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Gonioscopy: A model of the anterior chamber

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Abstract

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GONIOSCOPY:

A MODEL OF THE ANTERIOR CHAMBER

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Biography Page

Don P. Pegueros

Don is a graduate of Wasington High School, Class of 1981. He attended Olhone College where he recieved an A.A. degree in Natural Science 1981-1984. He also attended Cal State Univ. Hayward, CA where he recieved a B.S. in Biology 1984-1987. From 1988-1992, Don attended Pacific University College of Optometry and received his doctorate on May 17, 1992.

Diana L. Brophy

Diana graduated from Oregon City High School in 1984. She attended Pacific University and received a B.S. in Psychology in May of 1988. Diana attended Pacific University College of Optometry and recieved her doctorate on May 17, 1992.

GONIOSCOPY: A Model of the Anterior Chamber

How to use this model:

This is a model of the anterior chamber of the human eye. The express purpose of this model is to show the basic orientation and view obtainable using the technique of indirect gonioscopy. **It is important to remember that since mirrors are used the view seen is inverted and projected 180 degrees from where it is actually located.**

To view the anterior chamber in area A the mirror must be placed directly over area D. The viewer must stand closest to the area A facing the mirror above area D. The flash light should be directed into the mirror such that the angle structures can be viewed. Rotating the goniolens in clockwise (or counter clockwise) direction the viewer must continue to rotate so that he or she is always 180 degrees away from the mirror. The viewer should continue in this fashion until the entire 360 degrees of the anterior chamber angle is viewed. Remember that the area that is closest to the viewer is actually the area that is being observed.

WHAT YOU SHOULD SEE IN EACH OF THE AREAS:

Area A (mirror above area C): a raised melanoma, nevi- flat pigmented areas, pigmentation in the trabecular meshwork. This angle is a grade 2.

Area B (mirror above area D): normal angle and iris blood vessels, rubeosis at pupilary margin, rubeosis at anterior chamber angle. This angle is a grade 3.

Area C (mirror above area A): Peripheral anterior synechiae, iris processes, angle recession. This angle is a grade 4.

Area D (mirror above area B): The different angle grades from completely open, grade 4, through a closed angle, grade 0.

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Gonioscopy is a very important clinical technique that is used to examine the anterior chamber angle. It is particularly important in differentiating open and closed angle glaucoma. Gonioscopy is also used for detecting traumatic angle recession and angle neovascularization. In addition, it is used during the search for foreign bodies, abnormal pigmentation, and tumors within the angle. This technique should also be used if there is ever a question as to the depth of the anterior chamber angle prior to diagnostic dilation.

The anterior chamber angle can not be directly viewed under normal slit lamp examination. This is due to the fact that the light entering the cornea is greater than the critical angle. The critical angle is a specific angle of incidence in which the light entering is bent such that it is parallel to the surface. When light enters at an angle equal to or greater than the critical angle, the light will not emerge from the surface but instead will be reflected back into the original object. Because light reflected off the anterior chamber angle of a normal eye strikes the cornea at an angle greater then the critical angle, it is reflected back into the eye and we are unable to view the angle directly without some type of goniolens.

TYPES OF GONIOLENSES

Direct goniolenses (Koeppe lenses) have a steeper curvature than the cornea. The space between the lens and the cornea is filled with methylcellulose, saline, or some other solution. The solution creates an optical continuity between the lens and the cornea and replaces the cornea-air interface, altering the critical angle and allowing the angle to be viewed. The chamber angle is observed directly across the anterior chamber. A true image is seen with proper spatial orientation. This technique is especially useful in comparing the differences between the two eyes quickly and easily. A lens can be placed on both eyes and the examiner can move his viewing device, a hand held microscope with illumination, from one eye to the other. Direct gonioscopy allows excellent stereoscopic viewing of all quadrants and allows the viewer to transilluminate angle structures easily. The patient must be reclined while this procedure is done and almost no patient co-operation is required.

Indirect gonioscopy uses mirrored goniolenses (Goldmann) to essentially eliminate the front surface of the cornea. An angulated mirror which reflects the light rays originating from the chamber angle recess to the line of vision of the examiner is placed within the lens. The image, due to the mirrors, is inverted and is projected 180 degrees from where it originates. Since the image is inverted, this technique is referred to as indirect gonioscopy. The mirrored goniolenses are generally used in conjunction with a slit lamp for magnification and illumination.

The Zeiss goniolens is a polished, truncated glass pyramid surfaced in silver. The mirrored walls are inclined at 64 degrees. The lens is held by a tweezer called an Unger holder. The lens is held in contact with the patients cornea often with saline or contact lens conditioning solution between the two. With four usable gonio mirrors, 360 degrees of angle can be seen with only minimal rotation of the lens. The optic zone diameter is 9mm, which is relatively small in comparison to other lenses. This makes it more suitable for use with children and patients with narrow palpebral apertures. The Zeiss lens can be used more quickly, more comfortably, and more easily then any other goniolens.

The flat radius of curvature of the Zeiss lens, 7.85mm, in combination with the small optic zone, make this lens the best suited for indentation or compression gonioscopy. In this technique, the cornea is indented to increase the aqueous pressure which forces the walls of a normal angle to widen. This allows the examiner to distinguish between appositional and synechial angle closure in angle closure glaucoma.

Minimal pressure should be used in routine gonioscopy. Excessive pressure causes the chamber angles to appear both distorted and wider than they actually are. Striae, wrinkles or folds in Descemet's membrane, may also appear in the cornea with excessive pressure. Maintaining this proper pressure while maintaining a good view takes some practice.

There are three types of Goldmann goniolenses which are all used in conjunction with the slit lamp. All three have an optic zone of 12mm, and a base curve of 7.4mm. The single mirror lens has one mirror embedded in a truncated plastic cone. Only one quadrant can be viewed at one time and the lens must be rotated 270 degrees to view the entire chamber angle. The two mirror goniolens has two mirrors opposite each other. This lens need only be rotated 90 degrees to evaluate the entire angle. Both of these lenses have peripheral curve widths of 1.75mm, and an overall diameter of 15.5mm.

The Goldmann three mirror lens has only one goniomirror. This bullet shaped mirror is the shortest and roundest of the mirrors. The other two mirrors allow the examiner to view other areas of the fundus. The trapezoid shaped mirror allows viewing of the retina from the equator to the posterior pole. The semilunar lens, rounded on the edges and flat on top, provides views from the equator to the ora serrata. With only one goniolens, the Goldmann three mirror lens must be rotated 270 degrees to view the entire angle structure. The design of this lens, which has an increased mirror decentration and shorter mirror height compared to the single mirror lens, may make it more difficult to view narrow chamber angles. The three mirror is also markedly larger, with peripheral curve widths of 3.25mm, and an overall diameter of 18.5mm. In addition, it is approximately four times heavier then the single mirror lens.

Although these are some of the common types of goniolenses used currently, many more are available.

GONIOLENS INSERTION

The lens and the examiners hands should be washed before gonioscopy is performed. Fill the concave surface of the lens one-third to one-half full with 1.6% solution of hydroxyethyl cellulose (Goniosol) or Celluvisc. Be careful not to introduce air bubbles into the solution. Anesthetize each cornea with one drop of 0.5% proparacaine hydrochloride.

Position the patient in the slit lamp comfortably, making sure that his or her forehead is placed fully against the forehead rest throughout the examination. Tell the patient to look up and then evert the lower lid with the thumb of your hand that is on the opposite side of the eye you are examining. With the other hand grasp the outer edge of the lens between the thumb and first finger. Make sure that the proper lens surface (concave side) is directed towards the patient. Tilt and insert the lens so that one edge is placed in the inferior cul-de-sac. Quickly place your thumb on the upper lid to prevent it from forcing the lens out. Tell the patient to look straight ahead, while quickly but gently rolling the lens onto the cornea. Release the lower lid but continue to hold the edge of the lens between your thumb and first finger. Rest your remaining two fingers on the forehead rest to help prevent excessive pressure on the cornea.

The thumb and index finger are used to rotate the lens on the eye during the examination. If air bubbles form, this means that the lens is not properly positioned on the cornea. Try to reposition the lens while on the cornea by tilting the lens toward the bubble. If the bubble can not be eliminated with gentle manipulations of the lens, the lens should be removed and reinserted. Angle examination should be done with 16x to 35x magnification.

When removing the lens, roll it off in the opposite direction to insertion by pushing slightly on the upper lid and gently rolling the goniolens down and off the cornea. Sometimes the lens and the cornea will create a tight seal in which the lens does not easily roll off. Gently rocking the lens back and forth may help to break the seal. If this does not work, have the patient look down and push gently on the sclera, trying to break the suction. Never pull the lens forcibly from the eye! The seal will eventually break. The eye should then be irrigated thoroughly with saline. The cornea should be examined for staining using sodium flouresein. In addition, white light should be used to examine for a ground glass appearance. If staining is found, the patient should be informed of possible later discomfort and given some artificial tear preparation. Staining is more likely to occur when goniosol is used, when there was too much pressure used, with increased length of the procedure, and with an increased amount of lens movement (rotation). The patients individual epithelial strength also influences the amount of staining which occurs.

The goniolens should be cleaned with rigid contact lens cleaner and water soon after gonioscopy. Do not let the goniosol or celluvisc dry on the lens. Disinfection can be done with one part bleach to ten parts water. Soak the lens, concave side down, for ten minutes. Rinse and store.

It is very important that the patient knows what to expect before this procedure begins. This should include things such as: you will experience a cool feeling, there may be liquid running down your cheek, you may have a salty taste in your mouth, it will not be painful- but you may feel a slight pressure on your eye, and you may have some later eye discomfort. It is also important for the patient to be told why this procedure is being done. Adequate patient preparation helps in patient cooperation.

ANGLE STRUCTURES

The view in the goniolens mirror is as if you were a small person standing on the edge of the pupillary rough. The cornea is overhead like a dome. The iris is to the front, and the anterior lens surface is behind. A flat plane of iris is usually associated with a wide open angle, while a convex iris is seen in more shallow anterior chambers and narrow angles.

The iris root is the thinnest part of the iris. It may appear lighter in color then the rest of the iris. It represents the narrowest width of the anterior chamber angle. The insertion of the iris root onto the ciliary body determines the configuration of the anterior chamber angle. In myopes, the iris root is long and attaches itself more posteriorly on the ciliary body. In hyperopes, the iris root is usually short. It attaches more anteriorly on the ciliary body and the approach to the angle is narrower. The iris root is often difficult to view gonioscopically. Iris processes which may be present will be discussesd later.

The ciliary body extends anteriorly to join with the iris root.

It varies in coloration from a dense brown band to a reddish gray band. Width of the ciliary body varies with chamber depth. In myopic eyes which usually have deep chambers, a wider ciliary body band tends to be seen. The ciliary body may be hidden from view by a steep last roll of Fuchs, the most peripheral contraction furrow or by an anterior insertion of the iris root, or dense iris processes.

The scleral spur is the first of three concentric rings around the posterior peripheral cornea. It is a white band immediately above the ciliary body. It is an internal projection of a ridge of actual scleral tissue and forms the boundary between the ciliary body and the trabecular meshwork.

The trabeculum is the second concentric ring around the peripheral cornea. It appears as a translucent band of gray tissue which appears to arise from the scleral spur. The anterior part may look white, while the posterior part looks gray. The trabeculum's transparency decreases with age. It is the most important angle structure and should be examined over the entire 360 degrees.

Schlemn's canal may be visible within the middle one-third of the trabeculum. This is a vessel deep within the trabeculum which is usually filled with aqueous. It may appear as a grayish band, somewhat darker than surrounding trabeculum. The canal may be visible when outlined by accumulated pigment or when blood fills the canal (diffuse red line). One-third of all normal eyes, especially under the age of 50, have blood in Schlemn's canal. It may also be an indication that too much pressure is being placed on the goniolens.

The final angle structure visible is Schwalbe's line. It is a thin, cloudy, white line that denotes the end of the trabecular meshwork and the end of Descemet's membrane. When Schwalbe's line is particularily prominent and displaced anteriorly it is known as posterior embryotoxon. Patients with this condition are at a higher risk for glaucoma.

ANTERIOR CHAMBER MODEL

This is a model of the front half of a human eye. The express purpose of this model is to give a basic understanding of the theory and technique of gonioscopy. In addition, some underlying normal and pathological anterior chamber findings will be discussed.

A key to understanding indirect gonioscopy is to remember that the use of mirrors causes everything to be inverted and projected 180 degrees from where it is really positioned. To view something in the inferior angle, the mirror and the slit lamp are aimed towards the superior angle. When the nasal angle is viewed the lens mirror and slit lamp are aimed towards the temporal angle and so on.

SECTION A

To observe the structures in this area, the mirror must be placed above area C which is directly across from area A. The observer must stand facing the mirror, directly next to area A. The flash light is then aimed into the mirror above area C such that the angle structures can be viewed. Remember that we are actually viewing the structures that are in area A.

In area A, a raised tumor or melanoma is visible. Note the uneven coloring and the irregular borders. Performing gonioscopy when a melanoma is suspected allows the contours of the raised lesion to be observed in a different perspective. Gonioscopy is also the only way to determine whether the tumor involves the angle.

This is important information in following these lesions. Also in Area A there are numerous smaller flat freckles which are visible. These are normal pigment variations, nevi, but should be documented since they may rarely develop into melanomas. A main concern for any abnormally darkened area in the iris is its duration and stability. It is always a good idea to document size and shape. Ideally, anterior segment photos would be the most useful method of documentation.

Also in area A, note the pigmentation in the trabeculum. Accumulated pigment is particularly observable in the inferior angle quadrant due to gravity. It is usually found in the lower one-half of the trabeculum. It occurs as the pigment reaches the filtration area and is deposited on the the trabecular fibers. Excessive pigment accumulation may accompany pigmentary or open angle glaucoma, pseudoexfoliation of the crystalline lens, anterior pigment dispersion syndrome, anterior segment inflammations, trauma, diabetes mellitus, nevus, cyst, melanoma, and senescence. Pigment accumulation does not necessarily mean that the patient has glaucoma. It does, however, make them a glaucoma suspect.

SECTION B

Slide the goniolens in a clockwise rotation such that the mirror is now directly above area D. The observer must also move so that he or she is directly above area B and aim the flash light into the goniolens mirror so that the angle structures in area B can be viewed.

The first view in area B shows angle rubeosis. Note the fragile small vessels that are randomly oriented. Rubeosis can usually be detected first near the pupillary rough during routine slit lamp evaluation. It is important to use high magnification and have a sharp focus when looking for rubeosis. It is often very subtle, but is of immense importance to catch early. It is commonly found in disease processes where there is decreased blood flow to the eye, yet the retina requires the same oxygen as before. Examples of these include individuals with diabetes or retinal vein occlusion. Angle rubeosis often shows up later in the disease process and is important to monitor because it increases the likelihood of glaucoma and anterior chamber bleeds. Angle rubeosis may also look like iris processes. As the vessels increase in number, they may be followed by fibrous tissue which gradually "zippers shut" the angle, increasing the chance of glaucoma.

The second half of area B shows normal angle and iris vessels which may be easily visualized in the eye with light iridies. Notice the uniform circumferential alignment of these vessels. Closer to the pupil, the minor iris circle may be visible around the iris collarette. This circle is connected to the radial iris vessels which run in the superfical iris stroma toward the angle. These vessels are especially visible in infant eyes.

SECTION C

Continuing the clockwise rotation, the mirror should now be above area A. In this first part of area C some peripheral anterior synechiae can be viewed. As the mirror is rotated clockwise towards area A, iris processes are visible.

Iris processes are continuations of the anterior border layer of the iris and are found in about one-third of normal patients. They look like stalagmites or spoke like projections rising up and inserting into the scleral spur. They are often more dense nasally than temporally. They may be so dense that they make the angle appear closed. They are harder to view in light colored eyes.

Peripheral anterior synechiae occur when the iris becomes attached to the angle wall. These are usually caused by inflammation, surgery, or long standing angle closure glaucoma. They can occur at any level of the angle and may involve either the entire angle circumference or just a portion of it. Synechiae are often more anterior and are often seen amid iritic debris. Mound synechiaes are often quite distinct, appearing as a piece of iris which has been pulled up and stuck onto the angle wall. In some cases, the synechiae may cover the entire angle and form a false angle which appears to be totally closed. Differentiation between this condition and true angle closure can be made by noting that in synechiae the iris structures appear pulled up the angle wall.

Differentiating iris processes from peripheral anterior synechiae may be difficult. Peripheral anterior synechiae tend to be much broader then iris process. Peripheral anterior synechiae also tend to obscur the underlying angle structures more then iris processes.

As the clockwise lens rotation is continued, the last part of area C has a recessed angle which is visible. Angle recession occurs when the ciliary muscle insertion is ripped from the scleral spur. It usually happens secondary to blunt trauma to the eye or orbit. A recessed angle often appears as an unusually wide band of ciliary body. A portion of the iris may completely detatch from the ciliary body. When this occurs, a crescent shaped area in the angle is visible with retroillumination at the site of the tear.

In cases of unilateral glaucoma or after blunt trauma, traumatic angle recession must be considered. Evaluation of the depth of the angle recess may be very important. It is often extremely difficult to see with indirect gonioscopy. The best method for viewing angle recession is by using direct gonioscopy and applying two Koeppe lenses simultaneously to the two eyes such that a rapid comparison of the angles can be made. If there has been a tear into the face of the ciliary body, the angle recess will be extremely deep. Another clue to a possible area of angle recession is that iris processes present in the area may be torn from their insertion on the angle wall.

SECTION D

As the mirror is rotated over area B, we get a view of the final area. Remember that the observer must continue to rotate so that he or she is directly facing the mirror. As the mirror leaves area A and is over the beginning of area B, the first angle viewable is that of a completely open angle. Notice that all of the angle structures are visible. As the lens is rotated further into area B, the ciliary body can no longer be seen. This is a grade 3 angle. Further rotation reveals fewer and fewer angle structures until the lens is almost to area C. At this point none of the angle structures are visible indicating a completely closed angle. Various methods for grading angles are used. One method is grading by the number of structures visible. Although this does not take into account what is blocking the view, and it is the least accurate, it is quite easy to do.

Grade 0- no structures visible, closed angle.
Grade 1- Schwalbe's line visible
Grade 2- Schwalbe's line and trabeculum visible
Grade 3- Schwalbe's line, trabeculum, and scleral spur visible
Grade 4- Schwalbe's line, trabeculum, scleral spur, and ciliary body visible, wide open angle.

Think, if the ciliary body is visible, then the angle is wide open, grade 4. In a grade 4 or 3 angle, closure is impossible. In a grade 2 angle, closure is improbable. In a grade 1 angle, closure is possible. In a grade 0, the iris is already in contact with cornea. It is important to remember that too much pressure can make the angle look more open than it really is!

CONCLUSION

Gonioscopy is a necessary skill that all of today's optometrists should be able to perform. There are many disease processes which require this technique to be performed on a regular basis to confirm diagnosis and progression. It is a highly accurate way to determine the anterior chamber angle depth prior to diagnostic dilation. This procedure should be used when there is any question of the possibility of angle closure with dilation. It may also be done after dilation, again to determine the angle depth or closure.

This model is only an introduction to the uses of this procedure. Gonioscopy's role in the optometric practitioners' life expands with the increasing primary care role of today's optometry. It is essential to understand and be able to perform gonioscopy accurately and quickly.

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