Water Gonioscopy: A Technique for Intraoperative Visualization of the Anterior Chamber Angle

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ABSTRACT
Aim and objective: To describe a technique of lens-free gonioscopy that allows the anterior chamber angle to be visualized intraoperatively, without the use of a gonioscopy lens.

Background: Minimally invasive glaucoma surgery (MIGS) is an increasingly popular treatment option for mild to moderate glaucoma. We describe a technique of lens-free gonioscopy that allows visualization of the anterior chamber angle without the use of a lens. This simple intraoperative technique may be used to inspect the placement of MIGS devices within the angle.

Technique: To perform a water gonioscopy, the surgeon sits temporal to the eye. The patient’s head is turned 20–45° away from the surgeon, and the operating microscope is tilted 15–30° toward the surgeon. A reservoir of balanced salt solution is allowed to collect in the crater formed by the nose bridge and the bony orbital rim, external to the corneal surface. This body of liquid obliterates the cornea–air interface and hence allows visualization of the anterior chamber. In contrast to gonioscopy using a gonioscopy lens, water gonioscopy offers a lower magnification, ultra-wide field of view for angle visualization.

Conclusion: Water gonioscopy is a useful technique that anterior segment surgeons might use for quick visualization of the anterior chamber angle without the need for additional equipment.

Clinical significance: This is a simple technique that surgeons can use to visualize the anterior chamber angles intraoperatively. It is especially useful for MIGS that are placed within the anterior chamber angle, but this technique may also be used during other anterior segment surgeries, such as visualizing the haptics of an anterior chamber intraocular lens or checking for retained lens fragments in the anterior chamber angles.

Keywords: Anterior chamber angle, Gonioscopy, Minimally invasive glaucoma surgery, Surgical technique, Total internal reflection.

BACKGROUND
Minimally invasive glaucoma surgery (MIGS) is an increasingly popular treatment option for mild to moderate glaucoma.¹ Visualization of the anterior chamber angle is required for almost all MIGS surgeries. By convention, a direct gonioscopy lens is used to visualize the angle structures intraoperatively. However, during MIGS surgery, we have discovered a method of inspecting the anterior chamber angle intraoperatively without the use of a gonioscopy lens. The purpose of this article is to describe this technique of direct gonioscopy using a pool of balanced salt solution (BSS) external to the surface of the eye, to negate the total internal reflection that occurs at the cornea–air interface, hence allowing angle structures to be visualized directly.

TECHNIQUE
To perform a water gonioscopy, the operating microscope is tilted to 15–30° toward the surgeon. The patient lies supine on the operating table with his head turned 20–45° away from the surgeon, who is seated temporally. A BSS is allowed to pool in the crater formed by the nose bridge and the bony orbital rim, external to the corneal surface. An assistant’s thumb may be placed at the crater formed by the nose bridge and the bony orbital rim, external to the corneal surface. This body of liquid obliterates the cornea–air interface and hence allows visualization of the anterior chamber. In contrast to gonioscopy using a gonioscopy lens, water gonioscopy offers a lower magnification, ultra-wide field of view for angle visualization.

Conclusion: Water gonioscopy is a useful technique that anterior segment surgeons might use for quick visualization of the anterior chamber angle without the need for additional equipment.

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How to cite this article: Chiam N, Perara S. Water Gonioscopy: A Technique for Intraoperative Visualization of the Anterior Chamber Angle. J Curr Glaucoma Pract 2021;15(3):106–108.

Source of support: Nil
Conflict of interest: None

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The critical angle $\theta_c$ for a given combination of materials is:

$$\theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right) \text{ for } n_1 > n_2$$

Hence, during water gonioscopy, as light from the angle exits the eye, total internal reflection does not occur as the critical angle of the cornea–water interface is large, thus allowing angle structures to be viewed directly without further instrumentation.

The water gonioscopy technique, however, has a few limitations. As a trade-off for an ultra-wide field of view, angle structures are visualized in low magnification. Another limitation of this technique is its restricted use for the nasal angle (when the surgeon sits temporally) and inferior angle (when the surgeon sits superiority). Visualization of the other angles is limited by the difficulty in maintaining a pool of fluid without the nose bridge and surgeon positioning. However, as MIGS devices are commonly inserted in the nasal quadrant, water gonioscopy may be useful in many situations.

Surgeons may potentially utilize this easy technique for angle visualization following the implantation of other Schlemm’s canal devices (e.g., iStent, Glaukos Corp., Laguna Hills, CA, USA) and emerging goniotomy/trabeculotomy techniques. Water gonioscopy may also be used to inspect the haptics of anterior chamber intraocular lenses or to check for remnant lens fragments trapped in the angles during cataract surgery, particularly in femtosecond laser-assisted cases as lens fragments may be small.

**Conclusion**

Water gonioscopy is an interesting technique that anterior segment surgeons might use for quick visualization of the anterior chamber angle without the need for additional equipment. In contrast to gonioscopy with a gonioscopy lens, water gonioscopy offers a lower magnification, ultra-wide field of view of the angle structures. Potential uses of water gonioscopy include inspection of MIGS devices within the anterior chamber angle, visualizing the haptics of anterior chamber intraocular lenses, and screening for remnant lens fragments trapped in the angles during cataracts surgery.

**Clinical Significance**

Water gonioscopy is a simple intraoperative method of viewing the anterior chamber angle without the use of a gonioscopy lens. In contrast to gonioscopy using a gonioscopy lens, water gonioscopy offers a lower magnification, ultra-wide field of view of the angle structures.

**Video 1:** The view of the Schlemm canal implant is visualized through a direct gonioscopy lens (top). The view of the implant in the similar eye through water gonioscopy (below)

**Video 2:** Hydrus implant visualized through water gonioscopy. The surgeon can visualize the source of bleeding while removing the viscoelastic soon after implantation of the Schlemm canal implant.
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