TECHNIQUE

Streamlined method for anchoring cataract surgery and intraocular lens centration on the patient's visual axis

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I describe an intraoperative method for the consistent anchoring of the intraocular lens (IOL) and cataract surgery and on the patient's visual axis using coaxial microscope optics, surgeon-guided patient fixation, the precision pulse capsulotomy (PPC) device (Zepto) and utilizing the first (and fourth) Purkinje images. During surgery using a microscope with coaxial lights and optics, the patient is instructed to fixate on a given microscope light while the surgeon looks through the corresponding coaxial eyepiece. Then, the PPC device is centered on the Purkinje I image and a capsulotomy is performed. The resulting capsulotomy serves as a reference marker for the visual axis and IOL placement, with even capsule overlap, which results in IOL centration on this axis landmark. This method might help address the high variability in angle κ from patient to patient and provide visual benefits in cases of implantation of multifocal IOLs and other IOLs.

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Online Video

Surgeons vary in their approach to capsulotomy and intraocular lens (IOL) centration during cataract surgery. Some do not consider the anatomic or functional axes of the eye and do not routinely practice centration. Others commonly use the center of the dilated pupil because if its convenience as an easily visible landmark. In these cases, a manual continuous curvilinear capsulorhexis (CCC) is created to approximate a circular capsule opening centered on the pupillary center and the IOL is positioned to achieve capsule overlap as evenly as possible. Imprecision comes about as a result of the inherent deviation from roundness and centration of a capsulotomy created by hand and the potential asymmetry of the dilated pupil. In addition, the pupillary axis is displaced with respect to the visual axis by angle κ,[1,2] which is highly variable in pseudophakic patients.[3] This high degree of variability in angle κ between patients translates into a high degree of variability in chord mu,[2] which closely approximates the distance between the location of the visual axis and the pupillary center on the capsule plane. Chord mu variability might contribute to inconsistent or suboptimum outcomes when the pupillary center is used for alignment, in particular in cases using aspheric, toric, and multifocal IOLs.[4–8]

This paper describes an intraoperative method for the consistent anchoring of cataract surgery and IOL centration on the patient's visual axis using coaxial microscope lights and optics, brief patient fixation, and a precision pulse capsulotomy (PPC) device (Zepto, Mynosys Cellular Devices, Inc.)[9–11] to center on the first Purkinje image as it becomes aligned with the fourth Purkinje image. This technique is based on the subject-fixated coaxially sighted corneal light reflex as described by Chang and Waring[2] paired with the use of the PPC device. In this technique, the PPC device serves a dual function. The first is to assist the surgeon in establishing coaxial sighting along the patient's visual axis. The second is the conversion of the patient's individual visual axis into a visual axis–centered capsulotomy that is then used as a reference marker later in surgery. During surgery, with the transparent PPC suction cup inserted into the anterior chamber, the patient is instructed to fixate on a microscope light selected by the surgeon while the surgeon looks through the corresponding coaxial eyepiece. The PPC device is then centered on the Purkinje I (PI) image, which marks the patient's visual axis, and a capsulotomy is performed. The fourth Purkinje image should be aligned and mostly hidden behind

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PI when the patient is fixating on the co-axial light and can also be a very helpful guide. The resulting capsulotomy preserves the visual axis information and acts as a surrogate reference marker to guide IOL centration on this axis.

SURGICAL TECHNIQUE

Figure 1, *A*, shows the commonly used methods of creating the CCC at a convenient location on the capsule or approximately around the center of the dilated pupil without prespecified patient fixation. Figure 1, *B*, shows the technique of using patient fixation to determine the true visual axis followed by the creation of a PPC capsulotomy precisely on this axis. The technique requires the use of a surgical microscope with lights that are coaxial to the eyepieces. First, the surgeon selects 1 eyepiece through which the visual axis alignment procedure will be viewed (*panel 1*). Next, the PPC device is inserted into the eye and opened to its circular shape. The patient is then instructed to fixate on the microscope light through the transparent PPC device; the light is coaxial to the selected eyepiece (*panel 2*). After fixation is accomplished, the surgeon identifies the PI image and the center of the PPC device is maneuvered to coincide with the position of the PI image (Figure 1, *B*, *panel 3*, and Figure 2). The PI image under these coaxial lighting, patient fixation, and surgeon viewing conditions is the subject-fixated coaxially sighted corneal light reflex described by Chang and Waring[2] and is very near the patient's visual axis in the virgin eye. The surgeon viewing through the selected eyepiece at PI is looking along this axis. After PPC device centering on PI has been completed, a PPC capsulotomy is performed. The center of the PPC capsulotomy corresponds exactly to that specific patient's visual axis, and the capsulotomy edge serves as a reference marker that can be used later in surgery for IOL centration.

Results

Intraoperative PPC visual axis anchoring was performed in 86 patients having routine cataract surgery with monofocal or multifocal IOL implantation. All patients were able to fixate as instructed and received individualized PPC capsulotomies anchored on their specific visual axis. Monofocal and multifocal IOLs were then centered on the visual axis by alignment with the round PPC capsulotomy to achieve even 360-degree capsule overlap.

A series of photographs from a typical case in which anchoring to the visual axis using PPC was performed is shown in Figure 3 and Video 1 (available at http://jcrsjournal.org). At the beginning of surgery, with the patient lightly sedated, the surgeon practices fixation with the patient (Figure 3, *A* and *B*). The PPC device was removed from its packaging and inspected (Figure 3, *C*). The device push rod was extended forward to elongate the PPC capsulotomy ring and suction cup to facilitate insertion into the eye (Figure 3, *D* and *E*). Once in the anterior chamber, the push rod was retracted and the PPC tip regained its original circular shape (Figure 3, *F*). At this point, the patient was instructed to fixate on the selected microscope light coaxial with the left eyepiece, which is visible through the transparent PPC suction cup. As the patient maintained fixation, the center of the PPC device was maneuvered by the surgeon to coincide with the PI (Figure 3, *G*). The capsulotomy ring itself can also be used as a circular guide for centering the device on PI. During positioning, it was helpful to ensure that the push rod was left in the silicone neck with the tip of the push rod left just proximal to the capsulotomy ring (Figure 3, *G, arrow*) to provide stiffness in the neck region and facilitate device maneuverability.

Once PPC suction cup centration on PI was achieved, suction was activated and the push rod then fully retracted

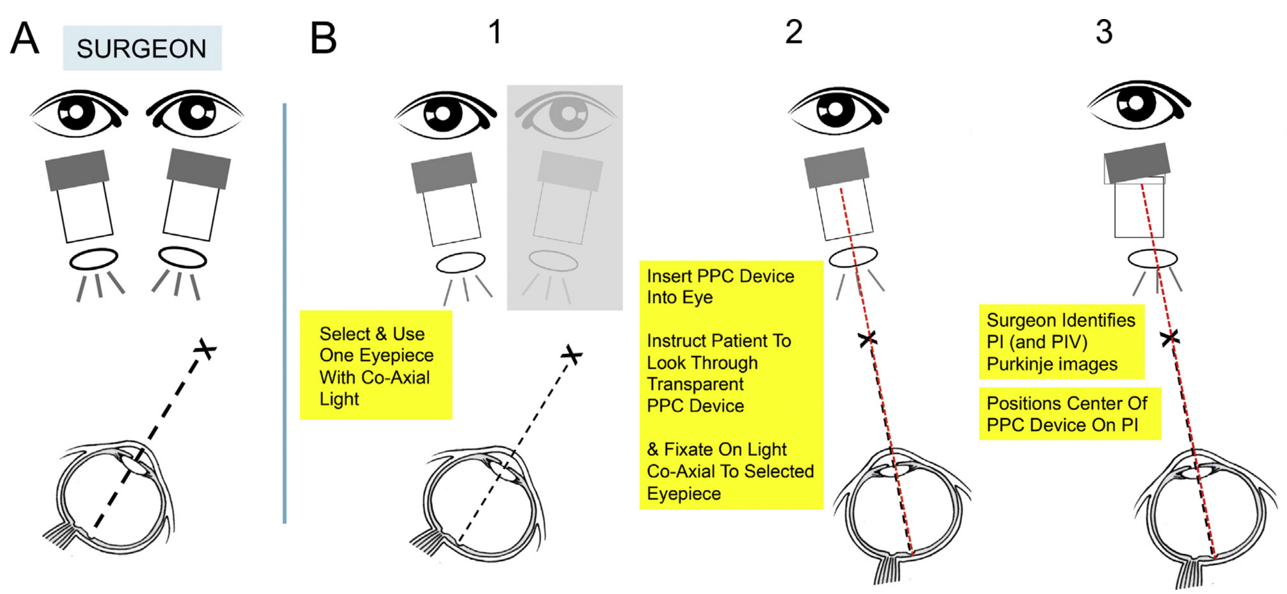

Figure 1. *A*: Schematic depicting a surgical scenario in which the approximate center of a manual CCC is created around the center of the dilated pupil and patient fixation is not specified. *B*: Schematics showing the steps in creating a visual axis centered capsulotomy using precision pulse capsulotomy (CCC = continuous curvilinear capsulorhexis; PI = Purkinje image I; PPC = precision pulse capsulotomy).