpQ_RbgHn4.

While it has the best success rate for preventing recurrence, by a wide margin, PERFECT is a long procedure—taking an hour to two hours of operating time, depending on your experience and skill level. However, I believe that anyone who's had a pterygium recurrence needs to undergo this technique, as opposed to the standard "rip and clip."

Ultimately, a pterygium isn't something you want to keep hacking off over and over again. If it recurs early on, and you don't feel comfortable doing the very refined PERFECT surgery yourself, it's a good idea to refer the patient to a specialist. ◂

ABOUT THE AUTHOR

Dr. Parker is a cornea specialist in practice at Parker Cornea in Birmingham. He has no relevant financial disclosures.



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References: 1. Medeiros FA, Meira-Freitas D, Lisboa R, Kuang TM, Zangwill LM, Weinreb RN. Corneal hysteresis as a risk factor for glaucoma progression: a prospective longitudinal study. Ophthalmology. 2013 Aug;120(8):1533-40. **2.** De Moraes CV, Hill V, Tello C, Liebmann JM, Ritch R. Lower corneal hysteresis is associated with more rapid glaucomatous visual field progression. J Glaucoma. 2012 Apr-May;21(4):209-13. **3.** Susanna CN, Diniz-Filho A, Daga FB, Susanna BN, Zhu F, Ogata NG, Medeiros FA. Am J Ophthalmol. A Prospective Longitudinal Study to Investigate Corneal Hysteresis as a Risk Factor for Predicting Development of Glaucoma. 2018 Mar;187:148-152. doi: 10.1016/j.ajo.2017.12.018. **4.** Felipe A. Medeiros, MD and Robert N. Weinreb, MD. Evaluation of the Influence of Corneal Biomechanical Properties on Intraocular Pressure Measurements Using the Ocular Response Analyzer. J Glaucoma 2006;15:364–370. **5.** Goldmann and error correcting tonometry prisms compared to intracameral pressure. McCafferty S, Levine J, Schwiegerling J, Enikov ET. BMC Ophthalmol. 2018 Jan 4;18(1):2. *CATS™ Tonometer Prism is distributed by Reichert Technologies ·

GETTING GREAT OUTCOMES WITH TORIC IOLS

Surgeons share strategies for making sure these patients end up with the best possible vision.

BY CHRISTOPHER KENT
SENIOR EDITOR

Among the many advanced-technology intraocular lenses now available to ophthalmologists, one of the most commonly used is toric lenses. Originally only available in monofocal designs, torics have now expanded to include multifocal and expanded-depth-of-focus lenses. Here, surgeons with expertise in measuring astigmatism and implanting and aligning these lenses share strategies to improve your outcomes.

Using the Right Technology

The first step when deciding whether a toric IOL is appropriate for a given patient—and what power to implant—is measuring the astigmatism of the eye. In terms of which instruments should be used to make those measurements, a 2019 clinician survey conducted by the American Society of Cataract and Refractive Surgery found that most surgeons, both in the United States and around the world, rely on topography and automated keratometry to guide them in their toric IOL power selection.

"If you're going to fix astigmatism, you need to be able to measure it and see it," notes George Waring IV, MD, FACS, founder and medical director of the Waring Vision Institute in Mount Pleasant, South Carolina. "Astigmatism can be regular or irregular, and regular astigmatism can be against-the-rule, with-the-rule or oblique. You need to be able to see it because you won't necessarily be able to tell whether your patient's astigmatism is regular or irregular unless you can visualize it. So you need either a topography or tomography device to understand the quantity, quality and orientation of the astigmatism. That's essential. Ideally, you'd also have the ability to evaluate the total keratometry, which includes the anterior and posterior corneal contribution to the astigmatism. Multiple devices can give you this, including the IOLMaster 700, the Lenstar, the Pentacam and corneal OCTs.

"In our practice we factor in the topography by using a weighted mean of the topographic and IOLMaster astigmatism readings," he continues. "Beyond that, because we're doing lens surgery earlier and earlier, we also consider the manifest refraction in younger patients. In addition, Hartmann-Shack wavefront aberrometry can give you useful information to supplement the manifest refraction guidance in many cases, but wavefront information certainly isn't essential."

H. Burkhard Dick, MD, PhD, FEBOS-CR, director and chairman of the University Eye Hospital in Bochum, Germany, believes that corneal tomography, which assesses both anterior and posterior cornea, is very useful. "This is of prime importance when smaller degrees of astigmatism are at issue, which is true in most of our cases," he notes. "A macular OCT is also valuable for checking to see if the patient has, for instance, macular gliosis, which predisposes to postoperative macular edema, and thus considerable patient dissatisfaction."

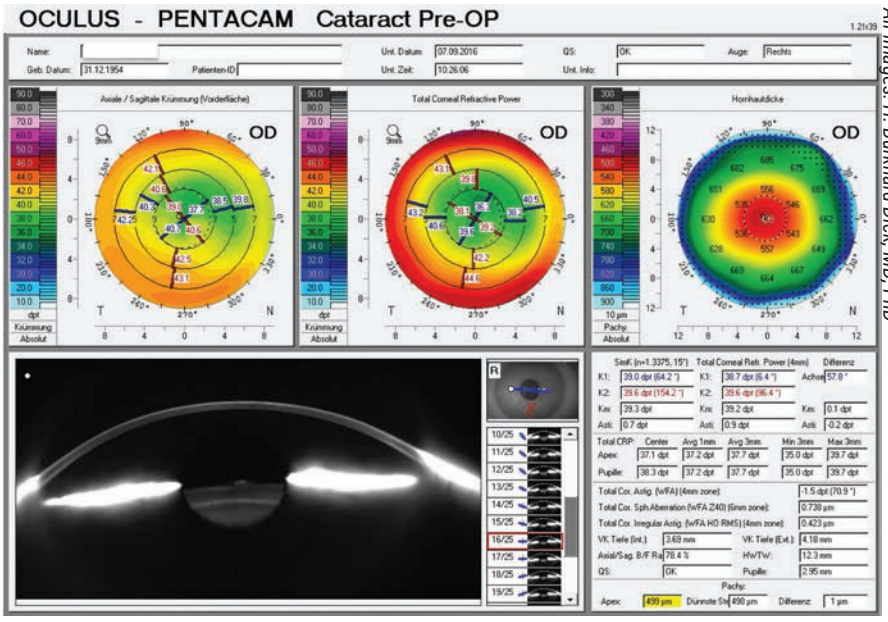
Dr. Waring notes that whether or not a toric IOL is a good solution for an eye with irregular astigmatism depends on the specifics of the eye

This article has no commercial sponsorship.

Dr. Dick is a consultant to LensAR, Johnson & Johnson Vision, Zeiss, Bausch+Lomb and Hoya. Dr. Waring reports financial ties to Oculus and Johnson & Johnson Vision. Dr. Hill reports no financial interests in any products mentioned.

in question. "A toric lens may not be able to address irregular astigmatism adequately," he points out. "However, in some cases it can. In the case of asymmetric bow ties, we'd be conservative and treat the least amount of astigmatism in the hemi-meridian, as opposed to the full amount in the opposing hemi-meridian. We also use the manifest refraction to guide us in our decision-making, in terms of what the patient will accept at the spectacle plane. Of course, if it's a markedly skewed radial axis, as it could be in a case of keratoconus, then the patient might not be a great candidate for a toric lens because toric lenses have radial symmetry."

Dr. Dick recommends using one of the established online calculators, such as the Donnenfeld calculator, to make a decision about whether a toric lens is really indicated for a given patient. "I'd hesitate to implant a toric lens if irregular astigmatism is involved," he adds. "I'd also be reluctant if there's a probability of keratoconus, or in the presence of major ocular pathologies like gliosis, macular degeneration or diabetic retinopathy."



All images: H. Burkhard Dick, MD, PhD

It's important to validate the Ks you get from your biometer by looking at a corneal map. Because autokeratometry extrapolates from a limited number of measurements, the Ks it provides may not reveal irregular astigmatism (like that shown above) that would make a toric lens inadvisable.

Interpreting the Data

Warren E. Hill, MD, medical director of East Valley Ophthalmology in Mesa, Arizona, notes that when choosing a toric IOL, it's helpful to first determine whether the type of astigmatism the patient has is appropriate. "Using a topographic or tomographic axial curvature map, look to see how the power is distributed across the anterior cornea within the central 4 mm," he says. "A pair of symmetric, astigmatic power lobes straddling the corneal vertex, with each lobe aligned along the same meridian, represents regular, symmetrical astigmatism. This is the ideal situation for a toric IOL.

"Next, look to see if a line can be passed through the corneal vertex and the center of each astigmatic lobe," he continues. "Where this line intersects the axis scale in the periphery is, by definition, the steep meridian. If we can't draw a single line representing one meridian through both astigmatic lobes, the astigmatism is then termed irregular."

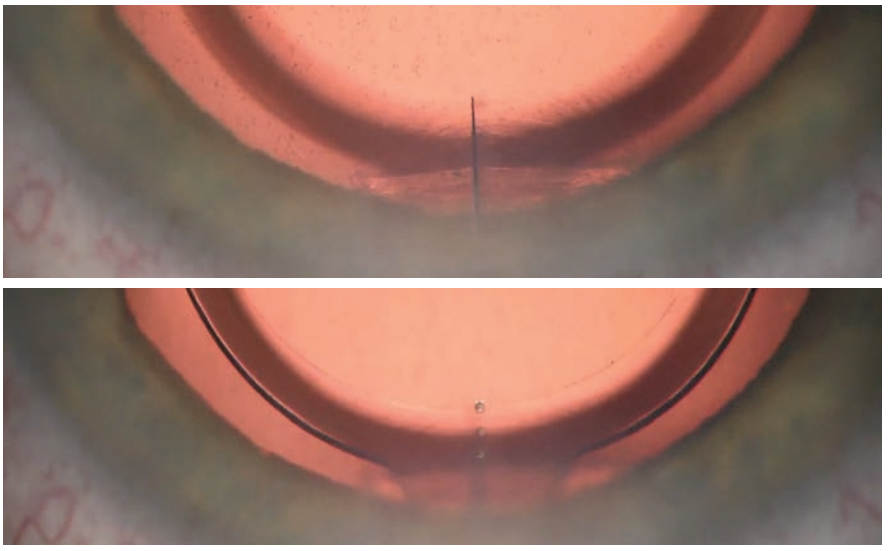
Another fundamental aspect is determining whether the astigmatism is symmetrical. "If the power distribution on either side of the corneal vertex is very different, it's termed asymmetric," Dr. Hill explains. "Elevated coma values are often associated with this type of topographic map, especially if an astigmatic lobe is present on only one side of the corneal vertex. Placing a toric IOL in this situation may result in variable amounts of image duplication and displacement with larger pupil sizes."

Dr. Hill says that if the astigmatism is both regular and symmetrical, and you've accurately identified the steep meridian, the next step is to determine the power difference between the two principal meridians. "Here, we use the steep meridian that was determined manually from the topographic axial curvature map to validate the power difference," he notes. "This power difference is often best determined with the autokeratometry feature of the Lenstar, IOLMaster, or other similar technology; simulated Ks shouldn't be used for this exercise. Note that if you're confident about the steep meridian but the autokeratometer is telling you something different, the Ks are most likely being measured at an incorrect location."

Dr. Hill notes that simply relying on a set of Ks from your biometer may lead to a poor outcome if you don't also look at a topographic axial map. "The topographic axial curvature map tells you whether you're dealing with regular and symmetrical astigmatism and lets you manually determine the steep meridian," he says. "This helps to validate the power difference calculated by autokeratometry, which will be less accurate if the meridians aren't correctly identified."

Managing Posterior Astigmatism

Some instruments can now provide accurate measurements of the



Some femtosecond laser systems can make guide marks on the cornea that can be used to align a toric IOL. Top: Microscope view of an aligned toric lens, focused on the corneal mark. Bottom, same eye, focus shifted to the toric IOL alignment marks.

posterior corneal surface and its refractive power and astigmatism. Is it worth measuring this directly? "In a perfect world we'd specifically measure the posterior corneal astigmatism," says Dr. Waring. "However, many offices don't have the technology to do that. If you're not going to measure that, it's very important to use a population-based nomogram."

"At the present time, in normal eyes the mathematical models used by the Barrett and the Abulafia-Koch methods [to calculate optimum astigmatism correction] appear to be more accurate than using direct measurements of the posterior cornea," Dr. Hill says. "However, you shouldn't use mathematical models for unusual eyes—such as those with keratoconus, penetrating keratoplasty or prior refractive surgery—or with Ks determined by total corneal power. For unusual eyes, a direct measurement of the posterior cornea is preferable, along with the use of the Barrett True K toric calculator. This can be accessed at: calc.apacrs.org/TrueKToric105/truek-toric.aspx."

"In eyes with high astigmatism, the posterior astigmatism is virtually irrelevant," Dr. Dick points out. "However, in astigmatism of 1.5 D or less, posterior astigmatism does play a role. A meticulous surgeon may choose to measure both anterior and posterior astigmatism and calculate the 'true net power,' which determines the refractive power, but some formulas, like the new Barrett formula, quite effectively predict posterior corneal astigmatism.

"I've seen a few cases where an eye had as much as 0.4 D of posterior astigmatism," he adds. "That becomes relevant if the overall astigmatism that one is trying to correct is around, say, 1 D. However, in my experience eyes like that are rare."

Marking the Axis

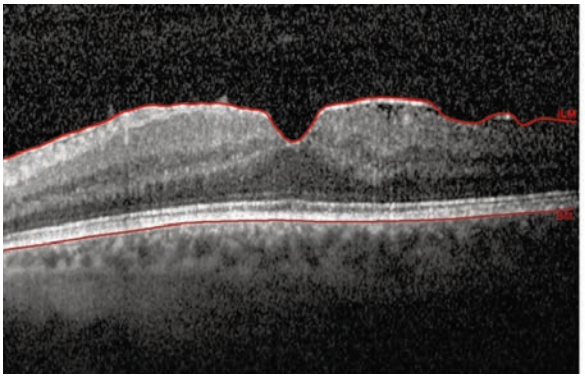
Many surgeons still rely on marking the cornea with ink to guide alignment of the implanted toric IOL, but higher-tech options are proliferating and becoming more widely used. For example, Dr. Hill says that his practice guides toric axis alignment by creating anterior capsule tags using the LensAR femtosecond laser, obviating the need to use external corneal marking.

Dr. Waring says that he uses a femtosecond laser to create 10-degree intrastromal femtosecond laser marks in the cornea. "These marks are archival," he notes. "That means we not only have an intraoperative registration, we have a postoperative archival registration that makes it easy to see if the toric lens has rotated.

"Today there are more and more options to use for aligning the lens, such as intraoperative light and registration overlays," he continues. "For example, Zeiss' Callisto does a real-time overlay for toric marking; that's one of the more elegant ways to align with corneal astigmatism. In addition, more and more femtosecond laser platforms are offering customized capsulotomies to identify and register the astigmatic axis to front end topographic diagnostic devices. However, we believe that using ink marks is still a great idea, particularly if you eventually transition into more advanced technologies. There's certainly no harm in doing both."

Dr. Dick says that while he appreciates the advantages of high-tech alignment technologies, he believes ink marks are still the gold standard. He offers several pearls for using this approach:

"It's important to use a gravitation-guided pendulum marker and



Many surgeons believe it's important to get a macular OCT before implanting a toric IOL, to detect conditions such as macular gliosis (shown above), which predisposes a patient to postop macular edema—and dissatisfaction.

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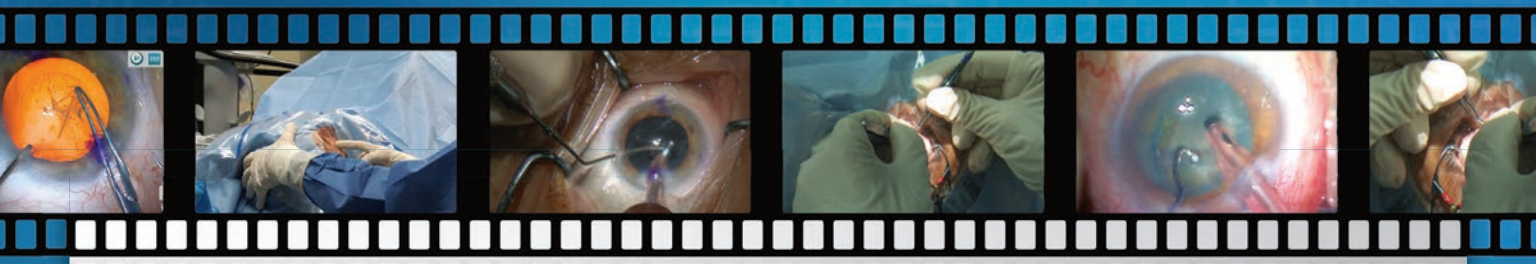

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Surgical Video by: Richard J. Mackool, MD

Video Overview: After routine phacoemulsification and IOL insertion, a spontaneous opening in the posterior capsule is observed without obvious cause. A small capsulorhexis must then be enlarged to permit reverse capture of the optic of the single piece, trifocal IOL.

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designate the target axis rather than the horizontal axis," he says. *(See photo, facing page.)* "When you have the patient sitting at the slit lamp and you mark the horizontal sector to use as a reference mark on the operating table, you may already be off by about five degrees. Having to then locate the alignment axis with a Mendez ring on the operating table means you have two opportunities for error. If you're trying to correct 1 or 1.5 D, this might be clinically irrelevant; but with high levels of astigmatism, any additional error leads to ever greater deviation."

Dr. Dick says using the right kind of marker makes a difference. "It needs to be a marker that makes slim markings and comes with four rather than two contact points," he says. "However, remember that a very fine marking might fade away by the time of surgery."

Dr. Dick believes the ideal option for alignment is laser-guided high-definition iris recognition, with an adjustment for measurements taken when the patient was sitting. "It's also excellent to place laser marks in the capsulotomy, or mark the target axis on the cornea using a femtosecond laser, a technique we recently published about," he says. "This method eliminates almost all sources of error, like confusing the left with the right eye. The software will intervene and tell you that you're not targeting the correct eye."

Minimizing Lens Rotation

It goes without saying that after going to great lengths to get the toric IOL aligned with the correct axis, the last thing a surgeon wants is to have the lens rotate.

"To ensure minimal rotation of the lens, you should take certain steps during the surgery and then counsel the patient about how to behave during the postop period," says Dr. Waring. "Intraoperatively, you want to do several things. First, make sure you remove all viscoelastic from behind the optic. Second, place a small amount of posterior pressure on the optic, to seat the optic and haptic in the posterior portion of the capsule. Third, use the I/A tool to hold the IOL in place during irrigation and aspiration. Fourth, ensure that you've adequately sealed your wounds."

Dr. Hill says that when he implants an Alcon AcrySof toric IOL, he seats the IOL with gentle downward pressure, using the I/A tip to initiate an interaction between the posterior surface of the optic and the posterior capsule. "Also, at the end of the case, don't over-inflate the eye with BSS," he adds.

Dr. Waring adds that it's also important to educate the patient about postop behavior. "It's critical to explain to your patients that they need to avoid rubbing or wiping their eyes, especially during the first week postop," he says. "Any outside pressure can increase the likelihood of toric rotation. Typically, if the lens is going to rotate it will happen during the first week, with the first 48 hours being the most critical."

Of course, despite all of your efforts, some toric IOLs may rotate postoperatively. Dr. Waring says he considers four metrics when deciding whether or not to go back in and correct the alignment of a toric lens. "First of all, is the patient aware of a visual problem?" he says. "Second, is their measured uncorrected visual acuity being affected by the alignment offset? Third, can we see under the microscope that the alignment is off by five degrees or more? Fourth, can we show with advanced technology, such as the ray-tracing technology in the iTrace toric check or the Berdahl-Harden toric calculator, that rotating the lens would improve things?"

Dr. Waring notes that he would typically check these things if the patient had a subjective complaint. "Of course, my team always checks

What About Intraoperative Aberrometry?

One of the high-tech tools that can be used to align a toric lens is intraoperative aberrometry, which provides a refractive analysis of the eye's vision while the patient is still on the table. This can allow the surgeon to fine-tune the alignment of a toric IOL to achieve the maximum astigmatism correction. Like many surgeons, Warren E. Hill, MD, medical director of East Valley Ophthalmology in Mesa, Arizona, sees value in this option. "Intraoperative aberrometry provides a net solution for the anterior cornea, the posterior cornea and the toricity and alignment of the toric IOL," he notes.

George Waring IV, MD, FACS, founder and medical director of the Waring Vision Institute in Mount Pleasant, South Carolina, says he doesn't routinely use intraoperative aberrometry for toric IOL alignment. "However, many surgeons do," he says. "It's a great tool for that purpose, but it can be very sensitive to intraoperative factors. It's another tool in the toolbox."

H. Burkhard Dick, MD, PhD, director and chairman of the University Eye Hospital in Bochum, Germany, notes some practical issues with its use. "This tool requires a major investment, and here in Germany its use has to be completely paid for by the patient out-of-pocket. That would require a lot of sales skill and time and effort on the part of the surgeon to inform and convince the patient that it's worth the cost.

"Beyond those considerations, the technology works well, but it adds slightly to the operating time," he continues. "Also, a clinic or hospital has to 'drill a hole' in its internet firewall to use it, which is not without risk. The other consideration is that intraoperative aberrometry only measures the patient's intraoperative status. Afterwards, with the patient attaining an upright position, IOL rotation is still possible."

—CK


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the IOL position under the microscope on day one postop," he says. "That's especially easy to do if you have the archival femtosecond laser marks."

Pearls for Success

These strategies will help to ensure that your toric IOL patients get the best possible outcome:

• ***Always validate the Ks you get from your biometer.*** Dr. Hill notes that failing to do this is one of the most common mistakes clinicians make. "Autokeratometry extrapolates from a limited number of measurements," he points out. Therefore, it's important to verify that the steep meridian manually obtained by autokeratometry agrees with what you know to be correct."

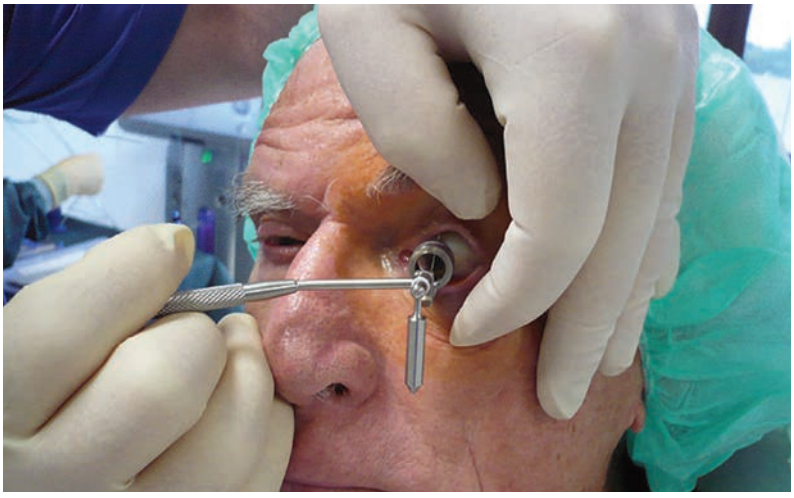
• ***Look for signs of amblyopia.*** Dr. Dick points out that testing the visual acuity in both eyes is the first step to take with a potential toric IOL patient. "This is mainly to exclude amblyopic eyes," he explains. "Using a toric IOL in an amblyopic eye is questionable, especially in very amblyopic eyes. If the first eye is amblyopic, then fixation will be insecure, making it possible to have measurement errors in both refraction and tomography. Moreover, dissatisfaction with the result in the first eye may lead the patient to refuse a toric IOL for the better eye, where it would really make sense if that eye has greater corneal astigmatism than the first eye."

• ***Be aware of pupillary distortions.*** "Pupillary disturbances and distortions—like constantly large pupils—are also reasons to refrain from implanting toric IOLs," notes Dr. Dick. "Pupil distortion can have an impact on the physiological compensation for existing or postoperative astigmatism, in terms of optics. Pupil distortion can decrease or increase the astigmatism, depending on the orientation of the distortion in relation to the steep corneal axis. A small oval mask in the IOL (analogous to the small round mask in the IC-8 from Acufocus) is definitely capable of compensating for corneal astigmatism if appropriately oriented.

"Pupillary distortion," he adds, "as well as non-uniform medical mydriasis, can have an impact on astigmatic axis detection if it's based on digital iris recognition."

• ***Be prepared to use special means to prevent rotation in cases of high myopia.*** "High myopes may have a large capsular bag with a diameter greater than the standard total diameter of a toric IOL," notes Dr. Dick. "Therefore, there's a greater chance of rotation in these eyes, especially with a plate haptic IOL.

"One option in this situation is posterior optic capture following a posterior capsulorhexis or capsulotomy," he continues. "An optic capture makes any rotation virtually impossible. Using a posterior optic capture would be critical in case of a one-piece IOL, because a sharp anterior edge could cause problems such as iris shaving. Alternatively, a three-piece IOL can be implanted into the sulcus with an optic capture through a well-sized anterior capsular opening."



If using ink marks to align a toric IOL, surgeons suggest making the marks with a gravitation-guided pendulum marker, and designating the target axis rather than the horizontal axis so there are fewer opportunities for error.

• ***Don't withhold offering toric options because you don't have high-end equipment.*** Surgeons agree that high-end equipment isn't necessary in order to offer your patients toric lenses. "What is essential," says Dr. Dick, "is having the ability to perform proper marking, and the availability of corneal topography and tomography and retinal OCT."

A Great Option

"I think toric lenses should be thought of as another way to improve your patient's vision, much like removing the cataract," says Dr. Waring. "You should present the option to your patients accordingly. This gives them the opportunity to go beyond just fixing the cataract; they can also fix the focus of the eye.

"We believe every cataract surgeon should be offering toric lenses," he adds. "Implanting a toric lens isn't technically very different from normal IOL implantation, except for the biometric considerations and rotation-related considerations I've mentioned. It's primarily a way to offer your patients more options and give them even better vision. It's also a good way for surgeons to become more comfortable with advanced-technology IOLs such as presbyopia-correcting IOLs, particularly since more and more of those now come in a toric version."

"It's essential that we avoid implanting toric lenses in the presence of pathological conditions," observes Dr. Dick. "However, given the prevalence of astigmatism in the general population and in our cataract patients—astigmatism that could easily be corrected with a toric IOL—we should probably be implanting far more of them than we are."

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IOL SURVEY: NEW LENSES TURN SURGEONS' HEADS

On this year's IOL survey, the new PanOptix Trifocal and Tecnis Toric II both made a splash.

BY WALTER BETHKE
EDITOR IN CHIEF

For years, surgeons have been casting about for an intraocular lens solution that would give their patients a wider range of vision. The latest technology approved in the United States aimed at this goal is trifocal lenses and, according to our current e-survey of cataract surgeons, it's intrigued physicians to the point at which a good number of them say they're either using them currently, or are willing to give them a try in 2021. Whether this interest will endure or is just a function of the immediate "bounce" a new technology gets simply by being new, only time will tell.

This is just one of the findings from this year's e-mail survey on IOL preferences. This time around, 9 percent of the 12,258 recipients on *Review*'s e-mail list opened the message, and 75 surgeons took the survey. To read about your colleagues' impressions of trifocal IOLs, as well as other lens technologies, read on.

Presbyopia-correcting Lenses

As mentioned earlier, surgeons are on the lookout for new options for presbyopic lenses.

The most popular option on the survey, with 67 percent of the surgeons choosing it, is the Alcon PanOptix Trifocal (non-toric) (average number implanted per month: 2; average charge/eye: $ 2,790). The PanOptix Trifocal Toric was next, at 59 percent (average number/month: 4.7; average charge: $3,347). The Tecnis Symfony extended-depth-of-focus IOL and the Symfony Toric were next, each chosen by 30 percent of the respondents (average number implanted/month: 6.6; average charge/eye: $2,594). The Tecnis MF +3.25 D (2.8 lenses implanted per month with an average charge of $2,500) was next, chosen by 18 percent of the surgeons. Ten percent of respondents say they use the Crystalens AO (average number/month: 2; average charge/eye: $2,798).

Forty-five percent of the surgeons say they're "satisfied" with their presyopia-correcting lens, 38 percent say they're "very" satisfied, 12 percent are somewhat satisfied and 6 percent are unsatisfied.

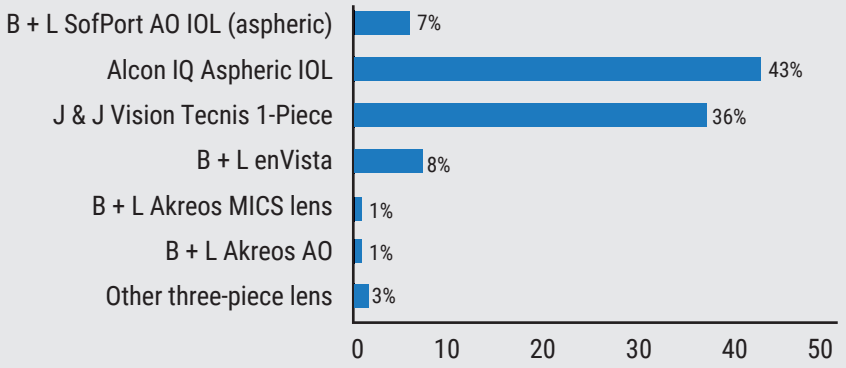
One surgeon who uses the PanOptix says, "The optics are the best available but it still has undesirable side effects." A surgeon from Alabama says the PanOptix gives "Good spectacle independence with minimal patient complaints/dissatisfaction." A California surgeon says the lens affords him, "Excellent range of vision, distance, intermediate, near…Very happy patients. It still has some nighttime halo issues like all multifocals."

"The PanOptix is providing good vision at all distances," says a surgeon from North Carolina. "But [to improve it] I [would] decrease glare." A surgeon from Missouri feels similarly, saying, "The lens's rings sometimes give glare." A Rhode Island surgeon also says there's some room for improvement. "My current [PanOptix] patients get good uncorrected distance and near vision," he says. "But it could be improved by changing material, e.g., Clareon."

"[PanOptix] gives good overall good range of vision up to 18 inches," says a surgeon from Michigan. "I would like fewer halos."

This article has no commercial sponsorship.

1. Preferred Non-Premium IOL for Most Cases



Another surgeon says he "still can't predict perfectly which patients may be unhappy with glare/halos."

For the surgeons who currently use the Symfony for most of their premium, presbyopia-correcting IOL cases, they say they're satisfied with the results, for the most part.

"Excellent quality of vision is maintained, and rings and halos are minimal," says one surgeon. "The lens is tolerant of residual refractive error and, with proper patient education and selection, these are very happy patients." One surgeon from Texas says he has "no issue with IOL material, glistenings, etc." Ron Glassman, MD, Teaneck, New Jersey, says the Symfony yields "few dysphotopsias, but weak reading." A surgeon from Washington agrees, saying, "It could use improvement in very-small-print near vision."

Hazard, Kentucky, ophthalmologist Syam Reddy primarily uses the Symfony, but says, "Not all the patients are happy. Sometimes I do not get the 'Wow' response."

In the Crystalens camp, a surgeon from Colorado says, "The lens doesn't accommodate 3 D, but it's the best overall for optical quality and contrast."

To try to optimize their results with presbyopia-correcting IOLs, 24 percent of the respondents say they "mix and match" lenses (i.e., they use a different lens in each eye of the patient in an effort to have one lens make up for the shortcomings of the other).

"I'll mix the toric version with the non-toric version—but both are the same platform," says Abram Geisendorfer, MD, of Quincy, Illinois.

William Lipsky, MD, of Houston, says, "I most often [combine] the ZKB00 and ZLB00, sometimes with a ZXR00. Now that the toric versions are available, it might be ZLB00 with ZCB00 or a ZXT."

A surgeon from Iowa is thinking along the same lines when he says, "[I combine] the Tecnis Symfony and Tecnis MF +3.25 D. These lenses balance each other's strengths/weaknesses well."

Looking down the road, as alluded to earlier, a good size portion of the respondents who don't currently implant premium lenses say the lens they're interested in trying is the PanOptix (30 percent) or PanOptix Toric (26 percent). Seventeen percent of the surgeons say they'd try the Symfony and 6 percent will give the RxSight light-adjustable IOL a try. Eleven percent of surgeons, however, don't plan on using presbyopia-correcting lenses.

One surgeon from California says she's thinking of giving the PanOptix a try. "It supposedly gives good vision at intermediate and near," she says.

"The PanOptix gives the best range of vision plus toric correction," says Jonathan Macy, Los Angeles, laying out the reasons he would give the lens a try.

Teaneck's Dr. Glassman is eyeing the Symfony. "It stays clear, and [poses] the least risk," he says. One surgeon says he's considering implanting the Tecnis multifocal 3.25 D because it seems to have "few long-term issues."

Eschewing today's technology, some surgeons are looking ahead to the approvals of lenses currently in development. "Indeed [I'd use] a Synergy IOL [Johnson & Johnson Vision]," says one surgeon. Another physician simply says he'll use "The Vivity [Alcon]."

One surgeon from California, though, representing the 6 percent who don't want anything to do with presbyopia-correcting IOLs, says, "[With presbyopia-correcting IOLs] there are too many patients who are unhappy after paying a lot of money."

Bread-and-Butter: Monofocals

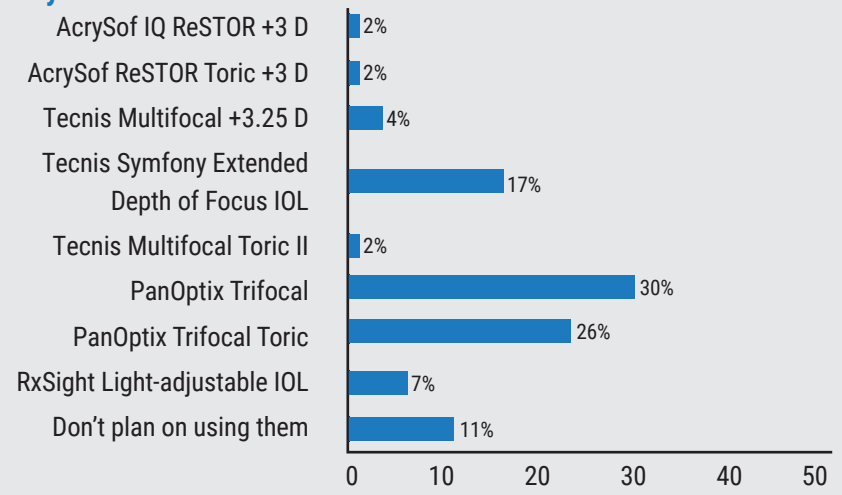
Though premium IOLs are an intriguing wrinkle in IOL design to discuss and speculate about, the lenses surgeons use for most of their cases are monofocal IOLs.

This year, the two most popular monofocal lens choices on the survey are the Alcon IQ Aspheric (43 percent) and the Johnson & Johnson Vision Tecnis 1-piece (36 percent). The Bausch + Lomb enVista was next, chosen by 8 percent of surgeons.

"I like the long-term success, stability and visual results [of the IQ Aspheric]," says St. Louis' Richard Wieder, MD. "I dislike [the] mild issues with glistenings." A surgeon from Michigan says he likes "the yellow tint, stability, asphericity and controlled unfolding…. I don't like the lack of a pre-loaded version."

"I like the better visualization around the edge of the optic if the patient needs subsequent pars plana vitrectomy," says a surgeon from South Carolina. A surgeon from

2. If Surgeons Start Using Premium Lenses, Which Lens Will They Start With?



Washington adds that, "I like how it slowly opens in the eye giving me time for perfect positioning."

A surgeon from Texas says he prefers the Tecnis 1-piece for its "ease of use, no glistenings, predictable results, excellent quality of vision and minimal dysphotopsias in my experience—'20/Happy' patients!" Regarding the Tecnis, another surgeon says, "Like: super clear optics. Don't like: aberrations; sticky haptics (i.e., haptics stick to the IOL and routinely need manipulation to deploy)."

Toric IOLs

Surgeons have more options for alleviating patients' astigmatism than ever before. Here are their current favorite modalities:

In the study, 35 percent of the surgeons prefer the AcrySof monofocal toric. Next is the new Tecnis Toric II, at 27 percent. The PanOptix Trifocal Toric is the preferred toric IOL for 19 percent of the respondents, and the Symfony Toric was chosen by 11 percent. The rest of the results appear in graph 3.

A Michigan surgeon who uses the AcrySof monofocal toric says, "This toric IOL using the ORA [intraoperative aberrometry] is very predictable in my hands."

"The Tecnis Toric II works well, with almost no rotation, gives great results and very predictable outcomes," says a surgeon from Texas.

A surgeon from Florida literally has a love/hate relationship with the AcrySof monofocal toric. "I hate glistenings," he says, "but I love the lens stability."

Phakic IOLs

Only 16 percent of the surgeons on our survey say they implant phakic IOLs, and all of them use the Staar Visian ICL (available in both toric and non-toric versions). Though they appreciate the benefits the lenses bring to select patients, they say there's room for improvement, as well.

"When they work, they're very good," says Dr. Lipsky. "But I can't wait for the improved version with fenestrations to eliminate PIs." Another surgeon says, "They're a great choice for patients who can't opt for corneal refractive surgery." Atlanta's Trevor Woodhams, MD, sees both the advantages and limitations of the devices, saying, "It's a good technology, but too expensive for patients. They're excellent for high myopes and 'funny' corneas. They're still too difficult to size prospectively, however."

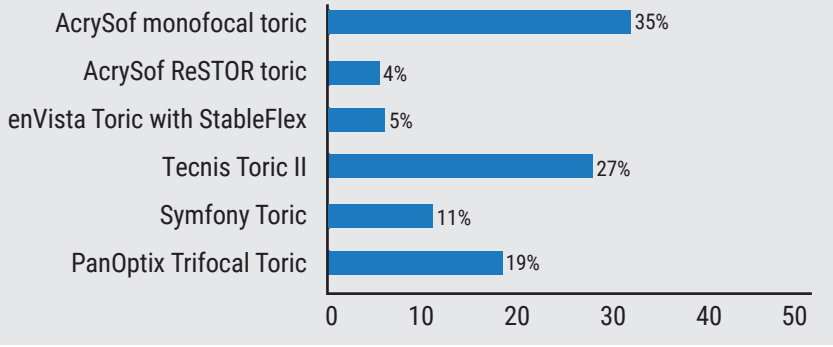
Managing Problems

Surgeons also weighed in on the nature and frequency of dislocated IOLs that require suturing.

Over the span of a year, 63 percent of the respondents say they never have to suture an IOL, 29 percent say they have to suture one to three lenses, 5 percent suture four to six and 3 percent suture seven to 10.

One surgeon says the main reason for suturing is often "previous surgery leaving questionable capsular/zonular integrity," and he sutures the lens either to the iris or the sclera with intrascleral haptic fixation. A surgeon from Virginia says, "I only suture an existing, dislocated lens, usually to iris." Dr. Lipsky uses the Yamane technique. "[The suture location is the] iris, mostly for dislocated IOLs," he says. "I use the Yamane technique without a suture most often."

3. Preferred Toric IOL



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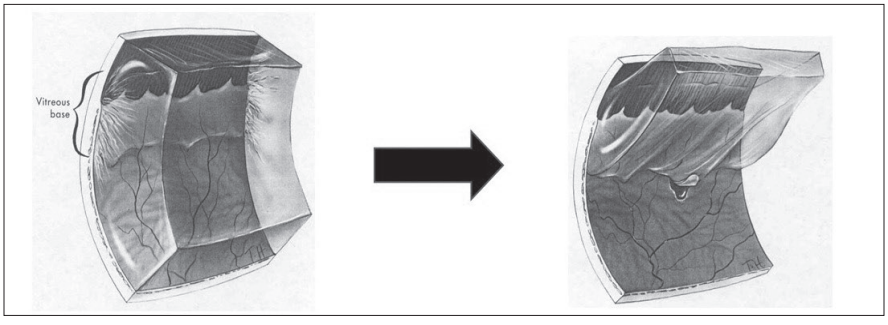
A SERIAL APPROACH TO RRD REPAIR

A surgeon discusses his approach to retinal detachment repair and why it works for him.

BY WILLIAM H. ROSS, MD, FRCSC
VANCOUVER, BRITISH COLUMBIA

In any surgery, the goal should be to perform the least invasive procedure to repair the pathology and to avoid intraoperative and postoperative complications. In this article, I'll review the current methods of rhegmatogenous retinal detachment repair, which include pneumatic retinopexy, scleral buckling and pars plana vitrectomy, and I'll discuss the University of British Columbia approach to detachment surgery.

I've been involved in the training of 60 vitreoretinal fellows, including 29 from the United States, 11 from Canada and 12 from Australia. By teaching all three methods in our vitreoretinal fellowship, we ensure that our graduate surgeons will be well equipped to address the many varieties of detachments with the appropriate procedure and achieve the best anatomic and visual results.



All images: William H. Ross, MD

Figure 1. Illustration of a retinal break at the posterior margin of the insertion of the vitreous base.

The UBC Serial Approach

In our fellowship training program, we teach a serial approach to the repair of RRD. We start by teaching the indications and benefits of the least invasive procedures, i.e., PnR and SB, and proceed with the indications and benefits of the more invasive PPV surgery.

The development of small-gauge vitrectomy units with high-speed cutters, wide-angle viewing systems, the use of intraocular gases SF6 and C3F8 and perfluorocarbon liquid has revolutionized the repair of RRD and led to the misconception that PnR and SB surgery are no longer necessary in the management of RRD.

Many fellowship training programs in the United States, Europe and Australia no longer teach PnR and SB surgery, despite the fact that studies have shown that the anatomic and visual results of these procedures are better than PPV surgery, especially in young, phakic patients.[1,2] These programs teach only PPV surgery in the management of RRD and accept the complication of cataract formation within one to two years and its sequelae.[3,4,5]

I feel strongly that teaching PnR and SB surgery should be an integral part of any vitreoretinal fellowship training program. In this article, I'll

This article has no commercial sponsorship.

Dr. Ross is a clinical professor of ophthalmology and the co-director of the vitreoretinal fellowship program at the University of British Columbia, Vancouver. He has no financial disclosures related to any product mentioned in the article.

outline the indications and techniques of PnR, SB and PPV surgery and discuss the complications of PPV surgery in phakic patients.

Lens Status and Age of Patients Who Present With RRD

It's important for the vitreoretinal surgeon to realize that the majority of patients who present with retinal detachments are phakic. The Netherlands study of 2,998 cases revealed that a full two-thirds, or 66.5 percent, of patients who presented with retinal detachments were phakic. It also demonstrated that the age of patients with detachments ranged from 55 to 59 years.[6] Since PnR and SB surgery don't result in cataract formation, they should be considered as the first options in the repair of RRD.

UBC Serial Approach to RRD Repair

1 ***Pneumatic retinopexy.*** PnR is the least invasive surgery and is especially suitable for phakic patients. It's performed using topical anesthesia in the office or in an outpatient setting. The procedure usually takes between 15 and 20 minutes. Approximately 40 percent of patients who present with RRD can be managed with PnR surgery.[7]

Indications. RRDs that involve the superior retina—i.e., between the 8 and 4 o'clock positions—have one to two breaks no farther apart than one clock hour and have no evidence of fixed retinal folds, holes with rolled edges or vitreous hemorrhage are especially suitable for PnR surgery.

Mechanism of repair. The buoyancy and surface tension of the gas bubble closes the retinal tear and allows the pigment epithelial layer to absorb the subretinal fluid. This method of repair allows the neurosensory retina to slowly reattach to the pigment epithelial layer, resulting in a high-integrity retinal attachment. (This concept will be discussed shortly.)

Preoperative discussion. Prior to performing the pneumatic procedure, we inform our phakic patients that there's a 70- to 75-percent chance, and our pseudophakic patients that there's a 60- to 65-percent chance, of surgical success. We also advise them that in phakic patients SB—and PPV surgery in pseudophakic patients—can also be used to repair the RRD. However, these procedures require hospital admission and are performed in the operating room.

Most patients will choose the first option of PnR. For those patients who choose not to proceed with an initial PnR surgery, we would schedule them for SB or PPV procedures. We would also advise against PnR surgery if the patient has to fly within seven to 10 days after the procedure.

Technique. First, perform a preoperative dilated fundus examination to ensure that the detachment meets the indications for PnR surgery.

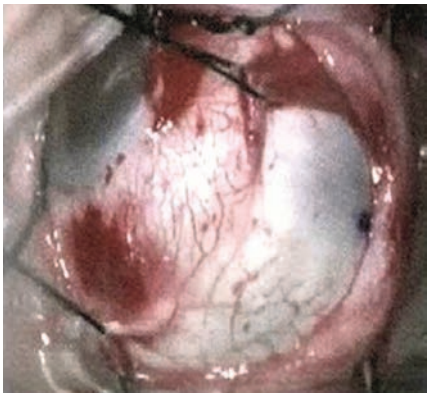


Figure 2. Mark the retinal tear identified with indirect ophthalmoscopy.

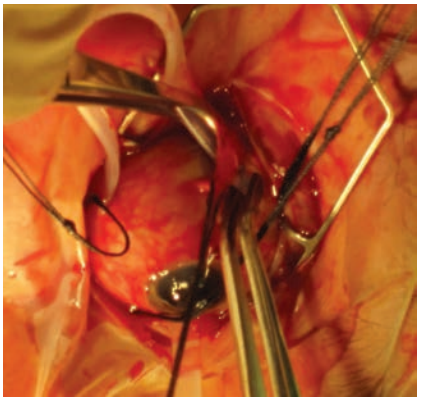


Figure 3. Place the thin 5-mm Ross 5 explant underneath the extraocular muscle.

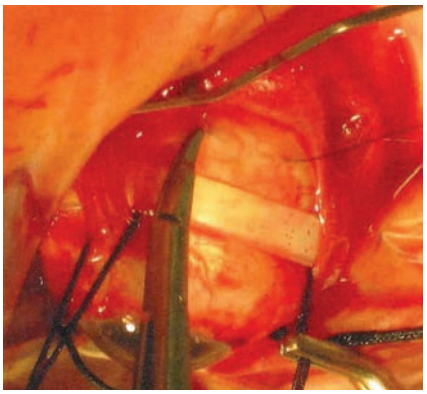


Figure 4. Make a long suture bite with 5-0 nylon.

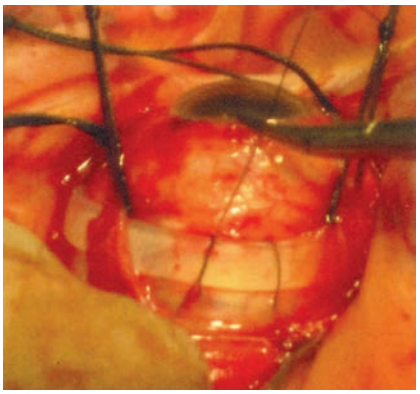


Figure 5. Tie the single mattress suture over the 5-mm band in the inferior quadrant. Sutures are placed 7 mm apart.

On the day of surgery, administer topical or subconjunctival anesthesia in the office or outpatient clinic. Next, perform cryopexy of the retinal tear (postoperative laser treatment is also an option). Create an anterior chamber paracentesis to release 0.2 to 0.3 cc of aqueous fluid. After the paracentesis is created, inject 0.5 to 0.6 cc of SF6 gas through the pars plana into the vitreous cavity. Position the patient so that the gas bubble will tamponade the retinal tear.

Result. As noted earlier, in phakic patients, we anticipate a 70- to 75-percent success rate. In pseudophakic patients, we anticipate a 60- to 65-percent success rate.[8,9]

Complications. Failure to flatten the retina occurs in approximately 25 to 35 percent of patients. Causes of failure include the inability of

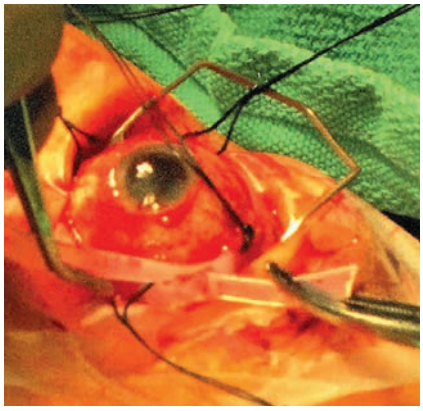


Figure 6. Place the silicone sleeve over the encircling bands and then enclose the silicone explant with a silicone sleeve. The sleeve encloses but does not tighten the band to avoid myopia.

the patient to position properly, the development of a new retinal tear as the gas bubble expands and residual persistent traction on the original tear after the gas bubble resorbs. After these initial failures, a subsequent SB procedure in a phakic patient would be performed with an anticipated reattachment rate of 92 to 94 percent. In the 6 to 8 percent of SB failures in phakic patients, a subsequent PPV would result in a final reattachment rate of 98 to 99 percent. In pseudophakic patients who don't respond to a PnR, a subsequent PPV would also result in a final reattachment rate of 98 to 99 percent.

It's important to note that an initial PnR failure has no adverse anatomic or visual effects on subsequent SB or PPV surgery.

Comments. The PIVOT Study by Roxane J. Hillier, MD, and her colleagues compared PnR surgery with PPV in the management of 176 phakic patients. At 12 months, a primary anatomic success rate was achieved in 80.8 percent of patients undergoing PnR versus 93.2 percent of PPV patients (p=0.045). Final anatomic success was 98.7 percent in the PnR group and 98.6 percent in the PPV group. Final visual acuity after one year was 20/40 in 90.3 percent of the PnR group compared to 75.3 percent in the PPV group. More importantly, 65 percent of phakic patients in the PPV group, as opposed to 16 percent in the PnR group, underwent cataract surgery within 12 months (p<0.001).[2]

A more recent, retrospective study by Rajeev Muni, MD, and colleagues involving 238 cases used fundus autofluorescence images to detect retinal vessel displacement in patients who had undergone PnR and PPV surgery. Retinal vessel displacement occurred in only 15 percent of patients undergoing PnR, compared to 42 percent of patients undergoing PPV.[10]

This study may explain the better postoperative vision in non-drainage PnR surgery. In PnR surgery a higher-integrity retinal reattachment is achieved by the retina being re-apposed as close as possible to the original location with no retinal vessel printing shown on fundus autofluorescence imaging. This presumably indicates alignment of the photoreceptors closer to their specific retinal pigment epithelial cell and therefore better final visual acuity.

2 ***Scleral Buckling.*** Scleral buckling surgery is the ideal procedure for phakic patients. Two-thirds of patients who present with RRD are phakic with an average age between 55 and 59 years.

SB surgery is an external procedure performed in the operating room using retrobulbar anesthesia. Since local retrobulbar anesthesia is used, the globe is made more accessible for placement of the silicone explant and the scleral sutures. The patient doesn't feel any pain during this procedure, which takes approximately 30 to 40 minutes.

A surgical innovation: The 5-mm encircling silicone band. The vast majority of retinal tears are 1 to 3 mm in size and occur at the posterior margin of the insertion of the vitreous base, i.e., 3 to 4 mm from the ora serrata (*Figure 1, page 44*). Therefore, a scleral buckle that covers 5 to 7 mm of peripheral retina will close most retinal tears.

In 2003, I developed a 5-mm-wide, 0.75-mm-high encircling band to manage RRD (Ross 5; MIRA Inc., Uxbridge, Mass.) and its compatible sleeve (Ross 75R; MIRA Inc.). The advantages of this explant are as follows: It's thin and therefore easy to place around the globe for 360 degrees under local anesthesia. Because of its thinness, it doesn't disturb extraocular muscle function and there's no postoperative diplopia. There's little, if any, induction of myopia since the band is enclosed—not tightened—by a silicone sleeve (Ross 75R). There's little chance of infection or rejection since the band is well-covered by Tenon's capsule and conjunctiva at the end of the

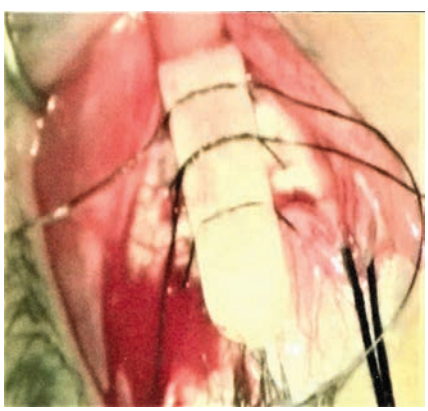


Figure 7. Place two vertical mattress sutures 7 mm apart to secure the one-half-thickness 5-mm radial sponge.

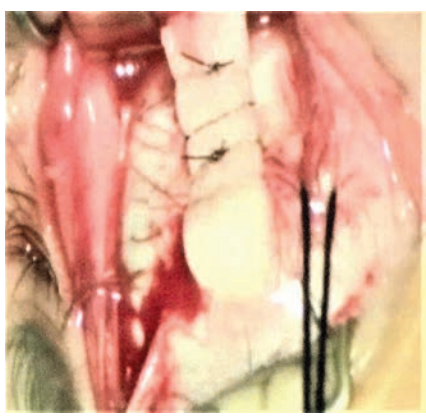


Figure 8. Tie the 5-0 nylon mattress sutures over the radial sponge before trimming the ends.

FOR MOST PATIENTS, DRY EYE SYMPTOMS HAVE AN EPISODIC IMPACT

FLARES: THE SPEED BUMPS OF DRY EYE

Most patients with Dry Eye suffer from short-term, episodic exacerbations—***Dry Eye Flares.***[1-3]

Many patients don't suffer from continuous symptoms.[3]

REENVISION DRY EYE

kala PHARMACEUTICALS

References: 1. Brazzell RK, Zickl L, Farrelly J, et al. Prevalence and characteristics of dry eye flares: a patient questionnaire survey. Presented at: AAO 2019: October 12-15, 2019; San Francisco, CA. **2.** Brazzell RK, Zickl L, Farrelly J, et al. Prevalence and characteristics of symptomatic dry eye flares: results from patient questionnaire surveys. Poster presented at: AAOPT 2019: October 23-27, 2019; Orlando, FL. **3.** 2020 Study of Dry Eye Sufferers. Conducted by Multi-sponsor Surveys, Inc.

Table 1. Retina Society Terminology for PVR (1983)

Grade	Clinical signs
A (minimal)	Vitreous haze and pigment clumps
B (moderate)	Retinal surface wrinkling, rolled edges of the retina, retinal stiffness and vessel tortuosity
C (marked)	Full-thickness fixed retinal folds in one quadrant (C-1) two quadrants (C-2) three quadrants (C-3)
D (massive)	Fixed retinal folds in four quadrants

procedure. Postoperatively, there's little, if any, pain.

The encircling explant will close the original tear(s), relieve vitreoretinal traction for 360 degrees and prevent the formation of new retinal tears, which could lead to redetachment. Because of these properties, the Ross 5 band has become very popular as an explant in SB surgery in Canada, the United States, Europe and Australia.

Indications. The indications for SB surgery are as follows:

1. Patients who are suitable but refuse PnR surgery. This could be due to an inability or unwillingness to position for three to four days following gas bubble injection; anxiety; or systemic conditions such as obesity or arthritis.

2. Patients with superior retinal breaks that are too far apart to be treated with a PnR procedure, e.g., breaks at the 10 o'clock and 2 o'clock positions.

3. Failed PnRs, due to the development of new inferior retinal breaks.

4. Inferior retinal detachments, especially in high myopes, which represent 35 percent of detachments.[11] These detachments are often secondary to retinal breaks at the lateral or posterior margins of lattice degeneration.

5. Detachments secondary to traumatic retinal dialysis. These types of detachments occur mainly in young males as a result of trauma. In 1981, I reported on 50 cases of traumatic retinal dialysis managed with SB surgery with a 98-percent success rate.[12,13]

6. Retinoschisis retinal detachments. In these cases small inner retinal breaks near the vitreous base develop as a result of an acute posterior vitreous detachment. These anterior inner-layer breaks allow liquid vitreous to gain entry into the retinoschisis cavity, pass through the outer retinal breaks and lead to neurosensory detachments. An encircling 5-mm band will close the small anterior retinal breaks and repair the detachment.

Mechanism of repair. The silicone band indents the sclera and approximates the retinal tear to the pigment epithelial cells. This indentation results in a relief of vitreous traction on the retinal tear and allows the retinal pigment epithelial layer to absorb the subretinal fluid. External drainage of subretinal fluid isn't necessary. If the 5-mm explant has been properly positioned to close the retinal tear, the fluid on the buckle and posterior to it will slowly resorb over two to three days.

Technique. SB surgery is an external procedure, except for anterior chamber paracentesis and possible drainage of subretinal fluid. In approximately 60 to 70 percent of cases, SB surgery can be carried out using an encircling band without drainage of subretinal fluid.

Prior to performing SB surgery, a peripheral retinal examination with 360-degree scleral depression must be carried out to identify all retinal tears and to identify and grade possible proliferative vitreoretinopathy (PVR) (*Table left*).

On the day of surgery, administer retrobulbar anesthesia. Open the conjunctiva for 360 degrees and hook the recti muscles with 3-0 silk sutures. Perform indirect ophthalmoscopy to identify and mark all retinal breaks (*Figure 2*), and then perform cryopexy of retinal tear(s). (Postoperative laser can also be used.)

Once the breaks are treated, place the encircling Ross 5 explant beneath the recti muscles for 360 degrees (*Figure 3*). Place a single 5-0 nylon mattress suture in each of the two inferior quadrants. These sutures are spaced 7 mm apart to cover the 5-mm band. The anterior scleral suture is placed 2 mm posterior to the ora serrata (line of muscle insertion) and the posterior suture is placed 7 mm posterior to the anterior bite. If the retinal tear is found to be more posterior, then the sutures are retro-placed 7 mm apart. We teach fellows to use long suture bites with 5-0 nylon so that when the suture is tied there's less shredding of the sclera (*Figure 4*). Tie the 5-0 nylon mattress sutures in the two inferior quadrants (*Figure 5*).

Next, perform an anterior chamber paracentesis. Place and tie a single 5-0 nylon mattress suture in each of the two superior quadrants. Use 2 to 3 mm of the Ross 75R silicone sleeve to enclose—not tighten—the explant to avoid myopia (*Figure 6*) and remove the 3-0 silk sutures.

Finally, close Tenon's capsule and conjunctiva with 7-0 vicryl or 6-0 plain gut, and perform indirect ophthalmoscopy to check for central retinal artery pulsations. If indirect ophthalmoscopy reveals a lack of pulsations in the central retinal artery, perform a second anterior chamber paracentesis.

We prefer non-drainage SB surgery. As noted earlier, this applies to approximately 60 to 70 percent of our phakic retinal detachments. As

in PnR procedures, this approach results in a slower re-apposition of the neurosensory retina to the pigment epithelial layer and a final, better postoperative visual acuity due to a higher-integrity retinal reattachment.

Patients who present with phakic detachments and associated PVR grades B, C-1 or C-2—i.e., retinal tears with rolled edges or fixed folds in one or two quadrants—are also candidates for SB surgery. For these detachments we can use a 5-mm encircling band or a 6- to 7-mm biconvex solid silicone explant. If a segmental buckle is used, two mattress sutures are placed 7 to 8 mm apart over the solid silicone explant in each quadrant. We then place a 2-mm encircling band through the groove in the explant, pass it around the globe and tie it with one mattress suture in each quadrant. Subretinal fluid is drained beneath the scleral explant and away from any retinal tears. This is followed by the injection of filtered air or balanced salt solution to maintain globe volume and prevent postoperative myopia. Again, just as in the other procedure, the 2-mm encircling band is enclosed in a sleeve without tightening the ends of the band to prevent myopia.

Patients with a posterior equatorial retinal break. These cases are managed differently. Radial sponges are especially suitable for closing the posterior break in these cases. Using two vertical mattress sutures, the radial sponge is sutured in the same meridian as the posterior equatorial retinal tear (*Figures 7 and 8*), supporting the tear and closing it nicely. There's no fish-mouthing of the retinal break, as would occur if a circumferential element was used to close the posterior retinal break. We use half-thickness 5- to 7-mm radial sponges with tapered ends. The sutures are placed 7 to 9 mm apart, depending on the size of the retinal tear. The sponge is then covered completely with Tenon's capsule and conjunctiva. If the sponge is well-covered, the risk of infection or rejection is very small.

In 1977, I reported on 100 cases of radial sponges used in retinal detachment surgery. The success rate was 94 percent. In two cases, there was rejection of the radial sponge.[14]

Complications. SB surgery has two major complications. The first is a failure of reattachment due to PVR grades C-1 to C-3. (Subsequent PPV surgery would result in a reattachment rate of 98 to 99 percent.) Second, subretinal hemorrhage or retinal incarceration can occur following drainage of subretinal fluid.

Comments. In my experience, the anatomic and visual results of SB surgery are equal to or better than PPV in the repair of phakic detachments. A prospective, randomized, multicenter clinical study reviewed the management of RRD in phakic patients and reported single-operation success rates of 63.6 percent and 63.8 percent, respectively, for SB and

A Summary of My Approach

During my 38 year-surgical career, I've performed 6,216 scleral buckling procedures and 2,687 combined pars plana vitrectomy and scleral buckling procedures. My approach to the management of rhegmatogenous retinal detachment consists of:

1. Pneumatic retinopexy. Since 40 percent of patients who present with RRD meet the criteria for PnR, and since there's a 75-percent success rate, 30 percent of all patients who present with RRD can be managed successfully with this simple out-patient procedure. This relieves a great burden of operating room surgery.

2. Scleral buckle. I use scleral buckling surgery on all phakic patients, with an expected success rate of 92 percent. In 60 to 70 percent of these detachments, I don't drain subretinal fluid. The 8 percent who fail then undergo PPV, with a final success rate of 98 to 99 percent.

3. Pars plana vitrectomy. I use PPV in phakic patients with giant retinal tears or vitreous hemorrhage, in pseudophakic patients with mild PVR and vitreous hemorrhage, and in those who refuse PnR surgery.

4. Combined SB/PPV. This is performed on patients who present with RRDs with severe PVR grades C-2, C-3 and D, and in failed SB surgery.

PPV in phakic detachments.[1] In our hands we anticipate a single operation success rate of more than 90 percent for both SB and PPV surgeries.

We recently reviewed the management of RRD in 100 phakic patients in our department who underwent SB surgery without drainage of subretinal fluid.[15] In 67 patients, an encircling 5-mm Ross band was used. In 19 cases a 6-mm silicone explant with a 2-mm encircling band was used, and in 12 cases, a radial sponge was used. The primary anatomic success rate was 97 percent and the final success rate was 100 percent, following secondary PPV surgery.

In combined macula-on and macula-off detachments, the average postoperative vision was 20/40. In the macula-off detachments, 60 percent of patients regained 20/50 or better vision and 29 percent achieved 20/30 or better vision.

In reviewing the literature of macula-off detachments, a visual recovery of 20/50 or better is only obtained in 40 percent of cases.[16] We feel strongly that our higher final vision was due to the high-integrity retinal reattachment resulting from slower re-apposition of the neurosensory retina to the pigment epithelial layer.

3 ***Pars plana vitrectomy.*** In our department, we perform primary PPV in approximately 30 percent of our RRD cases.

Indications. These include:

1. phakic elderly patients with moderate cataracts;
2. phakic patients who present with giant retinal tears;
3. phakic and pseudophakic patients with vitreous hemorrhage that obscures a view of the peripheral retina;
4. pseudophakic patients with tears not suitable for PnR;
5. pseudophakic patients with mild PVR, i.e., grades A, B; and
6. failed PnR procedures.

Mechanism of repair. The retina is reattached by removing the vitreous with high-speed cutters, draining subretinal fluid through a peripheral break, flattening the retina with an air-fluid exchange, and lasering the retinal tears and the peripheral retina, followed by gas-air exchange.

Technique. First, a core vitrectomy is performed and the remaining vitreous is then stained with Kenalog or Triesence. This residual vitreous is then removed with peripheral shaving, aided by scleral depression, and the retinal tears are marked with endodiathermy. At this point, you can use microforceps to strip membranes from the retina surfaces, if necessary.

Then, using active suction, subretinal fluid is drained through an existing peripheral retinal tear as an air-fluid exchange is carried out. This results in flattening of the retina. Endolaser is then applied around the retinal tear(s), and three rows of laser are applied to the peripheral retina for 360 degrees. Finally, SF6 or C3F8 air exchange is performed.

Although perfluorocarbon liquid can also be used to flatten the retina from the posterior pole to the ora serrata, this is not our preferred technique.

4 ***Combined vitrectomy and scleral buckling procedures.*** This approach is used in approximately 20 percent of our RRDs.

Indications. These include:

1. phakic patients with severe PVR grades C-2, C-3 and D—i.e., fixed folds in three or more quadrants;
2. phakic patients with vitreous hemorrhage that obscures a view of the peripheral retina;
3. giant retinal tears where the buckle is used to support the lateral horns of the tear; and
4. failed SB procedures. In these cases we apply three rows of laser on the buckle for 360 degrees at the end of the procedure.

Rationale. The encircling 5-mm band is placed around the globe to relieve vitreous traction on the peripheral retina before proceeding with PPV.

Technique. Place the 5-mm band around the globe with one mattress suture in each quadrant. Enclose the band in a silicone sleeve. Proceed with PPV as outlined above. Place three rows of laser photocoagulation on the buckle at the end of the procedure.

Recent studies have shown that a combined SB and PPV surgery results in a higher anatomic success

rate than PPV surgery alone.[17]

Complications. The complications of vitrectomy surgery in phakic patients include:

1. Progression of lens opacities, requiring cataract surgery within one to two years.
2. Loss of accommodation following cataract surgery.
3. In myopic patients (35 percent of RRD),[16] anisometropia following cataract surgery. This would require the patient to wear a contact lens or undergo clear lens extraction in the fellow eye.
4. An increased stimulus for postoperative PVR. PPV is an invasion of the vitreous.
5. Restriction of air travel due to gas expansion and elevated IOP following PPV surgery.

In conclusion, approximately 50 percent of all patients who present with RRD meet the criteria and can be successfully repaired with PnR or SB surgery. I strongly believe that these procedures are the treatments of choice to manage RRD, especially in phakic patients. Primary PnR and SB surgery produce equal or better anatomic and visual results compared to PPV surgery, without the complication of cataract formation and its sequelae.

1. Heinmann H, Bartz-Schmid KU, Bornfeld N, et al. Scleral buckling versus primary vitrectomy in rhegmatogenous retinal detachment: A prospective randomized multicenter clinical study. Ophthalmol 2007;114:4:2142-54.
2. Hillier RJ, Felfeli T, Berger AR, et al. The pneumatic retinopexy versus vitrectomy for the management of primary rhegmatogenous retinal detachment outcomes randomized trial (PIVOT). Ophthalmol 2019;126:4:531-9.
3. D'amico DJ. Different preferences between United States and European vitreoretinal surgeons: Personal observations. Curr Opin Ophthalmol 2016;27:3:196-200.
4. Hwang JC. Regional practice patterns for retinal detachment repair in the United States. Am J Ophthalmol 2012;153:1125-8.
5. Jackson TL, Donachie PHJ, Sallam A. et al. United Kingdom National Ophthalmology Database Study of vitreoretinal surgery: Report 3, retinal detachment. Ophthalmol 2014;121:643-8.
6. Van de Put M, Hooymans J, Los L, et al. The incidence of rhegmatogenous retinal detachment in the Netherlands. Ophthalmol 2013; 120:3:616-22.
7. Brinton DA and Wilkinson CP. Pneumatic retinopexy and alternative retinal detachment techniques. In: Ryan SJ, ed. Retina, vol. 3. St. Louis: Mosby, 2001:2047-62.
8. Hilton GF and Grizzard WS. Pneumatic retinopexy: A two-step outpatient operation without conjunctival incision. Ophthalmology 1986;93:5:626-41.
9. Tornambe PE, Hilton GF, Brinton DA, et al. Pneumatic retinopexy: A two-year follow-up study of the multicenter clinical trial comparing pneumatic retinopexy with scleral buckling. Ophthalmol 1991; 98:1115-23.
10. Brosh K, Francisconi C, Qian J, et al. Retinal displacement following pneumatic retinopexy vs pars plana vitrectomy for rhegmatogenous retinal detachment. JAMA Ophthalmol 2020; 138:6:652-9.
11. Schepens C and Marden BA: Data on the natural history of retinal detachment. Am J Ophthalmol 1966;61:2:213-26.
12. Ross W. Traumatic retinal dialyses. Arch Ophthalmol 1981;99:1371-4.
13. Ross W. Retinal dialysis: Lack of evidence for a genetic cause. Can J Ophthalmol 1991;26:6:309-12.
14. Ross W. Radial sponges in retinal detachment surgery. Can J Ophthalmol 1977;12:4:268-74.
15. Ross W, et al. Modern techniques and indications for scleral buckling surgery. Submitted for publication.
16. Albert S, Smiddy WE, Venkatraman A and Feuer W. Visual recovery after scleral buckling procedure for retinal detachment. Ophthalmol 2006;113:10:1735-42.
17. Ryan EH, Joseph DP, Ryan CM, et al. Primary retinal detachment outcomes study: Methodology and overall outcomes—Primary retinal detachment outcomes study report number 1. Ophthalmol 2020;138:935-42.

GLAUCOMA POINT-COUNTERPOINT:
SUSTAINED-RELEASE DEVICES VS. TRADITIONAL DRUG REGIMENS

GET READY FOR A NEW DAY

Think of the tremendous benefits sustained-release therapy can provide now and in the future.

ANDREW CAMP, MD
SAN DIEGO

Are you wondering why you should use the new sustained-release bimatoprost implant for your glaucoma patients when you're permitted to use it only once, lowering intraocular pressure for no more than six months in many cases? When considering bimatoprost SR (Durysta), perhaps you wonder how beneficial it will be for patients on multiple topical medications? After the bimatoprost implant biodegrades and you need to replace it by returning to a bimatoprost drop, will it seem like taking a step backward after taking a step forward?

I know these questions have been on the minds of many of my colleagues since last March, when this formulation was approved by the Food and Drug Administration for the reduction of IOP in patients with open-angle glaucoma or ocular hypertension. In response to these questions, I suggest we look beyond the current limitations of bimatoprost SR and explore the long-range benefits of what is truly a tremendous breakthrough therapy: the first implantable, sustained-release treatment for our glaucoma patients. Here, I'll outline three major factors that support the use of sustained-release glaucoma medications—improving compliance, increasing efficiency of treatment and introducing a pathway for new medications—and I'll explain why sustained-release therapy will soon become as common as traditional medications.

Bimatopost SR Performanc

Bimatoprost SR, administered by intracameral injection, is composed of biodegradable polymers that gradually release bimatoprost over 90 days. I participated as an investigator in ARTEMIS I, one of two 20-month randomized, controlled Phase III clinical trials that involved 1,122 patients.[1] In the trial, patients were randomized in the study eye to a 10-µg implant (which was later FDA-approved) or a 15-µg implant; or to topical timolol maleate 0.5% delivered twice daily to the topically-treated eye. Patients randomized to the implant received one of the two different-size implants three times over a 32-week period.

After 12 weeks, the IOP-lowering effects of both implants were noninferior to timolol, post-administration. Mean diurnal IOP was 24, 24.2, and 23.9 mmHg at baseline and from 16.5 to 17.2, 16.5 to 17.0, and 17.1 to 17.5 mmHg through week 12 in the 10-µg implant, 15-µg implant, and timolol groups, respectively.[2] Meanwhile, an earlier, Phase I/II APOLLO trial involving 75 patients who received 6-, 10-, 15- or 20-µg bimatoprost SR implants, compared to bimatoprost drops, produced similarly beneficial results.[3]

Even though bimatoprost SR was approved for one-time use, most of us involved in the FDA trials hope increased use of the implant and additional studies will lead to expanded approvals. Corneal endothelial cell loss and treatment-associated inflammation, most prevalent after 15-µg injections, appear to have motivated the FDA to stick to its limited approval for the time being. Ongoing Phase IV trials should shed

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This article has no commercial sponsorship.

Dr. Andrew Camp is an assistant professor of clinical ophthalmology at the Shiley Eye Institute and Hamilton Glaucoma Center, University of California, San Diego. He is also an Allergan study investigator, but has no other relevant financial relationships.

GLAUCOMA POINT-COUNTERPOINT:
SUSTAINED-RELEASE DEVICES VS. TRADITIONAL DRUG REGIMENS

STICK WITH WHAT WORKS

We absolutely must continue drug development, or we're doing our patients a disservice.

PREETHI GANAPATHY, MD, PHD
SYRACUSE, N.Y.

Eye drops are no fun. They're a bane for every glaucoma patient, certainly, but drops are a form of treatment that we, as physicians, know work. We have years of data showing that they prevent glaucomatous vision loss.

I often tell my patients that you have to look at the long game. As a patient, you may be feeling irritation from putting your drops in your eye or from having to use an alarm clock on your phone to remember to take your eye drops two or three times a day. I'm looking ahead to 10 years from now and saying, "What is your visual field going to look like compared to what it could look like if we don't use these drops?" Now, I definitely think that we as physicians who take care of patients with glaucoma are excited about the introduction of any sustained-release device that can relieve treatment burden from patients. But the question is: For whom should we provide sustained-release treatment and when is the right time? I am going to argue that the answer is not so clear-cut.

Drawing on the treatment philosophy I follow in my glaucoma specialty practice, and established medical evidence, I'll weigh in on why I think traditional eye drops still come out on top when compared with sustained-release therapy.

Drugs Work

We know drugs. Numerous randomized, prospective studies show that eye-drop therapy prevents structural and functional loss in glaucoma, with many years of follow up. We start eye drops because we know that the data supports their use long-term. So why consider a change? The most significant barriers to our medical treatment of glaucoma are adherence issues, patient burden and ocular surface side effects.

As a community, we're eager to offer our patients an alternative way to preserve vision—one that doesn't involve an alarm on a cell phone to remain compliant. So, the question in this point-counterpoint is not, "Will I continue using eye drops in my practice"—of course you will! Rather, "Is it the right time to adopt sustained-release implants and, if so, for whom?"

Drug Development

We absolutely must continue drug development, or we're doing our patients a disservice. The standard of care for glaucoma treatment has been essentially binary: topical eye drops or glaucoma lasers/surgery. Historically, most ophthalmologists have begun treatment with a topical prostaglandin analogue or beta-blocker, followed by the more burdensome alpha-agonists and carbonic anhydrase inhibitors, which are administered multiple times daily.

Just in the last decade, our treatment options have increased exponentially—and this is exciting! We've seen the efficacy of two new classes of glaucoma medications: the rho-kinase inhibitors (Rhopressa, netarsudil ophthalmic solution 0.02%; Aerie Pharmaceuticals) and nitric-oxide donating prostaglandin analogues (Vyzulta, latanoprostene

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This article has no commercial sponsorship.

Dr. Ganapathy is an assistant professor of ophthalmology and visual sciences at the Center for Vision Research, SUNY Upstate Medical University, Syracuse, N.Y. She reports no financial relationships.

Point: Get Ready for a New Day

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more light on the efficacy and safety profile of the 10-µg implant.

We see potential for the implant to be effective for far longer than the initially planned 90-day drug elution window. For example, 30 percent of eyes treated once with bimatoprost SR 10-µg and 15- implants in the APOLLO Study didn't need to be rescued or treated for 24 months after one injection.

The IOP readings of bimatoprost SR and topical bimatoprost subgroups in this study were nearly matched in the 14-to-16-mmHg range and didn't start to separate significantly until month 24.

Improved Compliance

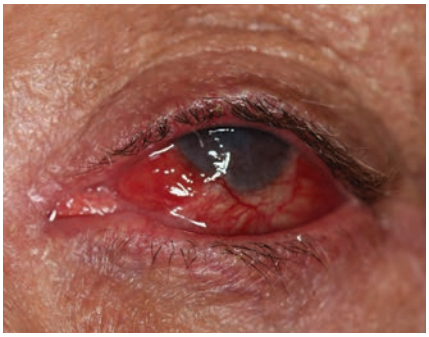
Why is the introduction of sustained-release medical treatment of glaucoma groundbreaking? Consider that one of the greatest barriers to topical medication use is the poor compliance of patients with topical therapy.[4,5] We know that the more patients need to use drops each day—both the number of times they need to put a drop in their eyes and the number of bottles they need to use—the more their compliance decreases. Implantable medication removes this barrier of non-compliance. In the retinal care arena, we've already seen improved outcomes in patients with the use of longer-acting anti-VEGF treatments or sustained steroid release agents, instead of monthly injections.[6] Hopefully, by increasing the length of time a medication is available through a sustained-release device for glaucoma patients, we'll achieve similar success.

Sustained-release medications will greatly benefit our patients, many of whom are on multiple medications. Patients taking multiple medications may need to devote up to an hour every day to the self-administration of their drops. As part of their regimens, they spend several minutes with their eyes gently closed, performing punctal occlusion, then need to wait an additional five to 10 minutes before their next drop. When they don't have enough time to wait because life gets in the way, they either skip their medications or use them so rapidly that the drops wash out, even more quickly than drops usually do. I know patients who have to use elaborate alarms and other systems to make sure they remember to take their medications at the right time. Sustained-release therapy, starting with bimatoprost SR, will give glaucoma patients taking multiple medications their time and lives back, and it will improve compliance.

More Efficiency

Besides improving compliance, sustained-release therapy makes treatment much more efficient. Keep in mind that when patients put glaucoma drops in their eyes, most of the medication gets washed into the tear ducts. As a result, maintaining a therapeutic drug level on the ocular surface for an extended period of time is extremely difficult. This is another factor that too often prevents patients from adequately managing their disease, leading to a poor prognosis in many patients diagnosed with glaucoma.[7]

One study found that the corneal bioavailability of topical ocular medication is less than 5 percent of the delivered amount.[8] Compared to topical dosing, bimatoprost SR was found to deliver concentrations of active drug that were 4,400-fold higher at the iris-ciliary body than concentrations produced by topical doses.[9] Besides acting directly on the tissue that needs to be targeted inside the eye, medication released by a sustained-release device can keep that medication active inside the eye for longer periods. This also means that much less medication is needed to achieve therapeutic effect. For example, a single bimatoprost SR implant has three orders of magnitude less medication than what's available in half of a 2.5-ml bottle of topical bimatoprost.



Andrew Camp, MD

Figure 1. This patient, who's been using five topical glaucoma medications for more than 20 years, could benefit substantially from sustained-release therapy, even if it provides relief from only one drop for six months, as would be the case for biomatroprost SR.

Other factors decrease the efficiency of topical medications. For example, many of our glaucoma patients are elderly and can't easily coordinate the self-administration of drops.[10] Some have tremors and miss their eyes. Others are inexperienced at self-administering the drops or have poor technique. Many have vision that's so poor that they can't see the bottle approaching their eyes. A lot of medication is wasted because of these issues, and that waste can be avoided with the use of sustained-release therapy.

Pharmacies are loath to dispense medications early, and insurances may not cover the cost of additional bottles of medication. This leads to treatment gaps for some patients who have difficulty with drops—gaps that can be avoided with sustained-release medications.

The efficiency of sustained-release implants may also allow us to explore new medication classes that would be even less reliant on patient compliance. Sustained-release delivery systems could allow for the use of medications that would otherwise require administration every two to three hours, such as cannabinoids.

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Counter: Stick with What Works
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bunod ophthalmic solution 0.024%; Bausch + Lomb).

Both offer the benefit of once-daily administration. Rho-kinase inhibitors are an entirely new class of drug that directly relaxes the trabecular meshwork and increases conventional outflow. Similarly, the nitric oxide donated by latanoprostene bunod has the potential to increase conventional outflow, in addition to the prostaglandin's ability to improve uveoscleral outflow. Moreover, recent trials have provided strong support for using selective laser trabeculoplasty as first-line therapy, and minimally invasive glaucoma surgeries present a compelling mechanism for lowering intraocular pressure in appropriate cases. Still, to this day, the workhorse of glaucoma treatment is topical ey- drop therapy—and we use it because we know it works.

Is It Our Time?

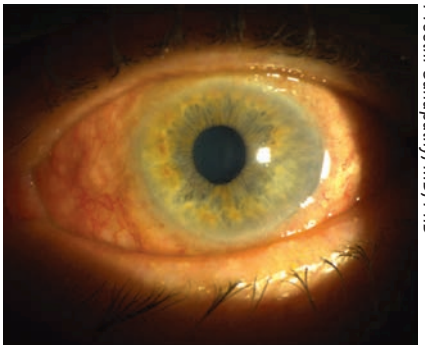
One thing I think about is that our retinal colleagues have used intravitreal injections and sustained-release treatment implants for a while now. So for those of us who treat glaucoma, the question has been: Where's our version of anti-VEGF?

Using drops multiple times per day is cumbersome, and there are variable effects if patients forget. As providers, we can't assess if a medication is working if the patient isn't taking it. I don't know how many times I've heard patients say, "I fall asleep at odd hours so I can't remember to take this drop." Or: "I can't take this drop. It's too hard." I tell them glaucoma is like a full-time job. "You have to remember to take these drops," I say. There's no glossing over the message. Granted, a few patients now and then will tell me they don't mind the drops. But I've never had a patient tell me, "Oh this is the best drop I've ever had!"

Pharmacologic therapy has to work hard to get from the ocular surface to the target tissues within the eye. The medication has to penetrate the cornea and maintain sufficient and sustained concentrations within the anterior chamber. The concentration of medication within a topical drop needs to be much higher than what actually gets into the eye. So, the surface side effects will be amplified for that reason. With sustained-release treatment, we can bypass some of these sources of patient burden.

Why Sustained-Release?

Sustained released implants include ocular inserts, therapeutic contact lenses, intraocular implants (subconjunctival, intracameral, and intravitreal), and punctal plugs.[1] Each of these has its own pros and cons. One expected benefit of the sustained-release treatments in development is that they will decrease drop frequency, sparing patients the challenge of remembering to take drops on time every day. But it's important to keep in mind that only injectable and intracameral implants promise to alleviate the adverse effects patients experience when they use drops. Sustained-release treatment in most cases is still directed from outside of the cornea, continuing the need for bothersome preservatives and high concentrations of medications to cross the corneal barrier. Ocular surface irritation and drop toxicity remain important concerns that many innovators haven't solved. In fact, the earliest sustained-release implant developed was a pilocarpine-releasing ocular insert that wasn't widely adopted because of resulting ocular irritation and not-so-great IOP control.



Preethi Ganapathy, MD, PhD

Figure 2. Sustained-release therapy can help reduce—but not eliminate—the adverse effects of topical therapy, such as this patient's follicular conjunctivitis.

The bimatoprost SR implant certainly represents progress. Is now the right time to make a change in your practice and use the brimatoprost implant? Possibly. Sustained-release treatment clearly represents the next frontier. It's exciting to be in ophthalmology at this time because of continuing innovations like this one.

Great Data

The ARTEMIS I and II[2] and APOLLO[3] prospective trials are well-designed, seminal studies showing that sustained-release implants can lower IOP while reducing these undesirable side effects. In the study, patients received various-sized implants in the study eye and either bimatoprost or timolol drops in the contralateral eye.

The implant bypasses the concern of patient adherence, and injection of the implant into the anterior chamber solves the problem of ocular surface disruption from frequent topical drop and preservative applications.[4] Since the intraocular application bypasses the corneal barrier, the concentration of drug in the anterior chamber can be several-fold lower than the concentration of an eye drop. And *voila*, the drug reaches the target tissue directly.

But for any clinical trial, I'm mindful that patients are carefully selected to accurately reflect the drug's efficacy. For example, any time you want to inject an implant into the front of the eye, the angle has to be wide enough to accept an implant. Patients with narrow angles are disqualified. Patients who have neovascular glaucoma aren't included. If someone has underlying inflammation, such as uveitis, or if a

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Point: Get Ready for a New Day

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By using a sustained-release device, you won't have to worry about the excessive schedules of topical dosing. Implanted sustained-release medications also obviate the need to design drugs to penetrate the corneal epithelium or stroma to access the outflow tract or ciliary body.

Rapidly Growing Field

Additional sustained-release pressure-lowering implants aren't that far away. Travoprost XR (Envisia Therapeutics) is a biodegradable anterior chamber travoprost implant that's currently in Phase II clinical trials. The iDose (Glaukos) is a titanium implant that's anchored to the trabecular meshwork and elutes travaprost into the anterior chamber. This device is expected to be removed and replaced once the drug reservoir is depleted. The iDose is also in Phase II clinical trials. Both implants should provide a therapeutic window of six to 12 months, and early results have been promising.

Multiple other methods of delivering sustained-release formulations of glaucoma medications are also under development.[11] Emerging alternative systems that could deliver glaucoma drugs on or near the ocular surface could involve punctal plugs, contact lenses, fornix rings/inserts and nanofiber mats. Subconjunctival implants may also provide sustained, IOP-lowering drug delivery to the tear film or intraocular tissues. A supraciliary route, extending from a suprachoroidal route, could allow for placement of anti-glaucoma drugs in the proximity of the ciliary body. Intravitreal routes could be used to maintain several months of drug retention from depot formulations, including drug suspensions, implants or other delivery systems.

These treatment routes could directly expose targeted tissues to sustained IOP-lowering or neuroprotective treatments. Notably, pharmacokinetic simulations indicate that dosing can be kept lowest when therapy is delivered intracamerally, as it is for bimatoprost SR, but will need to be higher when subconjunctival and ocular surface delivery systems are involved.

Best Patients

Many of the patients I've treated with the only sustained-release glaucoma therapy available at this point have found the medication to be a paradigm shift. They love not having to remember to use a drop every day, and they've found the implant to be much easier to tolerate than drops. Not needing to remember to self-treat with a topical medication or to tolerate a drop on the surface of the eye makes a big difference to them.

The implant will never be ideal in all circumstances—as no one treatment ever will be. Bimatoprost SR isn't for patients with active or suspected ocular or periocular infections, a history of corneal disease (including corneal endothelial cell dystrophy), low endothelial cell counts, angle closure, a history of corneal transplantation, absent or ruptured posterior lens capsules and, of course, a hypersensitivity to bimatoprost. I also wouldn't consider the implant for a young patient who is tolerating his or her medications or only needs a single medication.

On the other hand, even six months of treatment with bimatoprost SR can help some patients significantly. The medication may buy time for a non-compliant 85-year-old patient with respiratory compromise who wants to avoid the operating room until he's been vaccinated against COVID-19, for example. Likewise, a 72-year-old patient who was recently stented and is taking an anticoagulant could defer surgical management of her co-existing glaucoma until her other conditions stabilize.

Finally, bimatoprost SR may be a good option for a 78-year-old patient with severe ocular surface disease related to excessive topical medications. An implantable sustained-release device may allow her ocular surface to heal and increase the chance of a good surgical outcome.

Looking Ahead

As we continue with the use and development of sustained-release therapy in the care of glaucoma patients, think of the tremendous benefits it provides now and will provide in even greater degrees in the years ahead. Improved compliance, improved efficiency of treatment and the possibility of new medication classes are significant reasons to be optomistic about this emerging modality in glaucoma care.

1. Medeiros FA, Walters TR, Kolko M, et al. for the ARTEMIS 1 Study Group. Phase 3, randomized, 20-month study of bimatoprost implant in open-angle glaucoma and ocular hypertension (ARTEMIS 1). Ophthalmology 2020; 127:12:1627-1641.
2. Craven ER. Comparative data from the ARTEMIS and APPOLLO trials presented at the American Academy of Ophthalmology 2020 Hot Topics presentation, Sunday, Nov. 15, 2020.
3. Craven ER, Walters T, Christie WC, et al. for the Bimatoprost SR Study Group. 24-month phase I/II clinical trial of bimatoprost sustained-release implant (Bimatoprost SR, APPOLLO) in glaucoma patients. Ophthalmology 2020;127:12:1627-1641.
4. Vélez-Gómez MC, Vásquez-Trespalacios EM. Adherence to topical treatment of glaucoma, risk and protective factors: A review. Arch Soc Esp Oftalmol 2018;93:2:87-92.
5. Newman-Casey PA, Blachley T, Lee PP, et al. Patterns of glaucoma medication adherence over four years of follow-up. Ophthalmology 2015;122:10:2010-21.
6. Al-Khersan H, Hussain RM, Ciulla TA, et al. Innovative therapies for neovascular age-related macular degeneration. Expert Opin Pharmacother 2019;20;15:1879-1891.
7. Davis SA, Sleath B, Carpenter DM, et al. Drop instillation and glaucoma. Curr Opin Ophthalmol 2018;29:2:171-177.
8. Gause S, Hsu HH, Shafor C, et al. Mechanistic modeling of ophthalmic drug delivery to the anterior chamber by eye drops and contact lenses. Adv Colloid Interface Sci 2016;233:139-154.
9. Seal JR, Robinson MR, Burke J, et al. Intracameral sustained-release bimatoprost implant delivers bimatoprost to target tissues with reduced drug exposure to off-target tissues. J Ocul Pharmacol Ther 2019;35:1:50-57.
10. Singh RB, Ichpujani P, Thakur S, et al. Promising therapeautic drug delivery systems for glaucoma: A comprehensive review. Ther Adv Ophthalmol 2020; 12:25.
11. Kompella UB, Hartman RR, Patil AP. Extraocular, periocular, and intraocular routes for sustained drug delivery for glaucoma. Prog Retin Eye Res 2020; Sep 4. [Epub ahead of print].

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patient has cystoid macular edema, bimatoprost SR might not be the right therapy of choice. Patients with uveitis will be given topical prostaglandins if they absolutely need it. Most will tolerate it. But if they're receiving the prostaglandin via this implant, halting treatment won't be so easy if they don't tolerate it well. Removing an implant isn't as easy as stopping an eye drop.

Moreover, the new delivery systems can only take us so far at this point. Remember that bimatoprost SR replaces one drop for a limited amount of time. The Food and Drug Administration has approved it for a single use, for good reason. Studies have shown bimatoprost SR can reduce IOP for as long as two years in up to 30 percent of patients, which is a great number. On the other hand, if it doesn't work for two years, you're either injecting an additional implant off label, which raises its own risks, or you are going back to an eye drop.

Patient Burden

The crux of the argument that we should consider intraocular implants very carefully is simply that we don't have decades of data yet. Intraocular injections carry the additional risk of corneal endothelial loss, cataract formation, even endophthalmitis. It's no surprise that this one is approved for only a single use.

Am I suggesting that we abandon all intraocular glaucoma implants because of a small but real risk of endophthalmitis? Absolutely not. If so, our retina colleagues would never use Ozurdex (dexamethasone intravitreal implant), sticking only to topical steroids. Using our first implant to deliver a prostaglandin only makes sense because good data supports the efficacy of a prostaglandin. But practically speaking, bimaroprost is a once-daily drug. When implants hold medications typically dosed two to three times daily, we'll have another game-changer for patients.

The cost of the bimatoprost SR is another potential concern because it can be quite steep for the patient. If a patient has Medicare, and no secondary insurance, depending on the facility where the treatment is administered, a single implant can cost up to $800. Meanwhile, latanoprost costs a patient $10 per bottle *without* insurance. These are all factors that we must analyze carefully as we try to match our patients to their ideal drug treatments.

Finally, the adoption of intraocular injections will place a practice burden on the physician. Workflow will need to be adjusted to accommodate the extra steps of informed consent, patient positioning, appropriate pre-procedure protocols and post-procedure care. This translates into a significant time and staffing burden.

My Verdict?

Will I use this first sustained-treatment for my patients? Perhaps under limited circumstances. As a glaucoma specialist, before I begin to use a bimatoprost SR, I need to consider that most of my patients are taking multiple drugs. As I mentioned, this implant replaces only one of them. I certainly will never turn away from advances that might help my patients. But I will also continue to use all of the tools—including topical therapy—that I have been using for years to keep them stable.

1. Kompella UB, Hartman RR, Patil AP. Extraocular, periocular, and intraocular routes for sustained drug delivery for glaucoma. Prog Retin Eye Res 2020; Sep 4. [Epub ahead of print].
2. Medeiros FA, Walters TR, Kolko M, et al. for the ARTEMIS 1 Study Group. Phase 3, randomized, 20-month study of bimatoprost implant in open-angle glaucoma and ocular hypertension (ARTEMIS 1). Ophthalmology 2020; 127:12:1627-1641
3. Craven ER, Walters T, Christie WC, et al. for the Bimatoprost SR Study Group. 24-month phase I/II clinical trial of bimatoprost sustained-release implant (bimatoprost SR, APPOLLO) in glaucoma patients. Ophthalmology 2020;127:12:1627-1641.
4. Seal JR, Robinson MR, Burke J, et al. Intracameral sustained-release bimatoprost implant delivers bimatoprost to target tissues with reduced drug exposure to off-target tissues. J Ocul Pharmacol Ther. 2019;35:1:50-57.

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Patient Referrals: The First Office Visit

The initial encounter with a referred glaucoma patient is rife with opportunity and potential pitfalls. Here's help.

BY NATHAN RADCLIFFE, MD
NEW YORK CITY

When you're managing glaucoma, the initial patient encounter and glaucoma evaluation is always the most important. It's when diagnoses are made, treatment goals are set and a treatment plan is formulated. These are critical and time-sensitive.

Getting these things right during the initial visit is crucial, because these decisions set the direction of our disease management, possibly for years to come. Once we start on our treatment path, we often don't question certain fundamentals. For example, misclassifying the glaucoma as open-angle when it's actually closed-angle can be devastating, even for astute clinicians trying to do their best for the patient. To put it another way, a first-visit error (for lack of a better word) can really live on.

Here, I'd like to offer some thoughts about the things we need to address during a patient's first visit, to get our relationship with the patient off to a good start, address the patient's concerns and expectations, and ensure an accurate diagnosis and viable treatment plan. Many of my patients are referred to me by other doctors, and being in that position adds additional factors to consider during the first patient visit, so that's the primary focus of this article. However, I believe many of my comments will apply to any doctor seeing a glaucoma patient for the first time.

Before the Visit

As much as possible, don't see a referred patient until you've received the patient's records. It's perfectly reasonable to demand that the patient's records be delivered to your office prior to scheduling the visit, especially if you know it's an individual with a significant history. You need to understand how long the patient has had the disease, how quickly it's progressing, what the pressure was at the first visit, and which medications, lasers and surgical treatments the patient has had.

Unfortunately, many patients don't understand what it means to transfer records. They assume that doctors are automatically doing this all the time, so they expect me to have their records when they show up; they don't realize that I can't get their records without their signature. For that reason we explain this to new patients and tell them that we won't schedule their visit until we receive the records. (My favorite approach is to ask the patient to physically pick up their records from the other doctor and bring them to my office.)

One reason that having these records is so important is that patients can be very unreliable when it comes to their recollection of previous treatments. For example, I recently offered an SLT treatment to a patient, but she was convinced she'd just had this treatment at a different hospital. I was able to determine that that laser procedure she'd had was an iridotomy. If I hadn't been able to confirm that, I would have had to eliminate a procedure that could've helped the patient.

Another reason you need to have the records is that brimonidine allergy happens in about 20 percent of patients. In my experience, about 90 percent of the people who have a brimonidine allergy forget the name "brimonidine." If you don't have the records, you may give them the drop they're allergic to, causing a red, inflamed, itchy eye. This creates an unnecessary problem for both you and the patient.

All these aspects of the history—and others—are really important. Having said that, we all see patients who've been treated previously but don't have their records. I'm willing to proceed if the records are missing for a good reason, such as the previous treatment taking place in a foreign country. But it's always worth making the effort to get the records. Having the records makes everything a lot easier.

Managing Expectations

As we all know, unrealistic expectations can lead to trouble down the line. The first visit is the place to begin managing this potential problem. A few helpful strategies:

• ***Determine the level and nature of the patient's anxieties, and address them.*** It's crucial to find out what the patient is thinking and feeling about

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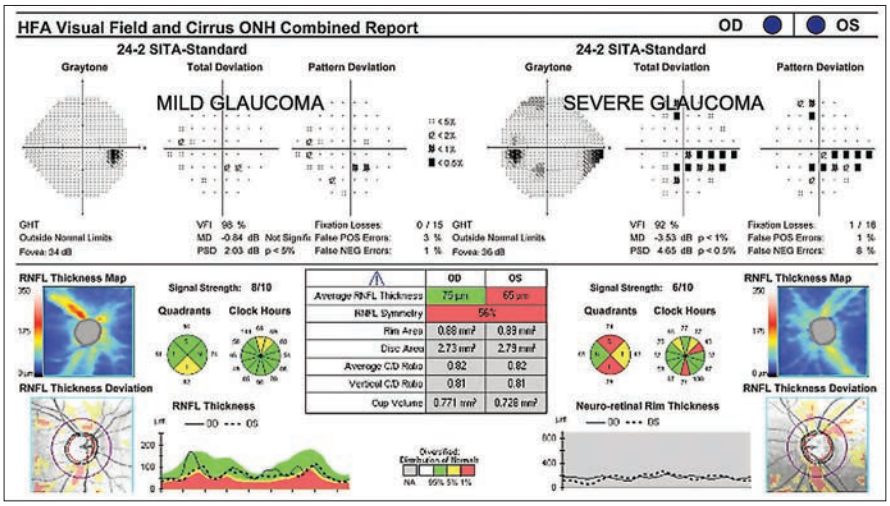
Dr. Singh is a professor of ophthalmology and chief of the Glaucoma Division at Stanford University School of Medicine. Dr. Netland is Vernah Scott Moyston Professor and Chair at the University of Virginia in Charlottesville.



Doctors sometimes grade a patient's disease based on the percentage of visual field lost, but a full visual field with signs of glaucoma (above, left) should be considered to have mild glaucoma, according to the ICD-10 classification system. An eye with both superior and inferior field loss (above, right) should be considered to have severe glaucoma, even though the damage isn't widespread.

his or her condition. Patients can bring a limitless amount of anxiety to their visit—and there may be no correlation between the patient's personal level of concern and their disease severity. Some patients will come in who have no disease but are very concerned; some will have serious disease but not be concerned at all. Regardless of which scenario you face, knowing what the patient is thinking and feeling is critical so you can address their concerns, lower their fear level and manage their expectations.

• ***Tell the patient that your goal is to avoid surgery, if possible.*** To me, the most important question you can answer for a glaucoma patient is whether he or she can be managed medically or will require surgery. With that in mind, I tell my new patients that my primary goal is to make sure they don't go blind, and my second goal is to help them avoid surgery, if possible. Patients usually understand the reason for these goals and agree with them.

• ***Set ground rules for the role of the referring doctor.*** If your patient was referred by another doctor, that doctor becomes "the third person in the room"—and the referring doctor's goals can complicate the initial visit. Sometimes referring doctors are asking you to take over the glaucoma care; sometimes they want you to manage the patient's glaucoma while they continue caring for the patient's other eye problems; and sometimes they have a specific procedure such as SLT that they'd like you to do. It's important to determine what the referring doctor's goals are during the first visit. (Of course, in some cases you may have to overrule those goals.)

If the referring doctor wants me to do a procedure, I'll usually do it—as long as I believe it's reasonable. After all, that doctor knows the patient better than I do. They've usually talked to the patient about the procedure, and the patient was amenable or they wouldn't be coming to see me. I don't think the glaucoma specialist always needs to question the referring doctor's requests. Once the treatment is done, I usually send the patient back to their doctor and say, "I'm here if you need me, but right now I think your doctor is doing a great job. You should continue seeing him or her for a while."

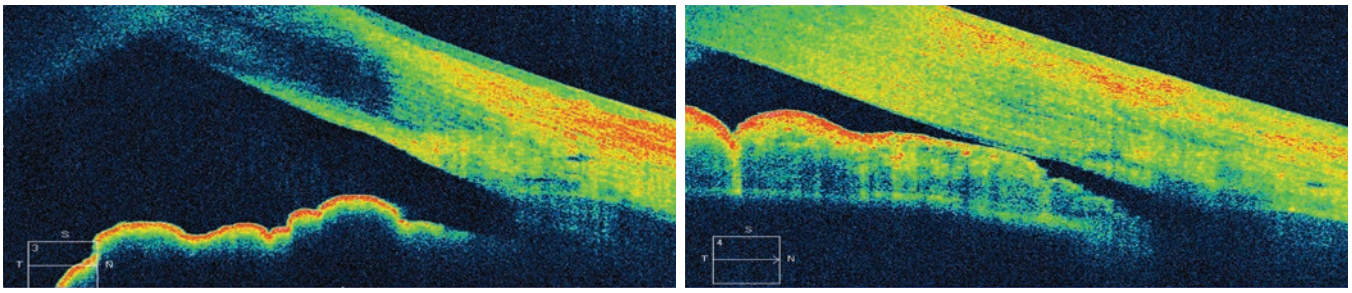
I believe one of the most important ground rules to establish in a referral situation is that only one glaucoma specialist should manage the disease on an ongoing basis. If that person is likely to be me, I invite patients to get a second opinion about any recommendation I make, if they wish; but after the second opinion, they have to either switch to the other doctor or stay with me. I don't do "two cooks in the kitchen." It's not uncommon for some patients to want that, but there are too many different ways to treat glaucoma to have more than one doctor calling the shots. So for me, the rule is: Every patient gets one glaucoma specialist—if they want one—but never more than one.

• ***Be careful about how you provide hope.*** It's really important to give patients hope, but we have to be very careful to provide hope in the right way. Many patients who've lost vision from glaucoma are hoping to have it restored. They want the impossible.

It's important to explain this to these patients, in the nicest possible way, and to remind them again from time to time. A patient who wants to regain vision probably won't accept that the lost vision isn't coming back if you only say it once. The desire to regain vision is so powerful that you'll often need to remind them: Once you lose vision to glaucoma you can't get it back.

The first visit is the place to start clarifying this. Begin with a hopeful and caring tone, saying, "We can treat you and take care of you and make sure you keep the good vision that you have. If we work together we can hopefully stabilize your disease and prevent future blindness."

It's also common for these patients to ask about new possibilities such as treatments using stem cells. You have to be very careful how you answer those questions. If you say something like, "There are doctors working on stem cell treatments for glaucoma and they look promising," most patients will take that to mean that at their three-month follow-up you'll have a stem cell treatment. They don't understand how slowly



Angle closure is a critial classification, but one that's often missed, in part because clinicians may not take the time to look at or scan the angle in dim light. Above: Open angle (left) vs. occludable angle (right).

progress is made in these areas. So, I tell them, "I don't think it's likely that we'll have that type of treatment in our lifetime, but we can hope." (They'll still keep asking how the research is going.) So we have to choose our words carefully and be prepared to live with whatever we've said.

Risk Factor Assessment

This is a relatively straightforward part of the initial exam. The goal is to identify high-risk patients. Factors to consider include:

• ***Consider the patient's age.*** I think of age as the double-edged sword of risk factors, because it does increase the likelihood of glaucoma getting worse, but it also decreases the amount of time the patient will have to live with the disease. So in some cases being older will increase the seriousness of the problem; in others, such as a patient with a mild case of glaucoma in their late 80s, the disease might not even need treatment.

• ***Factor in central corneal thickness and hysteresis.*** In recent years, corneal hysteresis (a measurement of the cornea's ability to manage stress) has been validated as a risk factor for both the development and progression of glaucoma. Most of my offices have an instrument to measure this, but I understand why a lot of people don't have access to the technology. If you can measure hysteresis, that's great. If not, be sure to consider the central corneal thickness as a risk factor.

• ***Don't assume patients will be aware of their family history.*** In my experience, most patients don't know for sure whether a family member has had glaucoma. Some will recall that a family member had eye surgery, but won't know whether it was cataract surgery or glaucoma surgery. For that reason I find it more helpful to simply ask if any family went blind over a period of years.

• ***If one eye has lost vision, find out why.*** About every fourth glaucoma patient I see has already lost vision in one eye. (Many people lose vision in one eye before they even go to a doctor.) If this is the case, it's important to confirm how vision was lost in the other eye. For example, if vision loss was caused by a previous glaucoma surgery, you may not want to do that surgery again. The patient's records may be crucial to answering this question.

• ***Don't under-stage the patient's disease.*** In my experience, doctors tend to grade a patient's disease based on the percentage of the field that's lost, even if there's damage in both the superior and inferior regions. They'll say, "He's still got half his field remaining, so it's not that bad." But glaucoma doesn't really work that way. The risk of an eye going blind from glaucoma is significantly higher if the eye has both superior and inferior field loss.

For example, consider the eyes shown on page 61. Many doctors would grade the field on the left as preperimetric glaucoma, or even a glaucoma suspect. In fact, according to the ICD-10 classification system, that's mild glaucoma. Similarly, many doctors would grade the field on the right as early or moderate glaucoma, when in fact it's severe glaucoma according to the ICD-10 classification.

To put it another way, if a patient shows signs of disease but still has a full visual field, that's mild glaucoma. A field with just a few points of loss is severe glaucoma, especially when you find damage in both the superior and inferior regions. That eye is at high risk of eventually going blind.

Needless to say, we do our patients a serious disservice if we under-stage their disease.

• ***Be careful when establishing the speed of progression.*** When we get the patient's old records we can start to piece this together and determine whether the patient is stable or deteriorating. In many cases, a patient is referred because the other doctor thought the patient was rapidly progressing, when in reality, the patient had one bad test. Simply repeating the test may be enough to indicate that the eye is actually stable. So, if the evidence appears to suggest the patient needs surgery, double check to make sure that conclusion is valid. Never base a decision to do surgery on the results of one test. (Of course, there may be exceptions. If the difference between an old test and your new test result is sufficiently extreme, and the other evidence you have supports rapid progression, you may be justified in taking the patient to surgery.)

• ***Factor in how many drops the patient is unable to use.*** That's important because every eye drop allergy or intolerance dramatically

increases the risk of the patient needing surgery.

The Physical Exam

There are several things you want to be careful not to miss during your first patient exam. These include:

• ***Endothelial disease.*** This is easy to overlook. Always take the time to check carefully for endothelial guttae, or prior surgeries such as tube shunts touching the corneal endothelium.

• ***Brimonidine allergy.*** Sometimes when patients are referred to our office they're already using multiple drops. In that case, if an eye looks red and inflamed and the pressure's out of control, a brimonidine allergy could very well be the problem. It's a very common reason for patients to seek out a second opinion, because the patient can tell something is wrong, even if the doctor doesn't see it.

So, if you're the doctor giving the second opinion, and the eye looks very toxic and red or inflamed, stopping brimonidine is often a successful strategy.

• ***Pseudoexfoliation.*** This is one of those conditions that gradually worsens over time, sneaking up on the doctor and patient. In the beginning it can be present in extremely subtle form, so if you're on the lookout you may spot early signs of pseudoexfoliation that many doctors would miss. Examining the mid-peripheral anterior lens capsule in the dilated eye for early exfoliation material or pigment can be the most sensitive way to detect the disease.

• ***An occludable angle.*** Angle closure is a critical classification, yet it's often missed. That's true for several reasons. One is that doctors often look at the angle in a brightly lit room, which can cause the angle to open.

Ideally, you should look at the angle using gonioscopy under dim illumination. In today's digital world, that means turning off the iPad, having the patient put their phone away, turning off the computer monitor and shutting the doors. (If you're not in the habit of doing gonioscopy in the dark, try it for a month. You'll be amazed how many additional cases of angle closure you detect.) People spend at least a third of their lives sleeping in the dark, and if someone has a narrow angle, you can bet their angle is even narrower during that time.

Another approach to monitoring the angle is anterior segment optical coherence tomography. It's a good screening tool, but it's subject to the same caveat; doctors often take the scan in a brightly lit room. Taking it in a very dark room is key to catching angle closure.

A few pearls:

• ***If you're checking for angle closure in a darkened room, be patient.*** If I'm using gonioscopy to check for a narrow angle in dim light conditions, and I get the sense that the patient's angle is closing, I'll wait a little longer—as long as five minutes. This will often result in the angle closing to a dangerous degree. I certainly don't do that with every patient; if I turn off the lights and the angle remains widely open, I can tell it's not going to close. But if the angle is starting to close in the dark, it's worth it to wait and see just how closed it will get.

• ***If you have anterior segment OCT capability, consider scanning every patient to check for angle closure.*** Doing so only takes about 20 seconds of technician time. This is routine in our practices, and we almost never bill for it. The result does sometimes catch me by surprise; an angle I didn't think was narrow looks quite narrow on the OCT scan.

• ***Remember that angle closure can change over time.*** It's important to check the angle periodically because angle closure can progress. An angle that looked open two years ago may now be narrow. It's easy to classify the patient at the initial exam and then stop looking, but that can backfire. I think it's important to reassess the angles at least once a year, and any time the patient's characteristics or IOP are changing. If you're consistent about this, you can save many people's vision.

Challenging Prior Conclusions

I've found it interesting how many times a note in the chart from a referring doctor (or a statement coming from the patient) turns out to be leading us in the wrong direction. For example, you may be told that a patient can't take one of the commonly prescribed drops, or that a drop was tried and produced little effect. I'm all for honoring these conclusions if I have all the options in the world still open to me, but the reality is that glaucoma patients go blind when they run out of options—medical, laser and ultimately surgery—so you don't want to eliminate a treatment option without checking to be sure it's really off the table. For that reason (and based on my first-hand experience) I always assume that these conclusions could be mistaken.

I refer to some of these assumptions as "pseudo-contraindications." For example, a patient may come in quite sure that he or she can't take such-and-such a medication. In many cases, this conclusion was the result of a miscommunication. I've experienced this with my own family. My aunt has glaucoma; she was placed on a medication while being seen by another doctor, but her pressure didn't come down much. The doctor said, "This drop isn't for you." Then, it was placed on the list of drops she couldn't use in the future—not an appropriate conclusion!

I've encountered pseudo-contraindications relating to several different drug classes:

— ***Beta blockers.*** Sometimes I've seen a note in a patient record saying "The patient can't take a beta blocker." If you ask the patient why, she may say, "My doctor prescribed me an asthma inhaler." Upon further investigation, the patient doesn't

have asthma but was prescribed an asthma inhaler for bronchitis several years ago. You may end up avoiding prescribing a beta blocker that could have helped the patient because of a misunderstanding. That's not uncommon.

— ***Prostaglandin analogues.*** Some patients have been told to avoid prostaglandin analogues because the label states that PGAs can cause uveitis. In my experience uveitis caused by a PGA is rare and almost unheard of. It's based on a case report from shortly after the PGAs were discovered, and my guess is that it was a patient who just happened to have uveitis that wasn't caused by the PGA. But because prostaglandins are involved in inflammation in the prostate and other areas of the body, the concept stuck.

Unfortunately, the result has been that some patients who are going blind with mild uveitis and severe glaucoma often don't even get tried on a PGA for fear of this contraindication mentioned in the labeling. This has eliminated the possibility of using the single most effective therapy we have to help many desperate patients, for no good reason.

— ***CAIs.*** Carbonic anhydrase inhibitors are technically in the sulfa class, but they're not contraindicated in patients who've had a sulfa antibiotic allergy. There's no cross-reactivity between those two medications; they both just happen to have an atom of sulphur in their chemical formulas. In fact, in the military soldiers with a sulfa allergy are routinely given an oral CAI—Diamox—without problems.

A 2013 study by M. Bruce Shields, MD, and colleagues evaluated more than 1,000 glaucoma patients; it found that while sulfa-allergic patients may have more allergies overall, the CAI class was not a particular problem.[1] Nevertheless, you'll still see a lot of pharmacists disallowing it to patients, some of whom might lose their vision without another drop.

For these reasons I don't assume that patients who say they can't use a drug are correct, if the reasoning sounds questionable to me. I rechallenge patients who say that a medicine didn't work for them, if they only tried it once briefly. I also check to see if a feared drug interaction is legitimate. At the least, you want to properly weigh the risk of the allergy or uveitis against what in most cases is a very serious risk of going blind from glaucoma.

If you do this appropriately, you may open up treatment options that will help to save the patient's sight.

> **"Pilocarpine is my "get out of jail free" card, for people who are really looking to avoid surgery. It's almost never been tried when a patient is referred to me."**

Overall Visit Strategies

Pearls to keep in mind:

• ***Don't be afraid to treat early glaucoma aggressively.*** Early glaucoma grows up to be severe glaucoma, and the more aggressively we treat early glaucoma, the better we do at keeping our patients out of trouble. The reality is that you can't always tell which early glaucoma patients are going to go on to need surgery. As a result, it's always a good idea to err on the side of more treatment, not less.

• ***Look for "low-hanging fruit."*** One of the best things you can do for a new patient is look for things you can do right away that may give them some relief. I think of these treatments as my "fastballs." These include:

— *If the eye is irritated, especially with follicular conjunctivitis, try eliminating brimonidine from the patient's regimen.* As noted earlier, brimonidine allergy is common and often missed. If the drug is causing some of the patient's suffering, eliminating it will bring the patient some quick relief.

— *Make sure the patient has really tried all of the main medications.* Any exclusions may have been the result of an inadequate trial or a false assumption, as noted above.

— *Make sure the patient has had SLT.* I've had many patients referred to me for surgery for whom I think SLT may handle the problem.

— *Try pilocarpine.* Pilocarpine is my "get out of jail free" card, for people who are really looking to avoid surgery. It's almost never been tried when a patient is referred to me. You might argue that it's an old treatment; it doesn't work that well, and it has pretty bad tolerability. That's true. But it gives me one more chance to show some due diligence before I take the patient to the OR.

• ***Before moving to surgery, exhaust your other options.*** When possible, proceed slowly. I do schedule some patients for surgery the first time I see them, but in most cases I try to develop a little rapport and trust with the patient first, and make sure we're comfortable with each other's styles. There's a long waiting time to get an appointment to see me, so I don't like to bring people to my office unless I think they're going to be comfortable not rushing. Once I know the patient is willing and able to proceed slowly, I'm happy to have one more visit, one more pressure check, one more trial of a new medication, before resorting to surgery. That can go a long way to show patients that you're willing to work for them and trying to avoid the need for surgery.

• ***If you need to make a surgical plan at the first visit, clarify expectations.*** If a new patient has advanced glaucoma or is progressing rapidly, you may need to make a surgical plan right away. However, because the patient is new, you won't have a well-established relationship with the individual. For that reason:

(Continued on p. 70)

Management Challenges In Sickle Cell Retinopathy

Though strides have been made in treating sickle cell retinopathy over the years, there's still far to go.

BY ADRIENNE W. SCOTT, MD
BALTIMORE

In 1971, Morton F. Goldberg, MD, published the now commonly used sickle cell retinopathy grading system based upon the distinct pattern of retinal vascular remodeling in the peripheral retina in patients with sickle cell disease. Over the years, this grading system has helped us understand the natural history of retinal vascular changes in sickle cell patients. Though modern advances in pharmacotherapies and surgical techniques have helped us improve visual outcomes, there's still a lack of Level 1 evidence to inform our management of sickle cell retinopathy.

In this article, we'll highlight knowledge gaps in SCR, discuss preferred practice patterns and analyze several illustrative cases of SCR management dilemmas.

The Grades of Sickle Cell

Dr. Goldberg's observations were derived from careful clinical exams using indirect ophthalmoscopy, 30-degree standard field fundus photography and fluorescein angiography with peripheral sweeps in patients with SCR.[1*] Following is a brief description of the grading system.

In Goldberg Stage 1, peripheral arteriolar occlusions are observed, which can then progress to Stage 2, arterio-venous anastomoses. Goldberg Stage 3 marks the onset of proliferative sickle retinopathy, in which arterio-venous connections proliferate into characteristic fan shaped complexes called "sea-fan" neovascularization, so named for their resemblance to the marine animal, *Gorgonia flabellum*. Patients with sickle cell disease generally maintain good vision until they progress to Goldberg Stage IV disease, when vitreous hemorrhage occurs due to vitreous contraction on sea-fan neovascular complexes. The avascular peripheral retina in SCD is thin and therefore prone to retinal breaks. Vitreous traction may cause sea-fan neovascularization to exert traction on the peripheral retina, resulting in Stage V (tractional or combination tractional/rhegmatogenous retinal detachment), and necessitating surgical repair.

Though this staging system for SCR is informed by peripheral retinal changes, Dr. Goldberg and his colleagues also described macular vascular changes including microaneurysm-like dots, dark and enlarged segments of terminal macular arterioles, and hairpin-shaped venular loops with slit lamp and indirect biomicroscopy.[2] Contemporary advances in retinal imaging including optical coherence tomography, optical coherence tomography angiography, ultra-widefield fundus photography and ultra-widefield fluorescein angiography have provided a greater understanding of macular and peripheral anatomy of the retina that contributes to pathophysiology of SCR.

How Retinopathy Relates to SCD

The most common causes of vision loss in SCD are sequelae of PSR, e.g., vitreous hemorrhage and/or retinal detachment. In our patients with diabetes, we're able to link poor glycemic control with the risk of developing sight-threatening proliferative retinopathy, and counsel the patient and referring primary care provider accordingly. In SCD, we still don't understand the correlation between the patient's systemic hemoglobinopathy and their risk of sight-threatening eye disease.

Genotype is the risk factor most strongly associated with development of PSR. PSR occurs earlier and more commonly in HbSC disease; it's noted in about 43 percent of HbSC subjects as compared with 14 percent of HbSS subjects in a Jamaican cohort study.[3] Though mechanisms for this disparity in PSR between HbSS and HbSC disease aren't completely understood, blood viscosity and overall circulation and transit time of abnormal hemoglobin cells may play a role. A hemoglobin S molecule results from a valine substitution for a glutamine, and the red cell survival time in HbS is about seven to 14 days. HbS polymerizes in the deoxygenated state. A hemoglobin C molecule results from

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Dr. Regillo is the director of the Retina Service of Wills Eye Hospital, professor of ophthalmology at Thomas Jefferson University School of Medicine, and the principle investigator for numerous major international clinical trials.
Dr. Yonekawa is an assistant professor of ophthalmology at Sidney Kimmel Medical College at Thomas Jefferson University. He serves on the Education Committee of the American Society of Retina Specialists, and the Executive Committee for the Vit Buckle Society, where he is also the vice president for Academic Programming.

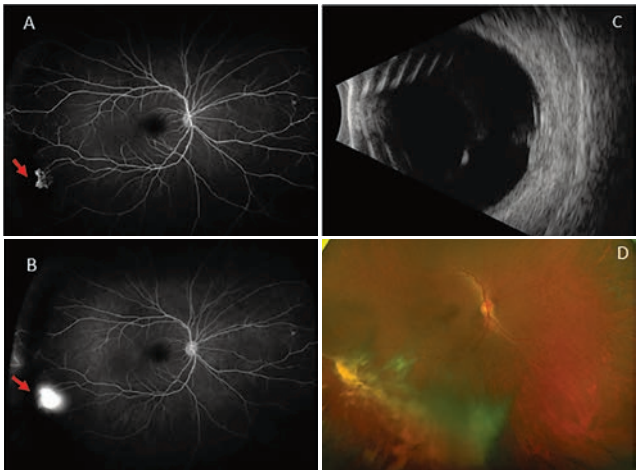

Figure 1. A 31-year-old man with HbSS disease and 20/20 vision presented with a small area of sea-fan neovascularization depicted on UWF-FA, panel A (early frame, red arrow) and panel B (late frame, red arrow). Observation and follow up in six months was advised. He was lost to follow up and presented urgently 2 years later with drop in vision to hand motions due to vitreous hemorrhage (Panel C, B-scan ultrasound). Scatter laser was applied once the vitreous hemorrhage cleared centrally. Subhyaloid and vitreous hemorrhage overlie the etiologic small sea fan neovascular lesion. (UWF-F, Panel D).

a lysine substitution for a glutamine. HbC molecules crystalize within red cells leading to higher blood viscosity in patients with HbSC disease. HbC red cells survive about 40 days. In HbSC, patients have a higher hematocrit and, therefore, also have a higher volume of abnormal hemoglobin molecules, decreased blood flow and longer vascular transit time due to increased sludging of blood in the microvasculature.

This sluggish blood flow results in prolonged hypoxia, and indolent release of pro-angiogenic growth factors such as vascular endothelial growth factor, promoting pathologic neovascularization. In HbSS, there may be more overall complete vaso-occlusions with obliterations of microcapillaries in the retinal circulation and, therefore, more complete areas of anoxia. SCR is quite heterogeneous in its presentations, and its phenotypic appearance can differ significantly, even across SCD patients with the same genotype.

Evidence of SCD vaso-occlusions within the retinal circulation in patients with SCD have been observed in patients as early as 6 months old, after the protective effects of fetal hemoglobin (HbF) abate. These vaso-occlusions in the microvasculature are cumulative over a lifetime. Age is another risk factor for PSR, with the highest rates of PSR progression between ages 20 to 39. We typically don't see active PSR or PSR progression in SCD patients over age 50, and in patients this age, much of the SCR we see has a "burnt out" fibrotic appearance of PSR neovascular complexes. Male sex and PSR in the contralateral eye are also risk factors for PSR development.[3] Persistent fetal hemoglobin, hydroxyurea use (increases blood flow and raises HbF), and chronic transfusions appear to be protective factors for SCR development.

Patients with SCD may have myriad medical complications from their hemoglobinopathy, including recurrent vaso-occlusive pain crises, strokes, silent cerebral infarcts, pulmonary hypertension, avascular necrosis of the bones and nephropathy. Further study is required to better understand how the hemoglobinopathy affects a patient with SCD and his or her risk for vision loss from retinal nonperfusion or retinal vascular occlusion or infarction, incidence of PSR or risk of PSR progression, and how these correlate with any of these other sequelae of SCD-related end-organ damage.

Screening for SCD Patients

Current sickle cell retinopathy screening guidelines are based only on expert consensus and strong recommendations, but low-quality evidence.[4] Recommendations include "referral to an ophthalmologist for a dilated eye examination to evaluate for retinopathy beginning at age 10," and "rescreen at one- to two-year intervals for persons having a normal dilated retinal examination."[4] Even though these recommendations aren't based on strong evidence, they're reasonable in that, as previously mentioned, it's unusual to observe PSR in children under the age of 10 with SCD, and the highest rates of PSR progression typically occur in the time frame from adolescence to 30 years of age.

One four-year, retrospective, observational cohort study further validated the expert consensus recommendations by evaluating optimal timing for sickle cell retinopathy screening.[5] The study's authors concluded screening for SCR in asymptomatic children could reasonably take place at age 9 for children with HbSC and at age 13 for children with HbSS. From my perspective, this recommendation is very similar to the NIH expert consensus paper, and screening at age 10 for all patients with all SCD genotypes appropriately captures the intent of this guideline.

In our clinics, we encourage referral of children with SCD as early as age 5, because although they're unlikely to have PSR, at this age even subtle microvascular occlusive disease can be identified with detailed retinal exams and imaging, including OCT and OCTA. Young children can be reasonably cooperative with the retinal exam and imaging at this age.[6] In partnership with our hematology colleagues, we find it helpful to discuss screening expectations for annual retinal examinations with pediatric SCD patients and their families, so, ideally, these surveillance visit patterns can be ingrained in these patients starting at a young age and can then continue for the rest of our patients' lives.

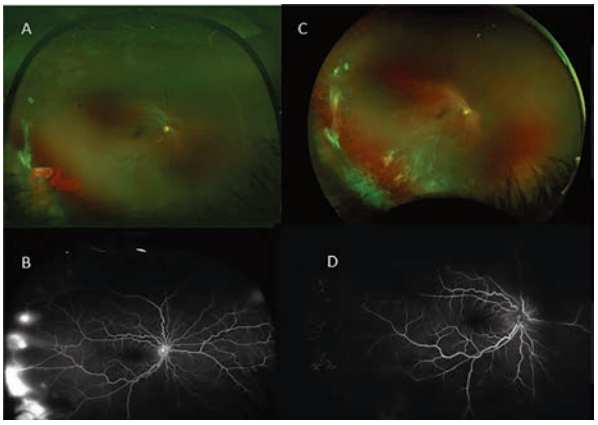

Figure 2. A 30-year-old woman with HbSC disease experienced recurrent visually debilitating vitreous hemorrhages despite prior laser photocoagulation (UWF-F, Panel A). Active leakage from sea-fan neovascularization was observed on UWF-FA (Panel B). Intravitreal bevacizumab was given. One month later, the vitreous hemorrhage decreased, and the sea fan neovascularization was noted to markedly regress (UWF-F, Panel C). Resolution of leakage is noted on UWF-FA (Panel D).

Managing PSR

PSR is typically treated to avoid disease progression in to Goldberg Stage 4 or Stage 5 disease. Scatter laser is the mainstay of treatment, while anti-VEGF therapy can be a useful adjunctive therapy.

• ***Scatter laser photocoagulation.*** When screening for SCR, the objective is to identify pathologic neovascularization so treatment can be considered, or if treatment is deferred, so these lesions can be documented and followed closely over time. PSR is unique among the proliferative retinopathies, as sea-fan neovascular complexes tend to auto-infarct and fibrose without visual consequence in upwards of 30 percent of eyes without visual consequence.[3] Laser photocoagulation remains the first line treatment. We recommend scatter laser treatment for patients with large, vascularized sea fan lesions; enlarging sea fans; monocular patients and/or those with advanced PSR in the contralateral eye; and in patients for whom follow-up may not be reliable *(Figure 1)*.

Laser photocoagulation has been shown to slightly decrease the incidence of vitreous hemorrhage compared to observation in control eyes with PSR.[7] Laser photocoagulation hasn't been shown to decrease incidence of new sea-fan neovascularization and appears to have minimal effect on induction of sea-fan auto-infarction.[7] Therefore, small sea-fan neovascular complexes can be observed. We recommend using UWF-FA to guide scatter laser treatment. We apply laser to barricade sea-fan neovascular complexes, and also apply it to the areas of surrounding peripheral retinal ischemia and to the transitional zone between perfused and non-perfused retina. Using previously described techniques based on the location of angiogenic growth factors identified in a study of autopsy eyes with PSR, we extend treatment just posterior to this transitional zone border.[8] Peripheral retinal ischemia has been shown to be progressive in SCR, however, we don't perform scatter laser for ischemia in the absence of neovascularization.

• ***Anti-VEGF injection therapy.*** Anti-VEGF medications are a helpful adjunct to scatter laser in PSR. Small case series have shown intravitreal bevacizumab to be helpful in facilitating resolution of vitreous hemorrhage when the hemorrhage prevents adequate laser initiation or supplementation; these injections can also be effective in decreasing vascular leakage and recurrent vitreous hemorrhage in PSR *(Figure 2)*.[9] Intravitreal bevacizumab has also proven to be a useful preoperative medication, causing regression of active sea-fan neovascular complexes and facilitating their dissection from the retinal surface, which decreases the risk of intraoperative bleeding in vitrectomy for retinal detachment repair. We don't yet have a defined optimal treatment paradigm for anti-VEGF injection for PSR management, however. We tend to treat as needed based upon vascularization of sea-fan complexes on clinical exam and UWF-FA, and upon the extent of sea-fan leakage on UWF-FA. Vitreous hemorrhages from PSR tend to significantly improve within 4 to 6 weeks with observation and with anti-VEGF treatment. Given the complexities of vitreoretinal surgery and perioperative management in patients with SCD (discussed below), we highly recommend observation and medical management of PSR vitreous hemorrhage, in the absence of retinal detachment, when possible.

• ***Surgery for PSR.*** It's important to recognize that patients with PSR neovascularization may have an undiagnosed mild hemoglobinopathy, and may present with vision loss due to vitreous hemorrhage or RD in the absence of known clinical history of SCD. Serum electrophoresis and re-

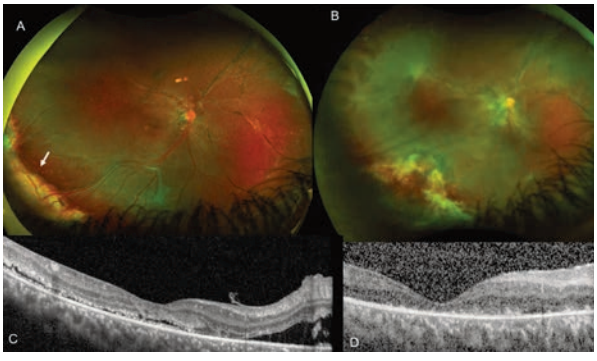

Figure 3. A 20-year-old patient with HbSC presented with a chronic tractional retinal detachment from PSR. A sea fan neovascular complex with subretinal lipid was present (A, white arrow). Subretinal fluid was present through the macula evident on OCT (Panel C). Vitrectomy and membrane peeling with silicone oil tamponade were performed. Recurrence of subretinal fluid was noted after initial repair, and a 41-encircling scleral buckle was placed. The retina remained attached after removal of the silicone oil (B). The OCT shows near resolution of the subretinal fluid (D).

ferral for hematologic work up should be obtained when patients present with retinal findings consistent with PSR in the absence of known hemoglobinopathy.

Surgical repair should be reserved for eyes with vision-threatening eye disease for which medical management options have been exhausted. Surgical indications in PSR can include non-clearing vitreous hemorrhage (particularly in a monocular patient), retinal detachment, symptomatic epiretinal membrane, macular hole or vitreomacular traction. The peripheral ischemic retina is thin, therefore eyes with SCD are prone to retinal breaks and rhegmatogenous retinal detachments, as well as tractional or combined rhegmatogenous/tractional retinal detachments.

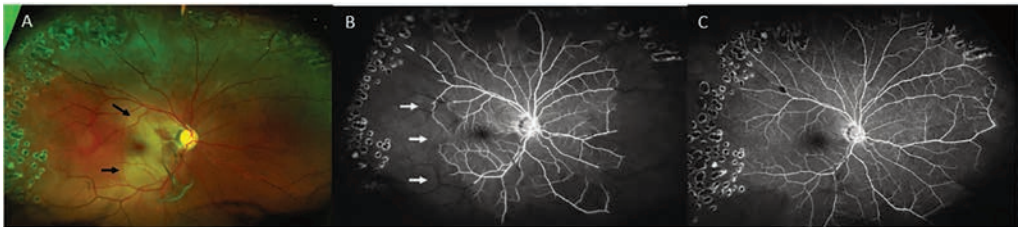

Figure 4. A 30-year-old patient with HbSC and history of PSR presented with sudden painless vision loss from acute CRAO. Macular whitening was visible (black arrows) (Panel A). UWF-FA demonstrates significant non-perfusion of the retinal vasculature (white arrows) (Panel B). UWF-FA 11 days following the acute CRAO and hospital admission for red cell exchange transfusion and intravenous hydration shows partial recovery of retinal perfusion (Panel C).

Epimacular proliferation may occur either by natural history or following scatter laser photocoagulation, resulting in symptomatic epiretinal membrane with macular pucker, macular hole or vitreomacular traction. Even when modern vitrectomy techniques such as widefield viewing to maximize retinal visualization, small-gauge instruments and valved cannulas to provide tight control of intraocular pressure are used, PSR eyes with RD are prone to iatrogenic breaks and may show complication rates of up to 50 percent.[10] Preoperative communication with the patient's hematologist is important to identify the possible role of preoperative exchange blood transfusion, and for the management of any anticoagulation therapy. Communication with the anesthesiologist during the surgery is also critical, taking care to maximize the patient's perioperative hydration, temperature, oxygenation and analgesia. We prefer general anesthesia for our SCD patients. Local anesthesia with sub-Tenon's block can be considered if general anesthesia is contraindicated. Care must be taken to monitor IOP, avoiding the use of a retrobulbar block to decrease the risk of central retinal artery occlusion. We use a bimanual surgical technique for dissection of preretinal membranes with chandelier illumination, try to employ segmentation rather than delamination techniques, and minimize any tension on the retina to avoid causing iatrogenic breaks.

Historically, scleral buckles were avoided in patients with SCD given the risk of anterior segment ischemia when high, broad scleral buckles were used. In light of the fact that patients with PSR-retinal detachment are typically young and phakic—with incomplete posterior hyaloid separation and possible inferior vitreous base pathology—low, narrow encircling scleral buckles or segmental buckles may be used, and we've found them to be beneficial in PSR surgery *(Figure 3)*.

Other Causes of Vision Loss

Advanced-stage PSR is the most common cause of significant vision loss in SCD, but sudden vision loss can also rarely occur from acute onset vascular occlusions in the posterior pole, central or branch retinal artery occlusion or acute macular infarction.

Retinal artery occlusion is more common in the HbSS but can occur in HbSC *(Figure 4)*. Many patients with SCD have chronic macular flow voids on OCTA, most noted in the deep retinal capillary vascular plexus to a greater extent than in the superficial plexus. These flow voids are commonly observed in the temporal macular region, a vascular watershed zone. Children with SCD were noted to have decreased macular vascular density but similar retinal thicknesses when compared to age- and race-matched controls unaffected by the disease.[6] Structural OCT macular thinning has also been observed in adults with SCD, suggesting that vascular occlusions precede structural retinal thinning. The visual significance of these macular flow voids remains unclear, and these patients are thought to be visually asymptomatic. However, microperimetry studies in SCD observed central scotomas that correspond to these areas of structural thinning.[13] Patients with these macular flow voids and corresponding areas of OCT thinning may have chronic subclinical near-vision deficits that we don't pick up on in our vision testing, as we don't routinely check near vision in these patients.

Rarely, acute vision loss with sudden onset of central scotomas has also been noted in patients with SCD from paracentral acute middle maculopathy (PAMM) or acute macular neuroretinopathy (AMN). PAMM likely occurs due to vascular flow impairment in the deep and/or intermediate retinal capillary plexus, and has been hypothesized to precede macular thinning in sickle cell maculopathy.[14,15] The deep capillary plexus may be particularly susceptible to ischemia given its high oxygen demand, and because its vascular supply occurs in a watershed zone

of the retinal circulation. Ischemic insult to the deep capillary plexus and possibly the choroid may result in AMN, often noted as a tear-drop-shaped, paracentral, hyperreflective lesion on infrared OCT *(Figure 5)*.[16]

It follows that given their predisposition to capillary occlusion and red-blood-cell sickling, patients with SCD would be vulnerable to these episodes of sudden vision loss. In our institution, when SCD patients experience sudden vision loss attributed to vascular occlusions, these events are treated as acute neurologic events, and these patients are referred for urgent hematologic consult, hydration, oxygenation and possible exchange transfusion. AMN and PAMM lesions typically resolve over time, though the natural course may be improved with systemic optimization of SCD through hydration, oxygenation and exchange transfusion. However, these patients typically complain of persistent central or paracentral scotomas, even after the acute infarct resolves and perfusion improves. Interestingly, these events have been reported to occur in various SCD genotypes, and don't necessarily correlate with an overall systemic SCD morbidity.

A Look Toward the Future

Though our knowledge of the pathophysiology, natural history and best practices in surgical and medical management of SCR has grown tremendously since the initial Goldberg classification was published in 1971, there remains much about SCR we still don't know. Fortunately, over recent years, there's been a heightened interest in sickle-cell disease and in sickle-retinopathy research, including an exponential increase in the number of publications evaluating retinal imaging in SCD—more in the past 10 years than in the previous four decades combined. Along those lines, in our retina practice we're working to establish evidence-based practice patterns for SCR, using imaging to incorporate not only peripheral retinal findings, but sickle maculopathy as well, with the goal being an update to the staging classification system.

It's an exciting time for our patients with SCD and for us clinicians. For years, hydroxyurea was the only FDA-approved medication for the treatment of SCD. Now, there are newer pharmacotherapies for SCD treatment, such as crizanlizumab (Adakveo, Novartis), a p-selectin inhibitor intravenous infusion shown to decrease the number of painful vaso-occlusive crises; and voxelotor (Oxbryta, Global Blood Therapeutics), which increases oxygen affinity to hemoglobin, inhibits red cell polymerization and reduces hemolysis.

Systemic therapies such as bone-marrow transplantation and CRISPR gene editing[11] have also had success in altering the disease course in SCD, and the hope is that these therapies will be curative. It'll be fascinating to observe the effects of these systemic therapies on SCD end-organ damage, including sickle-cell maculopathy and peripheral retinopathy. Unfortunately, many of these treatments aren't yet available to most patients with SCD due to their cost and their potential systemic toxicity (chemotherapy is required prior to bone-marrow transplantation and gene therapy).

Further, SCD affects approximately 100,000 Black Americans, many of whom are from medically underserved communities and facing daily struggles related to their disease care. For these patients, limited or no access to and/or mistrust of the medical community due to past ethical violations may prevent them from getting these treatments.[12] Because of these issues, in addition to understanding and treating hemoglobinopathy and end-organ damage in patients with SCD, we must also address racial disparities in health care so that this population can truly benefit from these groundbreaking therapies.

**(The full list of references is available in the online version of the article on reviewofophthalmology.com)*

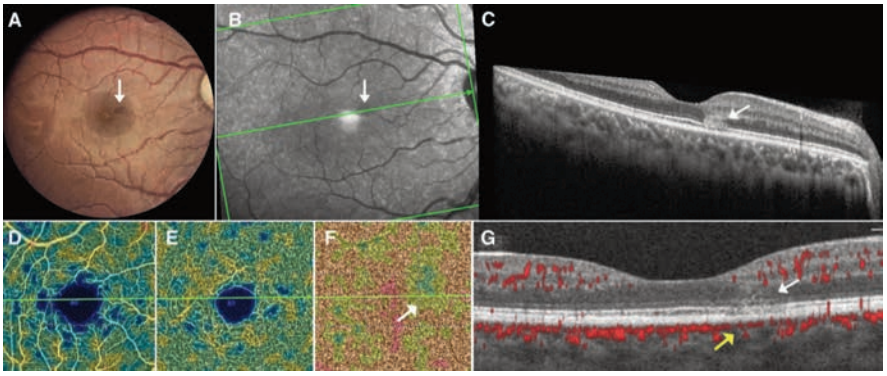

Figure 5. A 24-year-old HbSC patient presented with an acute paracentral scotoma. Fundus photos and near infrared reflectance images shows a tear-drop-shaped lesion in the superonasal parafoveal region (A and B, white arrows). OCT demonstrates hyperreflectivity nasal to the fovea involving the outer plexiform and outer nuclear layers with disruption of the ellipsoid and interdigitation zones (C, white arrow). At day four of follow-up, en-face OCTA of the superficial capillary plexus (D), deep capillary plexus (E) and choriocapillaris (F) showed no corresponding flow reductions in the SCP and possible flow deficits in the DCP and choriocapillaris in the area of the acute macular neuropathy lesion (white arrow). Cross-sectional OCT with angiographic flow (G) shows partial resolution of the outer retinal hyperreflective band with possible flow reduction in the DCP (white arrow) and choriocapillaris (yellow arrow).

ABOUT THE AUTHOR

Dr. Scott is an associate professor of ophthalmology in the retina division of the Wilmer Eye Institute at Johns Hopkins University School of Medicine.

Patient Referrals: The First Office Visit
(Continued from p. 64)

— *Make sure the patient understands the goals and risks of the glaucoma procedures you're considering.* This is essential to avoid unrealistic expectations and postop distress.

— *Remember to reinforce that you can't bring back vision that's already lost.* I often say, "Your eye doesn't have the vision you'd like it to have, but it still has useful vision, and I'd like to keep that vision for you with this surgery." As noted earlier, it takes some repeating to drive home the point that we can't bring back lost vision.

— *Remember that the referring physician may have unrealistic expectations as well.* Interestingly, this is not uncommon. You'd think that because this person is an ophthalmologist or optometrist and has a lot of experience his or her expectations would be realistic, but not everyone understands glaucoma as well as we might hope. I was sent a patient recently from a well-known ophthalmologist, and the referring physician was shocked that I couldn't bring back the vision lost to glaucoma.

The Main Points

To sum up, when a patient is referred to you, keep several things in mind during your first visit:

- If possible, don't schedule the visit until you have the patient's records in-house.
- Do your best to give the patient a realistic amount of hope—but be careful about the words you choose.
- Focus on the most important parts of the history.
- Don't omit critical exam features such as checking for an occludable angle.
- Look for some low-hanging fruit that you can address to reduce the patient's suffering.
- If surgery is needed, it's OK to be decisive. However, be clear about what the patient can and should expect.

One final thought: As important as the first visit is, it's also crucial to avoid simply staying the course for years after, assuming that the conclusions you drew during the first meeting still apply. Our glaucoma patients' diagnoses and treatment goals can change throughout their lives—probably not every visit, but maybe every few years. That's not to say that we should approach every visit the same as the initial encounter, but we should re-examine some key factors such as angle closure periodically. In short, remain vigilant for changes over time.

1. Guedes GB, Karan A, Mayer HR, Shields MB. Evaluation of adverse events in self-reported sulfa-allergic patients using topical carbonic anhydrase inhibitors. J Ocul Pharmacol Ther 2013;29:5:456-61.

ABOUT THE AUTHOR

Dr. Radcliffe is a clinical associate professor at New York Eye and Ear Infirmary, and practices at the New York Eye Surgery Center. He reports financial ties to Reichert, Allergan, Alcon, Novartis, Lumenis, Ellex, Aerie and Bausch+Lomb.

An older man presents at Wills Eye with complaints of distorted vision.

BY LUCY COBB, MD
PHILADELPHIA

Presentation

A 68-year-old African-American male presented to Wills Eye Hospital for evaluation of distorted central vision in his right eye in the setting of persistent uveitis. Seven months prior, he had undergone pars plana vitrectomy to remove retained lens material following cataract surgery. His postoperative course was complicated by uveitis in his right eye, which was controlled with once daily difluprenate 0.05% dosing, but flared with an attempt to taper further. Notably, he had a remote history of bilateral sarcoid-associated uveitis.

Medical History

In addition to the vitrectomy mentioned above, his ocular history was significant for cataract extraction with a Crystalens AO (Bausch + Lomb) posterior chamber lens in both eyes approximately one year prior to presentation, primary open angle glaucoma that was being medically managed, chronic right eyelid ptosis and prior bilateral uveitis attributed to sarcoidosis.

Past medical history included sarcoidosis, diagnosed by cervical lymph node biopsy, with no systemic symptoms for the past six years off oral prednisone. He also had a history of hypertension and atrial fibrillation, treated with anticoagulation.

Family history was significant for glaucoma in his mother. The patient was a nonsmoker, and other social history was noncontributory. His ocular medications included difluprednate 0.05% once daily OD and brimonidine 0.2% b.i.d. OU. His oral medications included: apixaban 5 mg daily; metoprolol 50 mg b.i.d.; atorvastatin 20 mg daily; and diltiazem 120 mg daily.

Examination

Ocular examination demonstrated a best-corrected visual acuity of 20/100-2 OD and 20/30 PH 20/25-1 OS. Intraocular pressures were 18 mmHg OD and 12 mmHg OS by Tonopen. Pupillary exam revealed equal, round and brisk pupils OU without a relative afferent pupillary defect. Confrontation visual fields were full OU. Anterior slit lamp examination of the right eye showed a well-healed phacoemulsification incision and stable arcuate incisions, scattered pigmented endothelial deposits but no active keratic precipitates, a deep and quiet anterior chamber and a Crystalens in the capsular bag superiorly and in the sulcus inferiorly without vitreous prolapse. Anterior slit lamp examination of the left eye showed a well-healed phacoemulsification

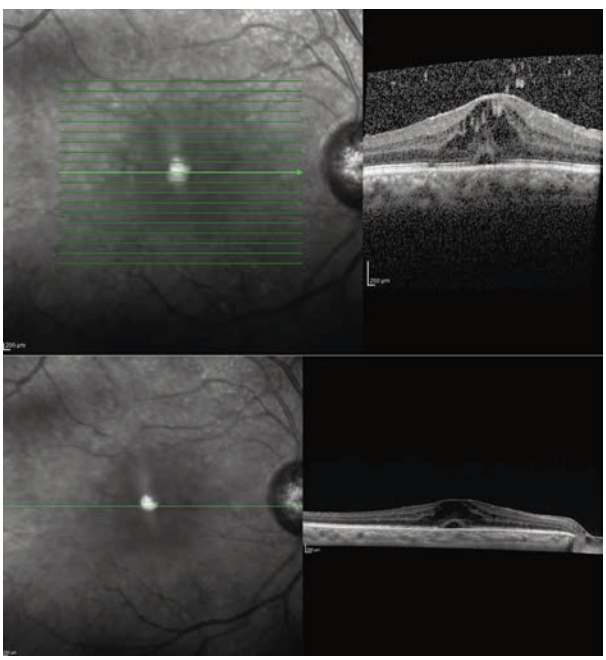

Figure 1. Optical coherence tomography of the right eye obtained on patient's initial presentation demonstrated cystoid macular edema.

scar, stable arcuate incisions, a Crystalens centered in the capsular bag and no other abnormalities. Fundoscopic examination showed a cup-to-disc ratio of 0.5 in the right eye and 0.65 in the left eye. Other notable findings in the right eye were asteroid-like opacities with rare cells in the vitreous and macular edema without evidence of vasculitis, snowballing or scleritis. Optical coherence tomography demonstrated retinal thickening consistent with macular edema *(Figure 1)*.

What is your diagnosis? What further workup would you pursue? The diagnosis appears below.

Diagnosis and Management

This patient's history, examination, and optical coherence tomography findings were consistent with cystoid macular edema associated with pseudophakia and uveitis. He had multiple risk factors for CME including prior cataract extraction complicated by retained lens material, vitrectomy, uveitis and sarcoidosis. Notably, he didn't have diabetes, wasn't taking prostaglandin eye drops for his glaucoma and didn't have any systemic sarcoidosis symptoms.

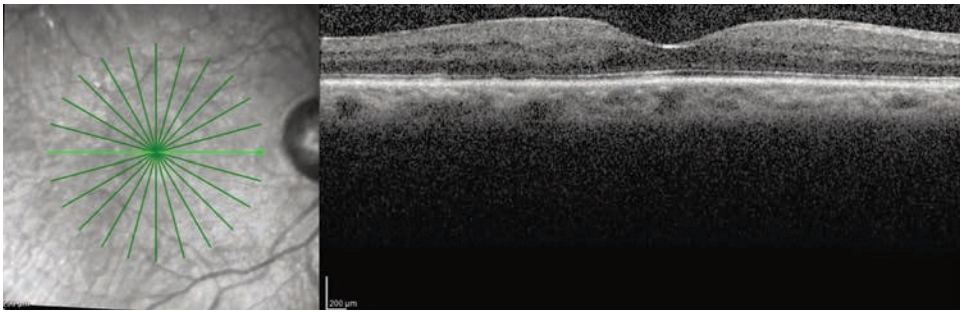

Figure 2. Optical coherence tomography of the right eye after two years of topical ketorolac and difluprednate treatment demonstrated resolved cystoid macular edema, with a foveal thickness measurement of 267 µm.

While his diagnosis of CME was confirmed with OCT, the subsequent management of his CME was challenging, and his course was atypical. Initial treatment of his CME at Wills included three doses of periocular sub-Tenon's triamcinolone acetonide and one injection of intravitreal bevacizumab over nine months, with continuation of his daily difluprednate 0.05%. His CME persisted without significant improvement despite these interventions, lack of systemic sarcoidosis symptoms and ongoing suppression of his uveitis. Over the following year, his severe CME was resistant to oral acetazolamide (initially 125 mg t.i.d., then increased to 250 mg t.i.d.), two injections of intravitreal triamcinolone acetonide and three injections of aflibercept. After two years of recalcitrant CME, there were low expectations for improvement, and he was started on ketorolac 0.5% q.i.d. and continued on difluprednate 0.05% once daily.

Surprisingly, after two years of topical ketorolac and difluprednate treatment, his CME resolved on OCT (*Figure 2*), with a foveal thickness measurement of 267 µm, and visual acuity improved to 20/60. His treatment course was complicated by one episode of ocular hypertension (maximum 30 mmHg) 21 months after his last aflibercept injection, which improved with timolol.

Examination

Cystoid macular edema, which presents as distorted central vision and macular thickening, can result from a diverse range of pathologies, including uveitis, postoperative inflammation, diabetes, retinitis pigmentosa, retinal vein occlusions and others. CME occurs when extracellular fluid accumulates in the outer plexiform and inner nuclear retinal layers and forms cystic collections between retinal septa.[1,2] Different diseases may lead to CME through disparate mechanisms, so determining the underlying etiology of CME is important for selecting an appropriate treatment. Although CME is often considered as a single disease entity, it is in fact a complex pathology with multiple pathways leading to its development, many of which are still not understood.[3]

This discussion focuses on two types of inflammatory CME (uveitic and pseudophakic), because these are most relevant to our patient's case. Approximately 40 percent of uveitis patients develop macular edema, 25 percent of

which is CME, and macular edema is the primary cause of vision loss in uveitis.[2,4–7] Risk factors for developing CME included older age at onset of uveitis, and chronic and persistent uveitis.[6] Pseudophakic CME complicates 0.2 to 3.3 percent of cataract extractions and typically occurs one to six weeks after surgery.[8] Risk factors include postoperative inflammation, combined procedures such as phacovitrectomy, and complications such as retained lens fragments.[8]

In both uveitic and pseudophakic CME, inflammatory cytokines and vascular endothelial growth factor are thought to cause disruption of the blood retinal barrier, which is composed of tight junctions between retinal pigment epithelial cells and capillary endothelial cells.[3,9] Treatments for uveitic and pseudophakic CME focus on reducing inflammatory cascades and VEGF, and targeting retinal fluid flow.

Steroids, in various forms, are the mainstay of inflammatory CME management.[7] Regional steroids, in particular, play a crucial role in treating eyes with suppressed uveitis but ongoing macular edema.[7,10] A recent randomized clinical trial compared the efficacy and safety of the three most commonly used regional steroid therapies for uveitic macular edema, including periocular triamcinolone acetonide, intravitreal triamcinolone acetonide and the intravitreal dexamethasone implant. Results published in 2019 showed that all three treatment groups had improved central macular subfield thickness on OCT, but the two intravitreal treatment groups had greater and faster onset of efficacy than the periocular group. Intravitreal injections, however, carried a slightly higher risk of IOP elevations than periocular treatment.[7]

When CME is resistant to steroids, anti-VEGF injections may be used. They have been shown to temporarily decrease macular thickness in persistent inflammatory CME in prior studies—but only if the uveitis is suppressed.[11,12] However, there has also been a report of a 1.3-percent incidence of acute intraocular inflammation following anti-VEGF injections.[13] Carbonic anhydrase inhibitors are also thought to be effective in steroid-refractory CME cases because they work on RPE dysfunction, which anti-inflammatory treatments don't target.[14] One study showed that 68 percent of patients with chronic inflammatory CME had improvement or resolution in their central macular subfield thickness on OCT after acetazolamide was added to their treatment regimens.[14] A benefit of acetazolamide is that it doesn't carry the risk of elevated intraocular pressure, but it can result in numerous systemic side effects with long term use.[14]

When our patient's CME failed to respond to steroids, anti-VEGF agents and acetazolamide, he was started on a topical NSAID. In the treatment algorithm for pseudophakic CME, NSAIDs are considered a first-line intervention with concurrent topical steroids.[8,9] They act by inhibiting cyclooxygenase enzymes, which are downstream of arachidonic acid released by uveal tissues postoperatively. A prior study showed that 54 percent of patients with pseudophakic CME had complete resolution of edema on OCT with six weeks of topical steroid and nepafenac treatment.[15] However, these results may be confounded by pseudophakic CME's typical course, which tends to improve spontaneously.[14] Compared to steroids, NSAIDs have a less extensive anti-inflammatory effect, so they are typically not expected to improve steroid-resistant CME.[8]

After two years of treatment with topical NSAIDs and difluprednate, our patient's CME resolved. This atypical clinical response demonstrates that although CME may have a common clinical presentation, it's modulated by diverse mechanisms yet to be fully characterized and which may respond to unexpected treatment modalities. Therefore, despite the availability of multiple evidence-based treatments for inflammatory CME, its management continues to be challenging. ◂

1. Fardeau C, Champion E, Massamba N, et al. Uveitic macular edema. Eye 2016;30:1277–1292.
2. Tomkins-Netzer O, Lightman S, Drye L, et al. Outcome of treatment of uveitic macular edema: The Multicenter Uveitis Steroid Treatment trial 2-year results. Ophthalmology 2015;122:2351–2359.
3. Daruich A, Matet A, Moulin A, et al. Mechanisms of macular edema: Beyond the surface. Prog Retin Eye Res 2018;63:20–68.
4. Lardenoye CWTA, van Kooij B, Rothova A. Impact of macular edema on visual acuity in uveitis. Ophthalmology 2006;113:1446–1449.
5. Rothova A, Suttorp-van Schulten MS, Frits Treffers W, et al. Causes and frequency of blindness in patients with intraocular inflammatory disease. Br J Ophthalmol 1996;80:332–336.
6. Grajewski RS, Boelke AC, Adler W, et al. Spectral-domain optical coherence tomography findings of the macula in 500 consecutive patients with uveitis. Eye 2016;30:1415–1423.
7. The Multicenter Uveitis Steroid Treatment Trial (MUST) Research Group, Thorne JE, Sugar EA, et al. Periocular triamcinolone versus intravitreal triamcinolone versus intravitreal dexamethasone implant for the treatment of uveitic macular edema: The PeriOcular versus INTravitreal corticosteroids for uveitic macular edema (POINT) Trial. Ophthalmology 2019;126:283.
8. Grzybowski A, Kanclerz P. The role of steroids and NSAIDs in prevention and treatment of postsurgical cystoid macular edema. Curr Pharm Des 2018;24:4896–4902.
9. Benitah NR, Arroyo JG. Pseudophakic cystoid macular edema. Int Ophthalmol Clin 2010;50:139–153.
10. Leder HA, Jabs DA, Galor A, et al. Periocular triamcinolone acetonide injections for cystoid macular edema complicating noninfectious uveitis. Am J Ophthalmol 2011;152:441–448.e2.
11. Mackensen F, Heinz C, Becker MD, et al. Intravitreal bevacizumab (avastin) as a treatment for refractory macular edema in patients with uveitis: A pilot study. Retina 2008;28:41–45.
12. Bae JH, Lee CS, Lee SC. Efficacy and safety of intravitreal bevacizumab compared with intravitreal and posterior sub-tenon triamcinolone acetonide for treatment of uveitic cystoid macular edema. Retina 2011;31:1:111-8.
13. Johnson D, Hollands H, Hollands S, et al. Incidence and characteristics of acute intraocular inflammation after intravitreal injection of bevacizumab: A retrospective cohort study [Internet]. Can J Ophthalmol 2010;45:3:239-42.
14. Pepple KL, Nguyen MH, Pakzad-Vaezi K, et al. Response of inflammatory cystoid macular edema to treatment using oral acetazolamide. Retina 2019;39:948–955.
15. Sengupta S, Vasavada D, Pan U, et al. Factors predicting response of pseudophakic cystoid macular edema to topical steroids and nepafenac. Indian J Ophthalmol 2018;66:827–830.

Not an actual patient.

*In some patients with continued daily use. One drop in each eye, twice daily (approximately 12 hours apart).[3]

†Xiidra is an LFA-1 antagonist for the treatment of dry eye disease. Pivotal trial data: The safety and efficacy of Xiidra were assessed in four 12-week, randomized, multicenter, double-masked, vehicle-controlled studies (N=2133). Patients were dosed twice daily. Use of artificial tears was not allowed during the studies. The study end points included assessment of signs (based on Inferior fluorescein Corneal Staining Score [ICSS] on a scale of 0 to 4) and symptoms (based on patient-reported Eye Dryness Score [EDS] on a visual analogue scale of 0 to 100).[3] A larger reduction in EDS favoring Xiidra was observed in all studies at day 42 and day 84. Xiidra reduced symptoms of eye dryness at 2 weeks (based on EDS) compared to vehicle in 2 out of 4 clinical trials. Effects on signs of dry eye disease ICSS (on a scale from 0-4; 0=no staining; 4=coalescent) was recorded at each study visit. At day 84, a larger reduction in inferior corneal staining favoring Xiidra was observed in 3 of the 4 studies.[3]

Indication

Xiidra® (lifitegrast ophthalmic solution) 5% is indicated for the treatment of signs and symptoms of dry eye disease (DED).

Important Safety Information

- Xiidra is contraindicated in patients with known hypersensitivity to lifitegrast or to any of the other ingredients.

NOVARTIS

Novartis Pharmaceuticals Corporation
East Hanover, New Jersey 07936-1080

Important Safety Information (cont)

- In clinical trials, the most common adverse reactions reported in 5-25% of patients were instillation site irritation, dysgeusia and reduced visual acuity. Other adverse reactions reported in 1% to 5% of the patients were blurred vision, conjunctival hyperemia, eye irritation, headache, increased lacrimation, eye discharge, eye discomfort, eye pruritus and sinusitis.
- To avoid the potential for eye injury or contamination of the solution, patients should not touch the tip of the single-use container to their eye or to any surface.
- Contact lenses should be removed prior to the administration of Xiidra and may be reinserted 15 minutes following administration.
- Safety and efficacy in pediatric patients below the age of 17 years have not been established.

For additional safety information about XIIDRA®, please refer to the brief summary of Full Prescribing Information on adjacent page.

References: 1. US Food and Drug Administration. Code of Federal Regulations, Title 21, Volume 5 (21CFR349). Accessed April 17, 2020. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=349&showFR=1 **2.** Jones L, Downie LE, Korb D, et al. TFOS DEWS II Management and Therapy Report. *Ocul Surf.* 2017;15(3):575-628. **3.** Xiidra [package insert]. East Hanover, NJ: Novartis Pharmaceuticals Corp; June 2020.

XIIDRA® (lifitegrast ophthalmic solution), for topical ophthalmic use
Initial U.S. Approval: 2016

BRIEF SUMMARY: Please see package insert for full prescribing information.

1 INDICATIONS AND USAGE

Xiidra® (lifitegrast ophthalmic solution) 5% is indicated for the treatment of the signs and symptoms of dry eye disease (DED).

4 CONTRAINDICATIONS

Xiidra is contraindicated in patients with known hypersensitivity to lifitegrast or to any of the other ingredients in the formulation *[see Adverse Reactions (6.2)]*.

6 ADVERSE REACTIONS

The following serious adverse reactions are described elsewhere in the labeling:

- Hypersensitivity *[see Contraindications (4)]*

6.1 Clinical Trials Experience

Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in clinical trials of a drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in practice.

In five clinical trials of DED conducted with lifitegrast ophthalmic solution, 1401 patients received at least one dose of lifitegrast (1287 of which received lifitegrast 5%). The majority of patients (84%) had less than or equal to 3 months of treatment exposure. One hundred-seventy patients were exposed to lifitegrast for approximately 12 months. The majority of the treated patients were female (77%). The most common adverse reactions reported in 5%-25% of patients were instillation-site irritation, dysgeusia, and reduced visual acuity.

Other adverse reactions reported in 1%-5% of the patients were blurred vision, conjunctival hyperemia, eye irritation, headache, increased lacrimation, eye discharge, eye discomfort, eye pruritus, and sinusitis.

6.2 Postmarketing Experience

The following adverse reactions have been identified during post-approval use of Xiidra. Because these reactions are reported voluntarily from a population of uncertain size, it is not always possible to reliably estimate their frequency or establish a causal relationship to drug exposure.

Rare serious cases of hypersensitivity, including anaphylactic reaction, bronchospasm, respiratory distress, pharyngeal edema, swollen tongue, urticaria, allergic conjunctivitis, dyspnea, angioedema, and allergic dermatitis have been reported. Eye swelling and rash have also been reported *[see Contraindications (4)]*.

8 USE IN SPECIFIC POPULATIONS

8.1 Pregnancy

Risk Summary

There are no available data on Xiidra use in pregnant women to inform any drug-associated risks. Intravenous (IV) administration of lifitegrast to pregnant rats, from premating through gestation day 17, did not produce teratogenicity at clinically relevant systemic exposures. Intravenous administration of lifitegrast to pregnant rabbits during organogenesis produced an increased incidence of omphalocele at the lowest dose tested, 3 mg/kg/day (400-fold the human plasma exposure at the recommended human ophthalmic dose [RHOD], based on the area under the curve [AUC] level). Since human systemic exposure to lifitegrast following ocular administration of Xiidra at the RHOD is low, the applicability of animal findings to the risk of Xiidra use in humans during pregnancy is unclear *[see Clinical Pharmacology (12.3) in the full prescribing information]*.

Data

Animal Data

Lifitegrast administered daily by IV injection to rats, from premating through gestation day 17, caused an increase in mean pre-implantation loss and an increased incidence of several minor skeletal anomalies at 30 mg/kg/day, representing 5,400-fold the human plasma exposure at the RHOD of Xiidra, based on AUC. No teratogenicity was observed in the rat at 10 mg/kg/day (460-fold the human plasma exposure at the RHOD, based on AUC). In the rabbit, an increased incidence of omphalocele was observed at the lowest dose tested, 3 mg/kg/day (400-fold the human plasma exposure at the RHOD, based on AUC), when administered by IV injection daily from gestation days 7 through 19. A fetal no observed adverse effect level (NOAEL) was not identified in the rabbit.

8.2 Lactation

Risk Summary

There are no data on the presence of lifitegrast in human milk, the effects on the breastfed infant, or the effects on milk production. However, systemic exposure to lifitegrast from ocular administration is low *[see Clinical Pharmacology (12.3) in the full prescribing information]*. The developmental and health benefits of breastfeeding should be considered, along with the mother's clinical need for Xiidra and any potential adverse effects on the breastfed child from Xiidra.

8.4 Pediatric Use

Safety and efficacy in pediatric patients below the age of 17 years have not been established.

8.5 Geriatric Use

No overall differences in safety or effectiveness have been observed between elderly and younger adult patients.

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