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Achieving Microincisional Surgery

Microincisional surgery with OZil IP and the INTREPID PLUS Fluidics Management System.

This article continues a series that explores advanced cataract techniques and technologies. Here, Kerry D. Solomon, MD, of Charleston, South Carolina, discusses his microincisional cataract technique and the emerging role of femtosecond laser technology in cataract surgery. To watch related videos, visit www.Eyetube.net and type the keyword "Intrepid" in the search bar.

MY CURRENT MICROINCISIONAL TECHNIQUES

BY KERRY D. SOLOMON, MD

As we cataract surgeons increasingly move toward a microincisional technique, we have an impressive arsenal of devices and surgical technologies available to help us protect the ocular tissues, minimize trauma to the eye, and induce as little astigmatism as possible. This article describes my current microincisional cataract technique using Alcon surgical products (Alcon Laboratories, Inc.): the INFINITI Vision System with OZil IP torsional ultrasound, ophthalmic viscosurgical devices (OVDs), and the AcrySof IQ ReSTOR IOL +3.0 D. I will also briefly discuss how I have started to incorporate the LenSx laser platform (Alcon Laboratories, Inc.) into my practice, and how this new technology may further enhance the ability to achieve patients' desired outcomes.

THE BENEFITS OF A 2.2-MM DUAL-PLANE INCISION

When performing traditional cataract surgery, I prefer a microincisional approach, because I find 2.2-mm temporal, clear corneal incisions to be structurally sound. These precise, square incisions induce a very small, predictable amount of astigmatism and are self-sealing. I do not move my incision around to manage astigmatism; I operate temporally and then manage astigmatism appropriately (eg, with toric IOLs, limbal relaxing incisions, or arcuate corneal incisions). Although I prefer a 2.2-mm dual-plane incision, surgeons utilizing 2.4-mm incisions can enjoy the same benefits of microcoaxial surgery.

CAPSULORHEXIS

I always aim to make my capsulorhexis 5.0 mm in diameter and, when possible, perfectly round. One challenge of operating through a 2.2-mm or smaller incision is maneuverability when creating the capsulorhexis. I use a forceps that I helped design with Crestpoint Management Ltd. (I have no financial interest) that has a cross-action design that eliminates oarlocking. A cystotome also works well. Once the capsulorhexis is complete, performing surgery through a 2.2-mm incision is the same as through larger incisions; hydrodissection and hydrodelineation should be no different, and the phaco technique requires minimal changes.

MICROINCISIONAL CATARACT SURGERY WITH THE NEW INTREPID PLUS FMS

I have adopted 100% OZil torsional ultrasound during microcoaxial surgery for several reasons. In the microincisional setting, where we must reduce the amount of fluid we move through the eye, the INTREPID PLUS Fluidics Management System (FMS) achieves this goal without shallowing the chamber. It allows for a deep and "rock solid" anterior chamber throughout the procedure. Although I now use lower surgical parameters with OZil torsional ultrasound, my efficiency has improved compared to using the same parameters with only longitudinal ultrasound. Furthermore, I appreciate the softer, more flexible feel and behavior of the newer INTREPID PLUS tubing, which provides the same protection against surge as did the original INTREPID FMS.

OZIL IP TORSIONAL ULTRASOUND

OZil Intelligent Phaco (IP) is a primary element of my current microincisional technique. Traditional longitudinal ultrasound creates some repulsion of lens material at the phaco tip because the phaco needle moves forward and

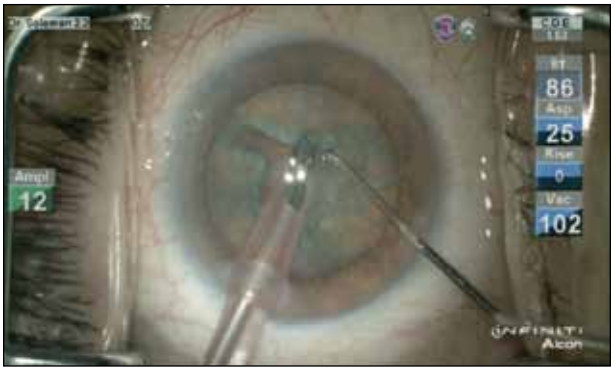

Figure 1. The author uses the KELMAN Mini-Flared phaco tip and OZil torsional ultrasound to create a groove in the nucleus and divide it into quadrants.

For important safety information about these products, please see pages 3-4.

backward through the incision. The OZil handpiece moves the phaco tip in a sweeping, oscillatory motion that reduces repulsion, so the lens material stays at the tip and exits the eye efficiently. This efficiency also allows me to use lower fluidic parameters, since I do not have to intermittently chase lens material around the anterior chamber. Because I do not have to chase nuclear material, the phaco tip remains positioned centrally within the 2.2-mm wound and keeps the fluidics in balance.

I prefer to use the angled, KELMAN Mini-Flared phaco tip with a 45º bevel, because it saves me from having to chop the nucleus; I simply groove and subdivide the nucleus into quadrants before removing them (Figure 1). To prevent full occlusion at the phaco tip, OZil IP software incorporates short pulses of longitudinal ultrasound through the OZil torsional handpiece when the vacuum reaches the preset threshold. These ultrasonic pulses are introduced only when needed to reposition the nuclear material at the tip, giving the tip the space it needs to continue shearing material (Figure 2). In my hands, the IP software represents another step forward in phaco technology.

COMPARATIVE STUDY

Recently, my colleagues and I performed a study that compared different ultrasonic technologies and incision sizes. We evaluated four groups of rabbit eyes that we grouped per incision size and ultrasonic technology: a 1.8-mm incision with longitudinal ultrasound and 1.8-, 2.2-, and 2.75-mm incisions with torsional ultrasound. The rabbits' right eyes underwent phacoemulsification according to their assigned group without IOL implantation. The left eyes served as controls (we made the incision but did not perform phacoemulsification).

Histopathology showed no inflammation immediately after surgery in any of the eyes. At day 4, the eyes that received a 2.75-mm incision and torsional ultrasound showed more inflammation compared to those with incisions of 1.8 and 2.2 mm, regardless of the type of ultrasound used. Furthermore, when we used scanning electron microscopy of the endothelial surface to evaluate postoperative incisional gaps, the gaps were largest in the eyes with 2.75-mm incisions. By day 4, the gaps were closed in all eyes except in the 2.75-mm group. These eyes also had a higher incidence of detachment of Descemet membrane. My colleagues and I concluded that a 2.75-mm incision seemed to heal slower and to induce more inflammation than smaller incisions (1.8 and 2.2 mm) after phacoemulsification in an animal model.[1]

OVDs

I use VISCOAT and ProVisc OVDs (Alcon Laboratories, Inc.) when performing surgery. I use

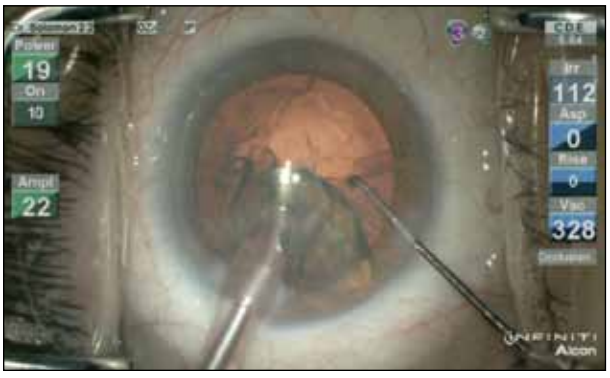

Figure 2. Short pulses of longitudinal ultrasound are automatically employed by OZil IP software only when the preset vacuum threshold has been met.

VISCOAT OVD when making the capsulorhexis and while performing phacoemulsification. I like that the ingredient chondroitin sulfate in VISCOAT OVD enhances its protective properties while allowing it to stay in the eye where I want it. After the nucleus is out, I use ProVisc OVD to fill the capsular bag and assist with implanting the lens. ProVisc OVD contains sodium hyaluronate, which enables it to wash out of the eye easily at the end of a case.

IRRIGATION/ASPIRATION

The OZil platform has a new curved polymer I/A tip that I feel cleans the capsule very safely. I like to remove the subincisional cortex first followed by the cortex. The I/A tip is so soft that I can easily polish any residual material from the anterior capsule with complete confidence that the capsule will not be damaged.

IOL INSERTION TECHNIQUE

I insert the tip of the injector inside the 2.2-mm incision while I introduce the lens. Using the MONARCH D cartridge (Alcon Laboratories, Inc.) in this way allows the incision to stay fairly small. I have measured hundreds of my incisions with calipers after inserting the lens, and they are almost always 2.3 mm, which means that they stretch by one tenth of a millimeter, at most, using this technique. Because these incisions are not stretched, they self-seal beautifully, and I rarely need to use a suture.

THE FEMTOSECOND LASER

The evolution of cataract surgery has included refinements in technique and technology to the point that it is now one of the most successful surgeries performed in modern medicine. Future improvements will be incremental and will further refine the precision of the outcomes. Yet, as small as the differences may be, they are nonetheless important for our patients.

I think of the femtosecond laser as a device with diverse applicability in cataract surgery. When used in conjunction with cataract surgery, the LenSx femtosecond laser is a powerful and extremely accurate tool for making the corneal incisions and capsulotomy and for fragmenting the lens. The ability to make these exacting incisions reproducibly every time is synergistic with my microincisional techniques, and thus this technology offers the very real potential to precisely match patients' desired outcomes.

The LenSx laser can be programmed to create incisions in a variety of patterns and shapes not available with bladed procedures, and they are self-sealing. The femtosecond laser can be used to ablate the cataractous lens, thereby reducing the application of phaco energy and potentially sparing zonular manipulation.

One of the most intriguing applications of the femtosecond laser is in performing the capsulorhexis. With the LenSx laser, it is possible to achieve nearly identical and perfectly centered capsulotomies in every eye. This capability has important implications for placing an IOL and achieving the optimal effective lens position.

CONCLUSION

If the advent of femtosecond laser cataract surgery is indicative of nothing else, it clearly signifies interest in continuing to improve the techniques and technologies used to perform cataract surgery. The truth is that we do not know what the future holds, and it is likely that new applications for our current technology will change what we do today. Equally so, new innovations will continue to push the limits of what is possible. The biggest winners in this push, of course, will be our patients, who will benefit from our continually expanding ability to give them the vision they want after surgery. ■

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1. Solomon KD. Wound architecture and wound healing after torsional and longitudinal phaco in rabbit model. Poster presented at: The Annual Meeting of the American Society of Cataract and Refractive Surgery/American Society of Ophthalmic Administrators; March 25-29, 2011; San Diego, CA.

LenSx® Laser

Important Safety Information

CAUTION: United States Federal Law restricts this device to sale and use by or on the order of a physician or licensed eye care practitioner.

INDICATION: The LenSx® Laser is indicated for use in patients undergoing cataract surgery for removal of the crystalline lens. Intended uses in cataract surgery include anterior capsulotomy, phacofragmentation, and the creation of single plane and multi-plane arc cuts/incisions in the cornea, each of which may be performed either individually or consecutively during the same procedure.

RESTRICTIONS:
- Patients must be able to lie flat and motionless in a supine position.
- Patient must be able to understand and give an informed consent.
- Patients must be able to tolerate local or topical anesthesia.
- Patients with elevated IOP should use topical steroids only under close medical supervision.

CONTRAINDICATIONS:
- Corneal disease that precludes applanation of the cornea or transmission of laser light at 1030 nm wavelength
- Descemetocele with impending corneal rupture
- Presence of blood or other material in the anterior chamber
- Poorly dilating pupil, such that the iris is not peripheral to the intended diameter for the capsulotomy
- Conditions which would cause inadequate clearance between the intended capsulotomy depth and the endothelium (applicable to capsulotomy only)
- Previous corneal incisions that might provide a potential space into which the gas produced by the procedure can escape
- Corneal thickness requirements that are beyond the range of the system
- Corneal opacity that would interfere with the laser beam
- Hypotony, glaucoma, or the presence of a corneal implant
- Residual, recurrent, active ocular or eyelid disease, including any corneal abnormality (for example, recurrent corneal erosion, severe basement membrane disease)
- This device is not intended for use in pediatric surgery
- A history of lens with zonular instability.
- Any contraindication to cataract or keratoplasty surgery.

ATTENTION: Reference the Directions for Use labeling for a complete listing of indications, warnings and precautions.

WARNINGS: The LenSx® Laser System should only be operated by a physician trained in its use. The LenSx® Laser delivery system employs one sterile disposable LenSx® Laser Patient Interface consisting of an applanation lens and suction ring. The Patient Interface is intended for single use only. The disposables used in conjunction with ALCON® instrument products constitute a complete surgical system. Use of disposables other than those manufactured by Alcon may affect system performance and create potential hazards. The physician should base patient selection criteria on professional experience, published literature, and educational courses. Adult patients should be scheduled to undergo cataract extraction.

PRECAUTIONS:
- Do not use cell phones or pagers of any kind in the same room as the LenSx® Laser.
- Discard used Patient Interfaces as medical waste.

AES/COMPLICATIONS:
- Capsulotomy, phacofragmentation, or cut or incision decentration
- Incomplete or interrupted capsulotomy, fragmentation, or corneal incision procedure
- Capsular tear
- Corneal abrasion or defect
- Pain
- Infection
- Bleeding
- Damage to intraocular structures
- Anterior chamber fluid leakage, anterior chamber collapse
- Elevated pressure to the eye

VISCOAT

Important Safety Information

CAUTION: Federal (USA) law restricts this device to sale by, or on the order of, a physician.

INDICATION: VISCOAT® OVD is indicated for use as a surgical aid in anterior segment procedures including cataract extraction and intraocular lens (IOL) implantation. VISCOAT® OVD maintains a deep chamber during anterior segment surgeries, enhances visualization during the surgical procedure and protects the corneal endothelium and other ocular tissues. The viscoelasticity of the solution maintains the normal position of the vitreous face and prevents formation of a flat chamber during surgery.

CONTRAINDICATIONS:
- At present there are no known contraindications of the use of VISCOAT® Ophthalmic Viscosurgical Device when used as recommended.

WARNINGS/PRECAUTIONS:
- Failure to follow "Directions for Use" on attachment of the cannula or use of an alternate cannula may result in cannula detachment.
- Precautions are limited to those normally associated with the surgical procedure being performed. Although sodium hyaluronate and sodium chondroitin sulfate are highly purified biological polymers, the physician should be aware of the potential allergic risks inherent in the use of any biological material.
- A transient rise in intraocular pressure in the early postoperative period may be expected due to the presence of sodium hyaluronate, which has been shown to effect such a rise. It is therefore recommended that VISCOAT® OVD be removed from the anterior chamber by thorough irrigation and/or aspiration at the end of the surgery to minimize postoperative IOP increases. Do not overfill anterior chamber.

ATTENTION: Reference the Package Insert for a complete listing of indications, warnings and precautions.

PROVISC

Important Safety Information

CAUTION: Federal (USA) law restricts this device to sale by, or on the order of, a physician.

INDICATIONS: ProVisc® OVD is indicated for use as an ophthalmic surgical aid in the anterior segment during cataract extraction and intraocular lens (IOL) implantation. Ophthalmic viscoelastics serve to maintain a deep anterior chamber during anterior segment surgery allowing reduced trauma to the corneal endothelium and surrounding ocular tissues. They help push back the vitreous face and prevent formation of a flat chamber during surgery.

CONTRAINDICATIONS:
- At present there are no known contraindications of the use of ProVisc® Ophthalmic Viscosurgical Device when used as recommended.

WARNINGS/PRECAUTIONS:
- Postoperative increases in intraocular pressure have been reported with sodium hyaluronate products. The IOP should be carefully monitored and appropriate therapy instituted if significant increases should occur. It is recommended that ProVisc® OVD be removed by irrigation and/or aspiration at the close of surgery. Do not overfill anterior chamber. Although sodium hyaluronate is a highly purified biological polymer the physician should be aware of the potential allergic risks inherent in the use of any biological material; care should be used in patients with hypersensitivity to any components in this material. Cannula assembly instructions should be followed to prevent patient injury.
- Postoperative inflammatory reactions such as hypopyon and iritis have been reported with the use of ophthalmic viscoelastics, as well as incidents of corneal edema, corneal decompensation, and a transient rise intraocular pressure.

ATTENTION: Reference the Package Insert for a complete listing of indications, warnings and precautions.

AcrySof® IQ ReSTOR

Important Safety Information

CAUTION: Federal Law restricts this device to sale by or on the order of a physician.

INDICATIONS: The AcrySof© IQ ReSTOR© Apodized Diffractive Optic Posterior Chamber Intraocular Lens (IOL) is intended for primary implantation for the visual correction of aphakia secondary to cataractous lens in adult patients with and without presbyopia, who desire near, intermediate and distance vision with increased spectacle independence. This lens is intended to be place in the capsular bag.

WARNINGS: Careful preoperative evaluation and sound clinical judgment should be used by the surgeon to decide the risk/benefit ration before implanting a lens in a patient with any of the conditions described in the Directions for Use Labeling. Some adverse reactions that have been association with the implantation of intraocular lenses are: hypopyon, intraocular infection, acute corneal decompensation, macular edema, papillary block, retinal detachment, and secondary surgical intervention (including but not limited to repositioning, biometry error, visual disturbances or patient dissatisfaction). As a result of the multifocality, some visual effects (halos or radial lines around point sources of light at night) may also be expected due to the superposition of focused and unfocused multiple images. A reduction in contrast sensitivity may also be experienced by some patients especially in low lighting conditions such as driving at night. In order to achieve optimal visual performance with this lens, emmetropia must be targeted. Patients with significant preoperative or expected postoperative astigmatism > 1.0 D may not achieve optimal visual outcomes. Care should be taken to achieve IOL centration, as lens decentration may resuly in a patient experiencing visual disturbances under certain lighting conditions.

PRECAUTIONS: Do not resterilize. Do not store over 45°C. Use only sterile irrigating solutions such as BSS© or BSS PLUS© Sterile Intraocular Irrigating Solution. Clinical studies with AcrySof© ReSTOR© IOL indicated that posterior capsule opacification (PCO), when present, developed earlier into clinically significant PCO. Studies have shown that color vision discrimination is not adversely affected in individuals with the AcrySof© Natural IOL and normal color vision. The effect on vision of the AcrySof© Natural IOL in subjects with hereditary color vision defects and acquired color vision defects secondary to ocular disease (e.g. glaucoma, diabetic retinopathy, chronic uveitis, and other retinal or optical nerve diseases) has not been studied. The long-term effects of filtering blue light and the clinical efficacy of that filtering on the retina have not been conclusively established.

ATTENTION: Reference the Physician Labeling/Directions for Use for a complete listing of indications, warnings, and precautions.