EyeWorld CME Supplement™

Supplement to EyeWorld September 2015

The X Factors: Three areas that will improve refractive cataract surgery outcomes

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Edward J. Holland, MD

Experts share insights on dry eye diagnosis and treatment, reducing residual error, and eliminating or reducing inflammation after refractive cataract surgery

Experts take aim at threats to optimal results

by Edward J. Holland, MD

> ***"… There is increased awareness of the significance of inflammation and the role it plays in outcomes regarding vision and pain."***

In this supplement, we will examine the "X factors"—the extra undefinable elements that may lead to the best possible outcomes for your refractive cataract surgery patients, who have high visual expectations from their procedures.

Our panel of experts will concentrate on the 3 factors that physicians can control to enhance refractive cataract surgery outcomes: dry eye diagnosis and treatment, reducing residual error, and eliminating or reducing postop inflammation.

Respondents to the 2014 ASCRS Clinical Survey reported important information about their practices regarding these issues and a range of others. This extensive survey revealed opinions and practice patterns based on responses from more than 1,500 unique respondents. It focused on 267 data points related to the most compelling and controversial issues facing ASCRS members and has guided the ASCRS Program Committee on its educational efforts.

Dry eye diagnosis and treatment

When members were asked, "How much do you believe the following tests can reliably increase your diagnostic accuracy of ocular surgery diseases (OSDs) and treatment efficacy?" 62% agreed or strongly agreed that Schirmer testing reliably increases their diagnostic accuracy. Only 13% use advanced tear film diagnostics at the initial point of care. The Schirmer test is more than a century old, and we believe there are newer, better ways to identify dry eye.

In response to a question regarding whether they follow the Dry Eye Workshop (DEWS)/Delphi guidelines for treating dry eye and meibomian gland dysfunction, most respondents didn't know or didn't use evidence-based guidelines (Figure 1).

Visual outcomes

When members were asked how many degrees of postoperative rotational error is acceptable after implantation of toric intraocular lenses (IOLs) before visual quality and visual acuity are significantly affected, nearly a third responded 10

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This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education through the joint providership of the American Society of Cataract & Refractive Surgery (ASCRS) and *EyeWorld*. ASCRS is accredited by the ACCME to provide continuing medical education for physicians.

Educational Objectives
Ophthalmologists who participate in this activity will:

- Distinguish predisposing factors putting patients at higher risk for inflammatory reaction after cataract surgery
- Identify the true impact of ocular inflammation levels on outcomes in refractive cataract surgery
- Identify new agents and acquire strategies to eliminate inflammation and relieve pain by maximizing the penetration of anti-inflammatory agents into target tissues
- Assess the clinical impact of various levels of ultrasound energy applied during cataract surgery, and how these differ with complex vs. routine cataract patients
- Recognize the amount of reduction in these levels available with laser cataract technology for specific types of patients

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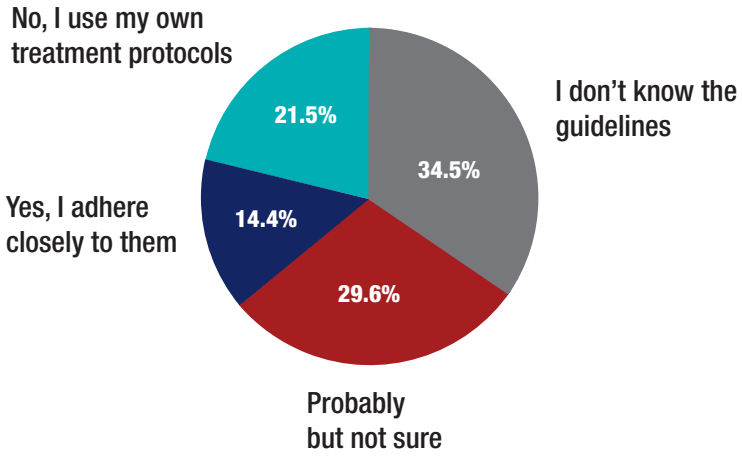

Figure 1. Most respondents to the 2014 ASCRS Clinical Survey did not know or use evidence-based guidelines to treat dry eye and meibomian gland dysfunction.

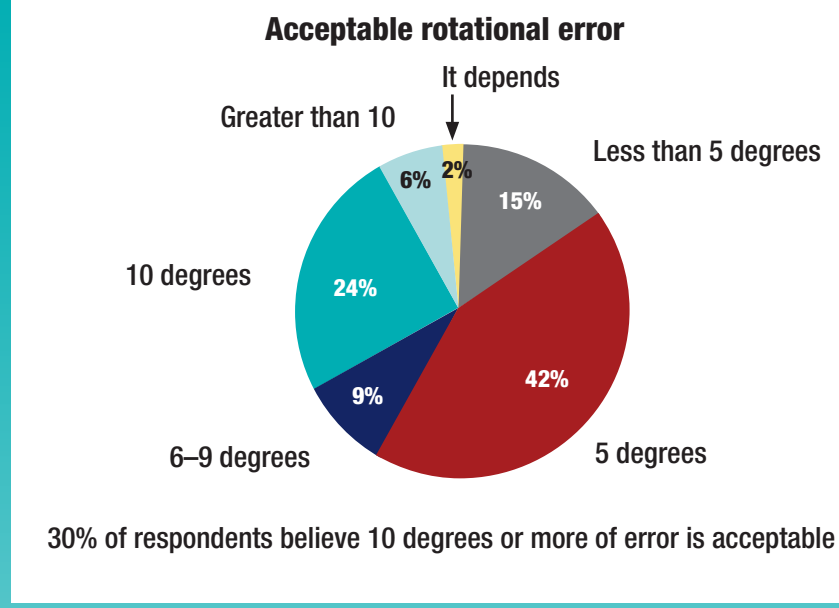

Figure 2. Although nearly a third of respondents believe 10 degrees or more rotational error is acceptable after implantation of a toric IOL, quality of vision will decrease significantly when rotation is 10 degrees or more.

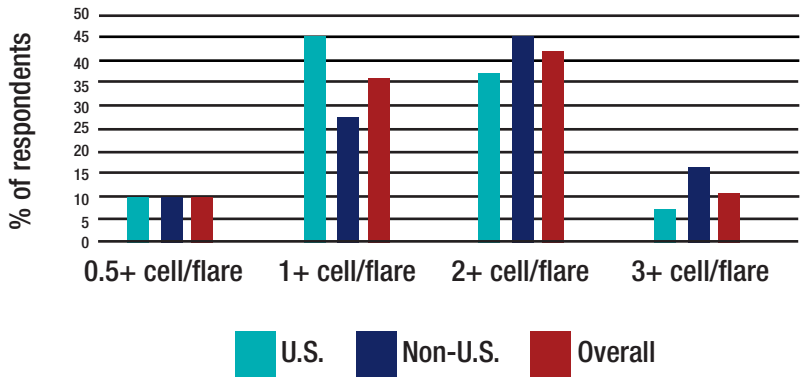

Figure 3. Almost half of respondents believe 1+ cell/flare has a clinically significant impact on visual acuity, quality of visual recovery, and/or patient comfort and satisfaction, showing increased awareness of the impact of inflammation on visual outcomes and pain.

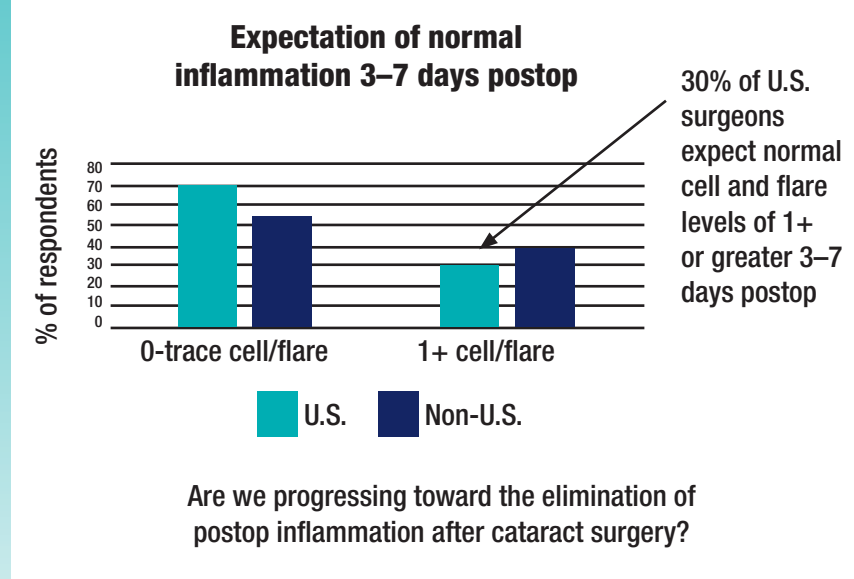

Figure 4. Thirty percent of respondents expect some degree of inflammation 3–7 days after cataract surgery. However, the question remains whether surgeons can reach a new point with newer medications to reduce inflammation and potentially reduce postoperative pain.

degrees or more is acceptable (Figure 2). However, we know we will see a significant decrease in quality of vision when we see rotation of 10 degrees or more.

When clinicians were asked, "What level of inflammation 3–7 days after cataract surgery do you believe has a clinically significant impact on visual acuity/quality of visual recovery and/or patient comfort and satisfaction?" almost half believe that 1+ cell/flare has a clinically significant impact on visual acuity, quality of visual recovery, and/or patient comfort and satisfaction (Figure 3). This demonstrates that there is increased awareness of the significance of inflammation and the role it plays in outcomes regarding vision and pain.

Thirty percent expect normal cell and flare levels of 1+ or greater 3–7 days after surgery (Figure 4).

Forty-seven percent of respondents are not preloading anti-inflammatories (NSAIDs or steroids) in cataract patients. Forty percent of respondents are using both steroids and NSAIDs one day after surgery.

Expert recommendations

Based on their experiences and expertise, our panel will share their recommendations regarding ways to optimize the ocular surface, reduce residual error, and reduce postoperative inflammation to deliver the best possible outcomes for your refractive surgery patients.

Reference

1. ASCRS Clinical Survey 2014. Global Trends in Ophthalmology. Fairfax, VA: American Society of Cataract & Refractive Surgery, 2014.

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Dry eye disease too important to ignore in surgical practice

by Preeya K. Gupta, MD

Preeya K. Gupta, MD

Surgeons need to identify and manage dry eye early to improve refractive outcomes

Cataract surgery has evolved into refractive surgery, enabling us to deliver visual outcomes our patients desire.

To make the most of advanced laser and intraocular lens (IOL) technologies, we need to identify and manage ocular surface disease—a potential source of postoperative refractive error.

Dry eye impact

Dry eye disease is one of the most common reasons to seek eyecare and impairs refractive outcomes in a number of ways. It creates a poor tear film, leading to unreliable preoperative measurements (e.g., biometry, keratometry, topography) (Figure 1).

Postoperatively, ocular surface inflammation adversely affects vision quality. Patients report image quality degradation and increased higher-order aberrations. Minimizing higher-order aberrations is especially critical in taking full advantage of advanced IOLs.

Furthermore, if we do not identify ocular surface inflammation and dry eye preoperatively, patients believe we created these conditions. When we identify the problem early, patients recognize they may have 2 disease processes and their expectations are more accurate.

A 68-year-old patient who had femtosecond laser cataract surgery came to us for a second opinion because she couldn't see well with her multifocal IOL. Her uncorrected vision was 20/25+1 OU, J1 (manifest refraction: plano-0.25 x 180).

Her records were unremarkable, but during the examination we identified 2+ meibomian gland dysfunction (MGD) on both lids and multiple punctate epithelial erosions. She had a 5-second tear breakup time, osmolarity was 308 and 310 mOsms/l, and she had positive MMP-9 results.

This illustrates that we cannot take advantage of advanced technology if we ignore the ocular surface.

Diagnostic options

To quickly diagnose ocular surface disease, we need to apply pressure to the eyelids and examine the margins and gland openings carefully for secretions. Without digital examination, we may miss gland disease.

Point-of-care testing is important and may include osmolarity, MMP-9 levels, non-contact tear breakup time, and lipid layer thickness assessment. Technicians can perform these tests and provide data to clinicians.

MGD is the most common cause of dry eye. Although it produces thick gland secretions, poor oil flow, and a foamy tear film, not all cases are obvious (Figure 2).

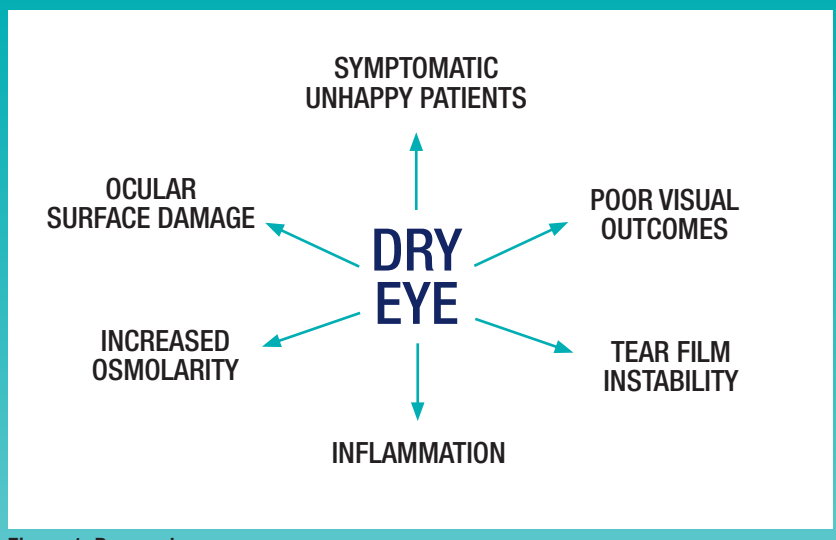

Figure 1. Dry eye has numerous consequences.

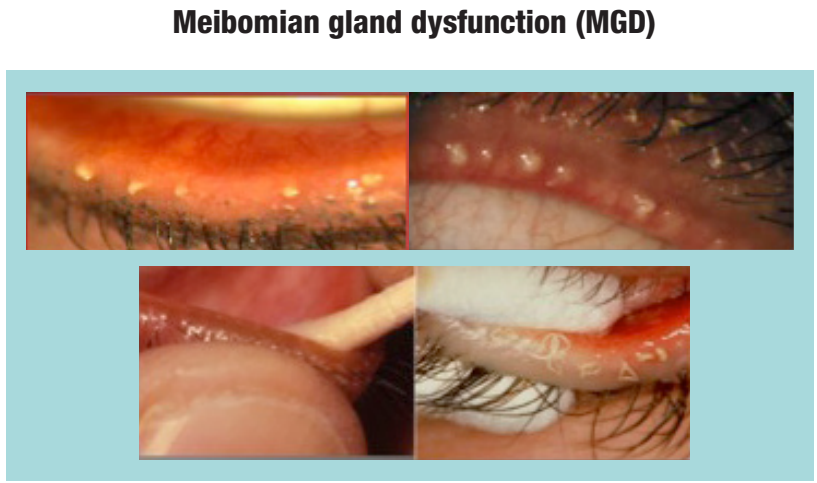

Figure 2. MGD may cause thick gland secretions, poor oil flow, or a foamy tear film (top). However, not all cases are obvious (bottom).

> ***"Disease-modifying procedures such as thermal pulsation and intense pulsed light therapy have revolutionized dry eye care."***

Dry eye treatment does not need to be difficult. Topical therapies such as artificial tears, hot compresses, lid scrubs, ointments, and gels can be offered for any level of ocular surface inflammation. I reserve cyclosporine and prednisolone or loteprednol for patients with elevated MMP-9 or osmolarity levels, but any inflammation must be addressed.

Disease-modifying procedures such as thermal pulsation and intense pulsed light therapy have revolutionized dry eye care, relieving symptoms and enabling patients to have surgery more quickly.

We should not reserve disease-modifying procedures for end-stage disease; we should offer them early to all patients with MGD.

Conclusion

We need to identify dry eye and ocular surface inflammation before surgery to avoid refractive surprises and unhappy patients. Treatment is not difficult. By intervening early with disease-modifying procedures, we can help patients achieve their goals more quickly.

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Steps to minimize residual refractive error

by Preeya K. Gupta, MD

Preeya K. Gupta, MD

A thorough game plan can help surgeons achieve patient satisfaction

Blurred vision is a leading cause of dissatisfaction after implantation of a premium intraocular lens (IOL).

One of the most common reasons is residual refractive error, which must be addressed to ensure patient satisfaction.

Postoperative enhancement

In a study of 550 patients, we found that the enhancement rate was 9.5% after implantation of multifocal IOLs and 6.7% after implantation of accommodating IOLs.[1] Research indicates that post-cataract refractive error typically ranges from –2.0 to +1.0 D.

At the 2013 ASCRS•ASOA Symposium & Congress, **Steven Schallhorn, MD**, reviewed outcomes in nearly 2,500 patients who had bilateral refractive lens exchange with a multifocal IOL. Patients with astigmatism >0.5 D less often reported that they were very satisfied (Figure 1).

Residual refractive error leads to poor patient satisfaction, poor vision quality, and poor uncorrected distance visual acuity. Surgeons should aim for less than 0.5 D of astigmatism.

Surgical game plan

To avoid residual refractive error, I have developed a surgical game plan.

We begin with a thorough medical history and examine topography and keratometry. At the slit lamp, I look for basement membrane dystrophy, Salzmann's nodules, dry eye, meibomian gland dysfunction, and pterygia; these patients often have astigmatism that will prevent accurate measurements. If we treat based on unreliable measurements, we may induce more astigmatism.

To manage expectations, we explain to patients that reactive stability can take a long time. I share that refractive cataract surgery is an art and everyone's eyes are not typical. I spend extra time on patients who had previous refractive surgery or have an axial length that is out of the typical range, which might affect IOL power calculations.

I inform patients if they will need a staged procedure, as with implantation of a multifocal IOL followed by laser vision correction.

It's best to address astigmatism during cataract surgery (Figure 2). Limbal relaxing incisions are effective for less than 1.5 D astigmatism. Toric IOLs are good for patients with higher levels of astigmatism who want good corrected distance vision or monovision. We also discuss planned postoperative laser vision correction for high levels of astigmatism after implantation of multifocal IOLs.

In addition, we plan the incision location and take into account our surgically induced astigmatism. Intraoperative aberrometry can also help refine IOL choices.

I explain that patients may need postoperative enhancements and typically use laser vision correction for small myopic or hyperopic surprises as long as the cornea is normal. For larger errors, especially hyperopic errors, a piggyback IOL or IOL exchange is a good option.

Conclusion

To achieve highest patient satisfaction, we need to minimize residual refractive error and use the right tool for the right situation. Patient education on the art of refractive cataract surgery is also key.

> ***"Residual refractive error leads to poor patient satisfaction, poor vision quality, and poor uncorrected distance visual acuity."***

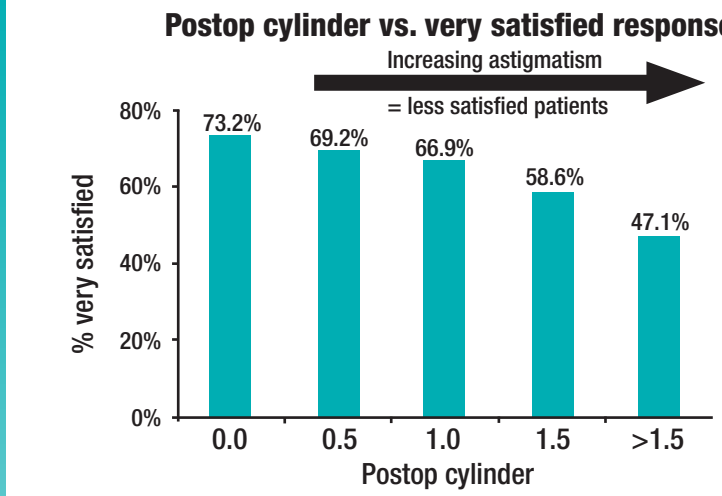

Figure 1. After bilateral refractive lens exchange with multifocal IOLs, patients with residual astigmatism >0.5 D less often reported that they were very satisfied.

Source: Adapted from slide provided by Steven Schallhorn, MD

Surgical planning

- Manage astigmatism (*at the time of phaco if possible*)
  - Limbal relaxing incisions (LRI): <1.5 D astigmatism
  - Toric IOL: >1.5 D astigmatism
  - Planned postop laser vision correction: for higher levels of astigmatism w/ MF IOL
- Think about incision location and SIA
- Intraoperative aberrometry is helpful
- Residual refractive error
  - Hyperopic surprise: piggyback IOL or IOL exchange
  - Myopic surprise: laser vision correction

Figure 2. Surgical plan to reduce postoperative residual refractive error

Source: Preeya K. Gupta, MD

Reference

1. Legault et al. In press.

Dr. Gupta is assistant professor of ophthalmology, cornea and refractive surgery, Duke University Eye Center, and clinical medical director of the Duke Eye Center at Page Road in Durham, N.C. She can be contacted at preeya.gupta@duke.edu.

Strategies to prevent edema and relieve pain by maximizing penetration of anti-inflammatory agents

by David A. Goldman, MD

David A. Goldman, MD

Reducing inflammation and pain increases patient satisfaction and improves visual recovery after cataract surgery

Intraocular lenses (IOLs) require a quiet eye for best visual results. We may be able to predict inflammatory responders before surgery by identifying predisposing conditions and reduce inflammation with new anti-inflammatory medications that offer greater penetration.

Predicting inflammation

Diabetes, glaucoma, and macular disease are just a few conditions that may increase postoperative inflammation. In addition, prostaglandins have been associated with cystoid macular edema (CME) and alpha-blockers such as tamsulosin with intraoperative floppy iris syndrome.

Furthermore, more inflammation may occur in patients with dense cataracts or darkly pigmented irises or those requiring additional surgical time.

Managing inflammatory mediators

Surgical trauma triggers the inflammatory cascade. Steroids and nonsteroidal anti-inflammatories (NSAIDs) work at different stages of this process, and I believe there is a synergistic effect when we combine them.

NSAID pretreatment reduces intraoperative miosis and increases postoperative comfort. After surgery

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Product Name	Indication
Bromfenac, 0.07% (Prolensa, Bausch + Lomb)	For the treatment of postoperative inflammation and reduction of ocular pain in patients who have undergone cataract surgery
Ketorolac tromethamine, 0.45% (Acuvail, Allergan)	For the treatment of pain and inflammation following cataract surgery
Nepafenac, 0.3% (Ilevro, Alcon)	For the treatment of pain and inflammation associated with cataract surgery
Phenylephrine and ketorolac injection, 1%/0.3% (Omidria, Omeros)	FDA-approved for maintaining pupil size by preventing miosis and for reducing postoperative ocular pain in adult patients

Figure 1. Nonsteroidal anti-inflammatory agents used to treat pain associated with cataract surgery

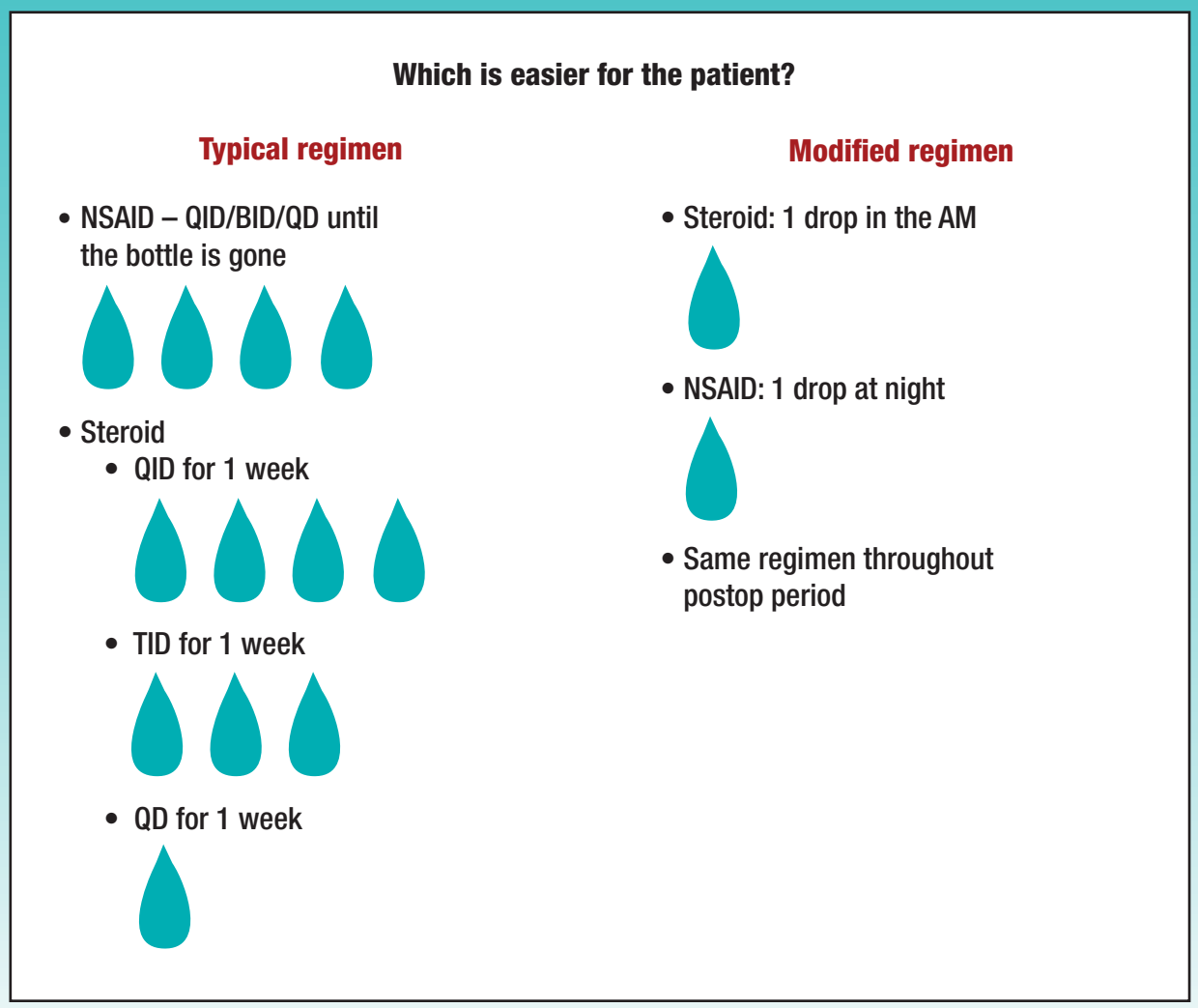

Figure 2. Eye drop regimen comparison

Supported by unrestricted educational grants from Alcon Laboratories and Omeros

Impact of ultrasound energy during refractive cataract surgery

by Mitchell A. Jackson, MD

Mitchell A. Jackson, MD

Reducing ultrasound energy during cataract surgery helps reduce postoperative inflammation

Surgical stress during cataract surgery triggers a cascade of metabolic events that result in inflammation.

However, by examining the surgical factors that contribute to inflammation, we can develop strategies to minimally disrupt other tissues and prevent heat damage.

Increased stress

Postoperative corneal edema is associated with ultrasound time and irrigation/aspiration (I/A) volume during the procedure, as well as the cataract density.

Surgical techniques such as the stop and chop technique result in greater phaco time, power, and effective phacoemulsification time (EPT) compared with the nuclear pre-slice technique. Divide and conquer requires more time and uses more energy than chopping techniques.

Viscoelastics also play a role in this process. Exothermic viscosurgical devices increase heat production more than cohesive viscoelastics.

During surgery, we need to avoid manipulation. Incisional trauma, epithelial trauma, and endothelial cell loss cause surgical stress. The surgical difficulties we encounter, such as a dense nucleus, broken capsules, retained nucleus or cortex, iris turbulence and trauma, and other challenges, also increase stress by lengthening our procedures.

Furthermore, if we are not careful, foreign substances such as intracameral antibiotics, generic forms of trypan blue, povidone iodine, and intravitreal preparations can increase the inflammatory response.

Procedure	Catalys (AMO)	Femto LDV Z6 (Ziemer)	LENSAR (LENSAR)	LenSx (Alcon)	Victus (B+L)
Anterior capsulotomy	X		X	X	X
Lens fragmentation	X		X	X	X
Corneal incisions	X	X	X	X	X
Arcuate incisions	X	X	X	X	X

The newest systems are highly automated and extremely precise, replacing the manual requirement for 3 of 5 steps (capsulotomy, fragmentation, corneal incisions).

Figure 1. In FLACS, the femtosecond laser creates the capsulotomy, entry wounds, and astigmatic incisions and performs lens fragmentation.

My femtosecond laser-treated lens removal

- Aspiration of nucleus fragments
  - Efficient vacuum aspiration
  - Dual-linear control of power and vacuum
  - Minimal to no post-occlusion surge
- Microburst (more energy efficient)
  - 26–28% ultrasound power
  - 1–75% duty cycle (waveforms per cycle)
  - 8 ms burst duration
  - Waveform – 60% depth
- Cortex removal
  - Precise vacuum control
  - Single-use silicone irrigation/aspiration handpiece

Simultaneous dual-linear control of aspiration and ultrasound enables fine-tuned optimization for post femtosecond cataract surgery

Figure 2. Dr. Jackson's procedure for femtosecond laser-treated lens removal

Gentler surgery

Advances in phacoemulsification technology and surgical techniques are reducing surgical stress.

Phaco technology now delivers ultrasound in smaller pulses of energy—resulting in less tissue trauma and inflammation.

Femtosecond lasers perform several functions in cataract surgery and precisely target laser energy to pre-fragment or soften the lens (Figure 1).

Femtosecond laser-assisted cataract surgery (FLACS) and ultrasound phacoemulsification use cavitation to disrupt tissue. However, the laser delivers energy more efficiently, with less heat and less collateral damage

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we can treat with NSAIDs and steroids for a synergistic effect. Rapidly reducing inflammation keeps patients comfortable and optimizes visual recovery.

Manufacturers have developed advanced anti-inflammatory formulations, taking existing active pharmaceutical ingredients and enhancing the vehicles to improve efficacy. They are safer for the ocular surface and available in different concentrations. Our goal is to enhance efficacy through increased penetration and tissue concentrations. Newer formulations decrease dosing, which may improve patient compliance.

Bromfenac, diclofenac, ketorolac, and nepafenac are the most common topical NSAIDs. Topical corticosteroids include dexamethasone, difluprednate, loteprednol etabonate gel, and prednisolone acetate. Vehicles in generic vs. brand name medications vary. Generic drops differ significantly in drop volume, viscosity, surface tension, and bottle tip.[1]

Pain is a continuum, however, Fung et al. reported that any postoperative pain significantly predicted patient dissatisfaction with care.[2]

NSAIDs effectively reduce postoperative pain (Figure 1). In a phase 3 trial, postoperative pain improved significantly in those receiving a new injectable formulation, phenylephrine 1% and ketorolac 0.3% injection vs. placebo.[3]

We also have compounded formulations of steroids and antibiotics that can be administered via a transzonular approach.

Although clinically significant CME ranges up to 6%, optical coherence tomography (OCT) imaging shows CME in up to 19% after cataract surgery. If a cataract patient with 20/20 vision complains of decreased visual acuity, we use OCT to check for CME. CME may reduce visual quality without reducing visual acuity.

There are many ways to maximize penetration of these agents, including prodrug technology, emulsion technology, increased residual time on the ocular surface, subconjunctival injection, intracameral or intravitreal injection into the eye, and increased dosing frequency.

For my patients, I prescribe an NSAID starting one day preoperatively. On the day of surgery, patients receive an NSAID before surgery; they receive a drop of difluprednate at the end of the case and one in recovery, as well as epi-Shugarcaine. My postoperative regimen is one drop of difluprednate each morning and one drop of nepafenac ophthalmic suspension before bedtime each day. Because patients dislike eye drops, this regimen with new formulations results in happy patients (Figure 2).

> **"Rapidly reducing inflammation keeps patients comfortable and optimizes visual recovery."**

Conclusion

All cataract patients require a quiet eye for the best visual results. Newer anti-inflammatories with enhanced drug delivery vehicles have improved concentrations while decreasing toxicity. Although CME is rare, it can be very serious, and NSAIDs and steroids are very helpful in preventing it.

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Dr. Goldman is founder of Goldman Eye, Palm Beach Gardens, Fla. He can be contacted at david@goldmaneye.com.

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> **"Advances in phacoemulsification technology and surgical techniques are reducing surgical stress."**

vs. ultrasound. The cavitation diameter is much smaller, resulting in up to 1,000 times less collateral damage.

Reducing inflammation results in faster visual recovery. In addition, decreased ultrasound energy is particularly important in patients with shallow anterior chambers, Marfan's syndrome, pseudoexfoliation or zonular dehiscence, and corneal disease.

All of the available femtosecond laser platforms have shown strong reductions in EPT and energy. We are developing more instrumentation to complement FLACS.

Based on my experience, any substantial reduction in phaco energy is highly beneficial (Figure 2). Although zero phaco is an excellent goal, minimizing phaco is a huge improvement. However, we need to avoid running huge volumes of fluid through the eye in our effort to minimize phaco.

Side effects from the femtosecond laser such as gas bubbles or increased intraocular pressure or temperature have not increased the risk of macular edema. [1]

Reduced inflammation

Data from a 25-center international study[2] examined the performance of standard coaxial phacoemulsification, coaxial microincision cataract surgery (C-MICS), and bimanual (biaxial) microincision cataract surgery (B-MICS). The EPT was 4.6 seconds in the 811 C-MICS cases. In comparison, in my 470 femtosecond cases performed with microburst phacoemulsification, my average EPT was 1.1 seconds.

Many reports in the literature show that FLACS reduces corneal swelling because there is less trauma to the endothelial cells. There is typically less macular edema because there's less inflammation.[3]

A recent study by Schultz et al. showed that prostaglandins increase instantly after femtosecond laser treatment.[4] Using preoperative nonsteroidals or intraoperative nonsteroidals such as phenylephrine 1% and ketorolac 0.3% injection helps reduce prostaglandin release and keeps pupils from shrinking, reducing postoperative inflammation.

Conclusion

Reduced ultrasound energy leads to a reduction in corneal edema, endothelial cell loss, and—most important—postoperative inflammation.

Decreased inflammation translates into improved vision and more rapid visual recovery.

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CME questions (circle the correct answer)

1. **According to Dr. Holland, which measure(s) improve(s) refractive cataract surgery outcomes:**
   a. Dry eye diagnosis and treatment
   b. Reducing residual error
   c. Eliminating or reducing inflammation after surgery
   d. All of the above

2. **According to Dr. Jackson, reduced _____ results in less postoperative inflammation after cataract surgery:**
   a. Preoperative testing
   b. Ultrasound energy in the eye
   c. Steroid use
   d. Nonsteroidal anti-inflammatory use

3. **Dr. Gupta explained that it is important to minimize astigmatism to:**
   a. <1.5 D
   b. <1.0 D
   c. <0.75 D
   d. <0.5 D

4. **According to Dr. Goldman, which condition(s) predispose(s) patients to postoperative inflammation?**
   a. Diabetes
   b. Beta-blocker use
   c. Increased penetration of medication
   d. All of the above

5. **Dr. Gupta reported that postoperative ocular surface inflammation can cause:**
   a. Poor patient compliance with medication use
   b. Increased penetration of medication
   c. Image quality degradation
   d. All of the above

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