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An educational video of the basic procedures in gonioscopy

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AN EDUCATIONAL VIDEO OF THE

BASIC PROCEDURES IN GONIOSCOPY

by

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This video is dedicated to all those interested in learning the art of gonioscopy. We hope that this video will enhance the learning of gonioscopic technique.

We would like to thank all of the patients who participated in the filming of this video. We appreciate the time and cooperation demonstrated by all of those patients involved.

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INTRODUCTION

Gonioscopy is a unique procedure which allows visualization of the anterior chamber angle and subsequent structures. Examination of the anterior chamber angle is an essential part of the diagnosis and management of the glaucomas as well as other ocular diseases. With the advent of diagnostic and therapeutic pharmaceutical agents within optometric practice, optometrists are routinely performing gonioscopic examinations.

For the primary care optometrist, gonioscopy has many clinical applications. It is commonly used to evaluate potentially narrow angles that are at risk of producing angle-closure glaucoma during a dilated examination. Furthermore, it is used to provide diagnostic information about patients with open or closed angle glaucoma or those at risk for glaucoma. Other indications for gonioscopy include conditions associated with secondary glaucomas such as pigmentary dispersion syndrome, pseudoexfoliation syndrome, previous ocular trauma, uveitis, iridocorneal endothelial syndromes, rubeosis irides, and developmental anomalies such as the anterior chamber cleavage syndrome. It is also used to evaluate the angle when there is a history of intraocular foreign bodies, intraocular tumors, and dislocated or subluxated crystalline lens.

The eye's anatomical configuration does not permit direct viewing of the anterior chamber angle structures. Light emanating from the anterior chamber angle strikes the cornea obliquely creating a total internal reflection. In the early 1900's a special

contact lens with an index of refraction similar to the cornea was developed. This contact lens called the goniolens permitted light from the anterior chamber to pass through the cornea thereby allowing visualization of the angle. The procedure then was termed gonioscopy derived from the Greek words "gonio", meaning angle, and "skopien", meaning to observe.

INTERNAL REFLECTION
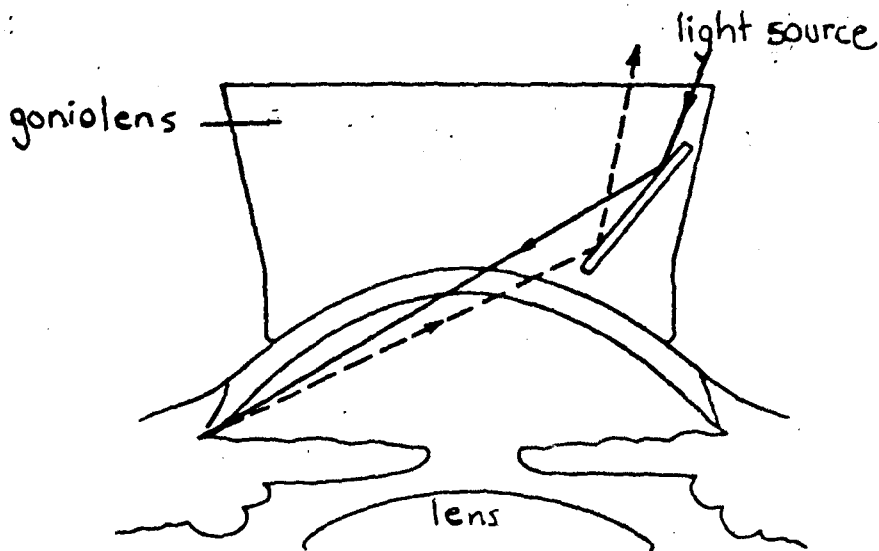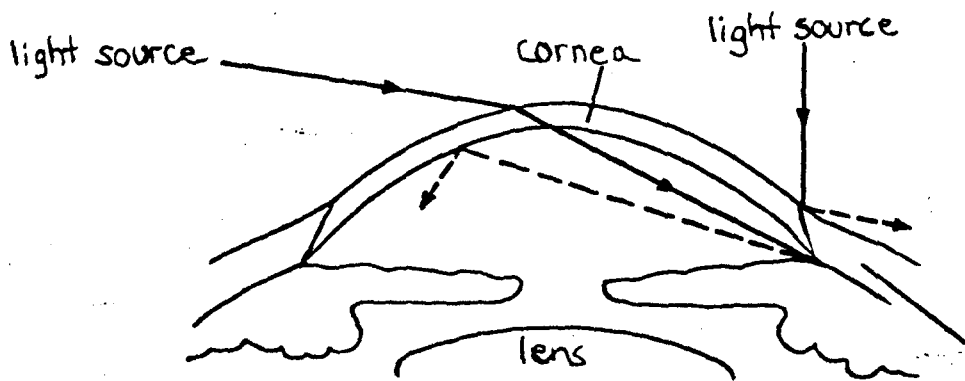
INTERNAL REFLECTION ELIMINATED
BY GONIOLENS

ANGLE ESTIMATION METHODS

VAN HERICK TECHNIQUE

The Van Herick angle estimation technique is commonly used by optometrists during a routine slit lamp examination to estimate the width of the anterior chamber angle[1]. In this technique, the thickness of a corneal optic section adjacent to the limbus is compared with the depth of the anterior chamber. The procedure for performing the slit lamp estimation involves positioning a narrow optic section at the peripheral cornea. A 60 degree angle is formed between the illumination beam and the viewing oculars of the slit lamp. The width of the angle can be estimated by comparing the width of the corneal optic section to the width of the shadow adjacent to the optic section. This shadow represents the distance between the anterior iris and the posterior cornea. The angle depth can then be estimated and graded.

Grading of the anterior chamber angle with the Van Herick Technique:

Grade 4:   AC depth =corneal thickness or greater

Grade 3:   AC depth =1/4 to 1/2 corneal thickness

Grade 2:   AC depth =1/4 corneal thickness

Grade 1:   AC depth =<1/4 corneal thickness

Grade 0:   AC depth = extremely shallow with no
                          peripheral anterior chamber

Gonioscopy is mandatory if an angle is estimated to be equal to or less than 1/4 of the corneal thickness (ie. grade 2 or less). This angle is narrow and subsequently considered to be at risk for angle closure during pupillary dilation.

Two other screening methods used to estimate the anterior chamber angle depth are the shadow method and limbal glow method.

SHADOW METHOD:

This procedure is performed with a penlight directed from the temporal side at a 90 degree angle to the line of sight. The patient fixates straight ahead. A light directed from the temporal side will cast a crescent-shaped shadow on the nasal side of the iris. In a normal patient with an open angle, the shadow at its widest part will be 1 to 2 mm. In a patient with a narrow angle, the shadow will be 3 or more mm wide[2].

LIMBAL GLOW:

This procedure is also called Vurgaft's Phenomenon of Internal Reflection. A penlight is directed from the temporal side similar to the shadow method. The angle is greater than 90 degrees to the line of sight. The examiner assesses the nasal luminescent reflection. If the angle is open, the nasal reflection will be round with a width of 1.5mm or greater. An angle that is narrow will have a very dim and narror luminescence[3].

GONIOSCOPY LENSES

There are 2 basic types of goniolenses, the direct and indirect.

DIRECT GONIOSCOPY: KOEPPE GONIOLENS

Direct gonioscopy allows observation of the anterior chamber angle through a dome goniolens such as the Koeppe lens. In this technique the patient is in the supine position. Examination requires the use of a special hand held magnification device and separate illumination system. It is still commonly used by ophthalmologists especially with certain surgical procedures.

INDIRECT GONIOSCOPY:

Indirect gonioscopy was introduced in 1938 following the development of the slit lamp biomicroscope. The goniolens has a mirror or silvered reflecting surface. A slit lamp provides the magnification and illumination necessary to view the angle.

There are several types of indirect goniolenses currently used by optometrists. The Goldmann Single Mirror, 2 Mirror and Universal 3 Mirror; Posner 4 Mirror, Zeiss 4 Mirror, Sussman, and Thorpe are various types available.

The 3 Mirror and single mirror lens permit viewing of the anterior chamber angle utilizing an optical coupling solution. A viscous gonioscopic solution is used to fill the corneal-lens interface since the lens vaults the cornea. The Universal 3 Mirror has a contact surface of 12mm to 18mm with a 64 D central base curve. There are 3 different mirrors, each inclined at a different angle to

permit viewing of the peripheral retina in addition to the anterior chamber angle. Anterior chamber structures are viewed using the A-shaped mirror which is inclined at an angle of 62 degrees. This lens is versatile in that it permits stereoscopic viewing of the posterior pole, mid and far peripheral retina as well as the anterior chamber angle. Another advantage is that it permits a stable view of the structures due to direct adherence of the lens to the cornea. To view the entire circumference of the angle, this goniolens must be rotated 360 degrees around the eye. See Table 1.

The Posner and similar Zeiss goniolenses have 4 equally angled mirrors which allow for examination of 360 degrees of the angle with minimal rotation of the lens. Each mirror is angled at approximately 64 degrees. The contact surface diameter is approximately 9.0mm and the base curve is 41.50D. Because the contact surface of this lens is smaller and flatter, the lens aligns with the central curvature of the cornea. As a result, this method tends to be quicker and less traumatic to the globe than the 3 mirror. A viscous solution may not be required since this lens approximates corneal alignment. The Posner and Zeiss lenses are mounted on a handle. The Sussman has the same lens design but without the handle. A disadvantage of the 4 mirror lens design is that it can be somewhat more difficult to maintain a stable view on the cornea for the novice gonioscopist. The 4 mirror type lenses allow viewing of the anterior chamber and the posterior pole, but unlike 3 mirror designs, they do not permit examination of the peripheral retina. 4 mirror designs can be useful for dynamic or compression gonioscopy due to the smaller contact surface on the cornea. The procedure for compression gonioscopy

consists of applying gentle pressure on the cornea with the goniolens. This facilitates evaluation for peripheral anterior synechiae in patients with angle-closure or narrow angles. Pressure with the 4 mirror reduces the clarity of your view due to the induced folds in the corneal endothelium. See table 2.

TABLE 1:

CHARACTERISTICS OF 3 MIRROR LENSES

Base curve: 7.36 mm/ 64.00D central base curve
Contact surface diameter: approx 12 mm-18 mm
Mirror angle for anterior chamber viewing: 62 degress

Goniolens types:
      Goldmann
      Universal
          Small and large contact surface diameters

Structures viewed:anterior chamber angle, posterior pole, mid and far peripheral retina

Technique:
-permits very stable viewing
-must be used with viscous solution
-must be rotated 360 degrees to view entire anterior chamber angle

* Cannot be used for compression gonioscopy

TABLE 2:

CHARACTERISTICS OF 4 MIRROR LENSES

Base curve: 41.50 diopter
Contact surface diameter: 9.0 mm
Mirror angle: 64 degrees

Goniolens types:
      Posner: with fixed handle, plastic
      Zeiss: with removable handle, glass
      Sussman: no handle

Structures viewed: anterior chamber angle and posterior pole

Technique:
-somewhat difficult to stablize for novice gonioscopists
-requires minimal rotation to view entire angle
-requires no viscous solution

Can be used to perform compression or indentation gonioscopy

THE GONIOSCOPY PROCEDURE

INSTRUMENTATION REQUIRED FOR GONIOSCOPY:

Materials to perform gonioscopy include a topical anesthetic, slit lamp, goniolens, gonioscopy solution , facial tissue, and a sterile saline irrigating solution. The gonioscopic solution will depend on the type of goniolens that is used. As previously mentioned, when using a 3 mirror lens, a viscous fluid is necessary to fill the cornea/lens interface. When using a 4 Mirror lens, on the other hand, a fluid may not be necessary. Traditionally, gonioscopy solutions are made from preserved 2.5% methylecellulose; however, viscous artificial tear products work very well. Celluvisc is a preservative-free 1% carboxyethylcellulose solution with an adequate viscosity.

INITIAL SLIT LAMP SET-UP:

The initial slit lamp set-up includes the mirror in clickstop, beam at maximum height, slit width of a medium parallelpiped, medium illumination, 10-15X magnification, and a zero degree angle between the illumination and magnification systems. During gonioscopic procedure, it may be necessary to modify the magnification and illumination systems to enhance view of angle structures and to reduce glare. Prior to performing gonioscopy, both the patient and the examiner must be comfortably positioned.

The biomicroscope set-up, the magnification and illumination systems, may be modified during gonioscopy to enhance viewing of the angle structures as well as to help reduce any glare.

PREPARATION OF THE GONIOLENS:

Prior to inserting the goniolens, the lens must be adequately cleaned and disinfected. After the examiner has cleaned his hands, we recommend the following procedure for effective cleaning of the goniolens: first clean the goniolens contact surface with a rigid contact lens cleaning solution, then rinse with tap water or saline. The contact surface is then disinfected with a 1:10 bleach concentration or glutaldehyde/chlorohexadine solution for optimally 10 minutes. The use of alcohol or hydrogen peroxide solution to disinfect the lens is not recommended as this may damage the goniolens. Following disinfection, the goniolens must be rinsed thoroughly with saline.

Once the goniolens has been properly cleaned, it is ready to be filled with goniofluid. Fill the bowl of the goniolens to about 1/3 to 1/2 full of solution. Care is taken to avoid bubbles forming in the solution as the bubbles can interfere with viewing. This is especially important with 3 Mirror and single mirror lens designs.

PATIENT PREPARATION:

Prior to gonioscopy, the anterior segment of the patient's eye should be examined to determine the presence of any conditions which would contradict gonioscopic examination. This includes globe lacerations or perforations, corneal abrasions or lacerations, corneal ulcerations, infectious red eyes. Indications for using a bandage contact lens to perform gonioscopy include a history of recurrent corneal erosion, severe dry eye, neurotrophic keratitis, corneal dystrophies,

and if the patient has an allergy to topical anesthetics hereby allowing gonioscopy without anesthesia. See table 3.

A single drop of topical ophthalmic anesthetic such as 0.5% Proparacaine is instilled into the patient's eyes. Not only does this serve to anesthetize the cornea, it diminishes the patient's blink response. Although gonioscopic screenings usually can be completed within seconds, often detailed examination will require more time for the procedure. In this event, it may be necessary to insert a second drop of anesthetic 10 minutes later. The patient is then seated comfortably behind the slit lamp.

TABLE 3:

CONTRAINDICATIONS FOR GONIOSCOPY

1. Globe lacerations or perforations
2. Corneal abrasions or lacerations
3. Corneal ulcerations
4. Infectious red eyes
5. History or Recurrent Corneal Erosion
6. Severe Dry Eye
7. Neurotrophic keratitis
8. Corneal Dystrophies

BANDAGE CONTACT LENS:

It may be necessary at times to view the anterior chamber angle in an eye with a compromised anterior surface. In this event a bandage contact lens can be used to perform gonioscopy with minimal affect on the anterior surface. Conditions associated with the use of a contact bandage lens include corneal dystrophies, history of recurrent corneal erosion, and severe dry eye. Furthermore, if there is a history of allergies to topical anesthetics, the use of a bandage contact lens will permit gonioscopic examination without anesthetic. See table 4.

TABLE 4:

INDICATIONS FOR USING A BANDAGE CONTACT LENSES

1. Corneal dystrophies
2. History Recurrent Corneal Erosion
3. Allergy to topical anesthetics
4. Severe Dry Eye

INSERTION, VIEWING, AND REMOVAL OF THE GONIOLENS:

Insertion technique will vary slightly depending on the type of goniolens used.

The Universal 3 Mirror
Insertion:

With the patient positioned comfortably behind the slit lamp, the examiner should also be seated comfortably to be in position to stabilize the goniolens onto the patient's eye. The goniolens is held between the examiner's thumb and index finger. The other hand should be used to stabilize the patient's upper lid. The patient is first asked to look up. The examiner then pulls down on the patient's lower lid using the middle or fourth finger of the hand holding the goniolens. The lower edge of the goniolens is now placed beneath the lower lid. The lens is gently moved forward on the cornea. The patient is then instructed to look straight ahead. The lids can be released. The examiner must hold the lens in place while viewing the angle structures. Excessive pressure should not be exerted on the cornea.

Viewing:

The examiner must then position the slit lamp for viewing through the gonioscopy mirror. With the 3 Mirror goniolens, the A shaped mirror is the one used for gonioscopy and, therefore, is the mirror to be focused on. If the A shaped mirror is positioned superiorly or at the 12 o'clock position, this will permit viewing of

the inferior angle. Hence, the structure viewed is always 180 degrees from the position of the mirror. To view the entire circumference of the angle, the goniolens must be rotated 360 degrees. Clockwise rotation should be performed carefully and slowly. The examiner must be careful not to exert excess corneal pressure. Furthermore, the examiner must be careful not to destabilize the lens while rotating as this may create unwanted air bubbles.

Removal:

With the 3 mirror lens, a suction is created between the lens and cornea that tends to help stabilize lens position. To remove the lens after viewing all angles, this suction needs to be broken. To remove the lens, have the patient look up. Slight pressure can then be applied to the lower lid at the edge of the goniolens. This should be sufficient to break the suction. The lens can then be easily removed. The lens should not be attempted to be removed by pulling forward without breaking the suction as this may induce unnecessary trauma to the globe.

The Posner 4 Mirror with handle:

Recall that the Posner 4 Mirror differs from the Universal 3 mirror in that it has a smaller and flatter contact surface. Hence, the lens is not held in place on the cornea through suction. The examiner must align the Posner onto the patient's cornea by carefully holding the handle in position.

Insertion:

To insert the Posner, the patient is instructed to look up. The examiner holds the handle pointing superior or inferior. To examine a patient's left eye, the examiner holds the goniolen with the right hand. The patient is instructed to look straight ahead as the lens is gently placed on the eye. The lens may be better stabilized by utilizing the side of the patient's face or the headrest of the slit lamp to support the hand holding the Posner handle.

Viewing:

If no air bubbles are obstructing the view, the slit lamp can be carefully moved to position. For the beginning gonioscopist, this may be difficult as the goniolens must be held steadily in place while the slit lamp is simultaneously moved into position. Once the slit lamp is in place, the mirror can be focused on. Remember again that the superior mirror permits viewing of the inferior angle. Complete 360 degree rotation is not necessary with the Posner 4 Mirror lens. All 4 quadrants can be viewed by careful manipulation of the slit lamp to each of the 4 mirrors. The examiner should avoid using excess pressure in an attempt to help stabilize the goniolens on the eye. This excess pressure can distort the cornea and, in turn, distort the gonioscopy view with the 4 mirror due to the folds in the corneal endothelium.

Removal:

Removal of the Posner is quite simple.   The examiner gently lifts the lens off of the cornea. A suction is not created on the cornea as is with the Universal 3 mirror design.

FOLLOWING GONIOSCOPIC PROCEDURE:

Following gonioscopy, it is recommended that a slit examination using a staining dye such as Fluorescein be performed to check for any corneal epithelial disruption.   Although not common, gonioscopy may result in some minor disruption to the corneal epithelium in which case ocular lubricants and patient education are appropriate.

Following gonioscopy, if it is apparent that a patient has some hypersensitivity to the topical anesthetic or gonioscopic solution, it may be necessary to lavage the cornea.   The recommended procedure is to irrigate the patient's eye with saline.   It may be necessary to warn the patient that there may be some redness and discomfort due to hypersensitivity to solutions.   Use of the non-preserved ophthalmic lubricant Celluvisc significantly reduces the incidence of corneal complications.   The preservatives in commercially available gonio-solutions may be associated with significant corneal epithelial disruption.

NORMAL GONIOSCOPIC FINDINGS

To evaluate gonioscopic findings, the appearance of the angle should be viewed as though the examiner is standing on the iris looking into the anterior chamber angle. In this respect, the iris appears as the ground, the angle structures appear as the horizon, and the cornea as the sky. In this sense, gonioscopic examination starts at the iris and proceeds through all the angle structures until clear cornea is reached. Structures are observed from anterior to posterior. Structures observed include the iris root, ciliary body, scleral spur, trabecular meshwork, schlemm's canal, and Schwalbe's line.

PUPILLARY MARGIN and PERIPHERAL IRIS

The first structure to observe is the iris starting at the pupillary margin and progressing toward the peripheral iris. The structure and contour of the iris should be observed. The iris should be examined for elevations and any abnormalities such as iris nevi, iris cysts, the presence of tumors. The pupil border should be examined as well to look for the presence of blood vessels found in patients with rubeosis irides, dandruff-like material found in pseudoexfoliation syndrome, posterior synechia and sphincter atrophy.

It is important for the examiner to determine the angular approach of the iris. The approach may vary from convex to plano to concave. Is the iris bowed forward with respect to the iris base or is the angular approach essentially flat? Determination of the angular

approach can help ascertain whether the angle is wide or narrow. In the adult normal angle, the iris root is seen to insert into the ciliary body. This insertion creates depth to the angle. If the iris is obviously flat and inserts well down into the ciliary body as in a posterior insertion, then expect the angle to be wide open. If the iris bows forward ie. convex and the iris base is involved, then one may suspect a narrow angle.

A plateau iris is the term used to describe an angle configuration in which most of the iris has a plano approach to the angle, but the peripheral iris root dips sharply posterior and is very close to the trabecular meshwork. Gonioscopic examination will reveal a flat iris approach with narrow peripheral angle depth. A small roll and trough are apparent just before the iris inserts on to the ciliary body.

The significance of identifying plateau iris configurations is the occurrence of primary angle closure without pupillary block following pupil dilation. With pupillary dilation, the peripheral iris thickens and leads to iris crowding the angle. This mechanism results in acute angle closure glaucoma.

CILIARY BODY

The next structure to view is the ciliary body. This is the deepest, most posterior structure and is often hidden by the last roll of the iris or by iris processes. The color of the ciliary body band can vary from a dull brown, golden brown to pale grey. The width of the ciliary body band depends on the position of the iris insertion. A posterior iris insertion will result in a thicker ciliary body band

whereas a more anterior insertion will result in a thinner ciliary body band. It is typically narrow in hyperopes and wide in myopes. The blood vessels of the major arterial circle of the iris may appear in the peripheral iris running circumferential to the ciliary body. This is especially common in blue eyed patients.

IRIS PROCESSES

The ciliary body band may be hidden by iris processes. Iris processes appear in approximately 1/3 of normal eyes. They usually are few in number and are more common nasally. In lightly pigmented irides, the iris processes may appear gray whereas in darkly pigmented irides, the iris processes may appear dark brown. Iris processes are extensions of the iris root and tend to follow the contour of the angle. It is important for the examiner to distinguish iris processes from anterior synechia.

SCLERAL SPUR

After the ciliary body band, the next structure to observe is the scleral spur. It appears as a white, opaque band that actually is a short extention of sclera. It forms the interior wall of the scleral pocket where Schlemm's canal rests. The longitudinal muscle of the ciliary body inserts into the scleral spur. The scleral spur may be partially obstructed by iris pigment or by numerous dense iris processes.

TRABECULAR MESHWORK

Anterior to the scleral spur is the trabecular meshwork. This is the structure which represents the aqueous sieve and therefore debris within the anterior chamber is most likely to accumulate here. Although the coloration of the trabecular meshwork varies greatly, it is usually a dull gray or tan band. The width of the trabeculum can vary. The termination of iris processes may assist in localizing the trabecular meshwork. A speckled, textured appearance of pigment is frequently noted in the posterior portion of the trabecular meshwork. This is usually most prominent inferiorly. The midtrabecular meshwork is the junction of the pigmented and nonpigmented trabecular meshwork. Pigmentation in the trabeculum is commonly present in older individuals and people with dark irides. Certain disease states such as pigmentary dispersion syndrome, pseudoexfoliation syndrome, previous ocular trauma, and previous uveitis can also lead to pigmentation of the trabecular meshwork.

View of a nonpigmented trabecular meshwork may be enhanced by the corneal wedge technique and by applying pressure to observe blood in Schlemm's canal.

SCHLEMM'S CANAL

A darker gray or reddish line can sometimes be observed between the anterior 2/3 and posterior 1/3 of the trabecular meshwork. This is Schlemm's canal. The major volume of aqueous fluid passes through the trabecular spaces into the canal of Sclemm. If excess pressure is applied to the eye, Schlemm's canal may fill

with blood and appear red in color. In some instances valuable structural and positional information may be provided by inducing the canal to fill with blood. Blood in Schlemm's canal can be induced by exerting enough pressure to force episcleral venous blood to retrograde fill the canal with a single mirror or 3 mirror style goniolens. The pressure with these lenses will not distort the angle width like a 4 mirror, and the visibility of Schlemm's canal would caution that at least 2/3 of the trabecular meshwork is exposed.

SCHWALBE'S LINE

The next structure to observe is Schwalbe's line. It is the most anterior structure of the angle. It represents the peripheral limit of descemet's membrane of the cornea. It appears as a thin, opaque white line. It may appear slightly raised. This may represent the change from corneal to scleral curvature. In older patients or patients with pigmentary dispersion, pigment may be deposited around Schwalbe's line and accumulate at this transition area. In this event it is important to differentiate Schwalbe's line from trabecular meshwork so that appropriate angle width can be determined. In certain disease entities such as Axenfeld's syndrome, Schwalbe's line may appear particularly prominent and anteriorly displaced. An excessive accumulation of pigment at Schwalbe's line may be apparent in conditions such as pigmentary dispersion, pseudoexfoliation, uveitis, trauma, or melanoma. Pigmentation of Schwalbe's line is referred to as Sampaolesi's line.

Schwalbe's line often can be extremely difficult to visualize. Varying the angle of the light source and observing contrast changes

between the faintly tan colored trabecular meshwork and the faint gray colored peripheral cornea may help to identify Schwalbe's line. It often illuminates as a thin, pearly white landmark between the trabecular meshwork and the cornea. Corneal wedge is a subtle technique that facilitates localization of Schwalbe's line.

CORNEAL WEDGE

Identification of the Schwalbe's line can be made by examination of a corneal wedge. The posterior and anterior reflections of a corneal optical section form a wedge that meets at Schwalbe's line. This technique only works at 6 and 12 o'clock. Due to technical difficulties with the low levels of illumination used in this technique, a corneal wedge is impossible to photograph for the video.

NORMAL ANGLE VESSELS

Blood vessels may normally be visible within the anterior chamber angle. Normal angle vessels do not extend anterior to the scleral spur. Normal angle vessels include the circular and radial ciliary body vessels as well as the radial iris vessels. Vessels of the major arterial circle may be visible in the peripheral iris. The importance of examining vessels within the angle is to determine the presence of any new vascular growth such as with rubeosis irides and neovascular glaucoma.

RECORDING AND GRADING GONIOSCOPIC FINDINGS

Once the entire circumference of the anterior chamber angle has been thoroughly examined, it is important to document the findings. Important components of a gonioscopic recording system should include the following:

1. deepest, most posterior structure visible

    ie. no structures, Schwalbe's line, trabecular meshwork, scleral spur, ciliary body

2. estimation of the angular approach

    ie. concave, convex, flat

3. estimation of the position of the iris insertion into the ciliary body

    ie. anterior insertion, posterior insertion

4. indication of the presence of iris processes

    -if present, the amount can be graded

5. indication of the presence of any pigment

6. presence of iridocorneal abnormalities

It is very important to keep in mind when evaluating structures that the mirror viewed actually represents visualization of structures 180 degrees away. For example, when viewing a mirror position inferiorly, examination is actually of structures superior and therefore, should be recorded as superior structures.

In a gonioscopic examination, the examiner should always compare the patient's eyes. There should be symmetry between the anterior chamber angles of the two eyes. Angle width and

pigmentation should be approximately similar. Asymmetry may represent a pathological condition.

Common abbreviations used in recording gonioscopic findings:

CB=ciliary body

TM=trabecular meshwork

SS=scleral spur

SL=schwalbe's line

IP=iris processes

PIGMENT GRADING:

Grade pigmentation on a scale of 1 to 4 scale with a grade 1 being a minimal amount and a grade 4 being densely pigmented.

Documentation can be represented on a diagram similar to the following:

RIGHT EYE   superior

temporal   nasal

inferior

EXAMPLE:

```
          TM w/ +3 pig
              ╲      ╱
               ╲    ╱
CB w/ 1+pig     ╳     CB w/ 2+pig
               ╱    ╲
              ╱      ╲
          TM w/ 3+pig
```
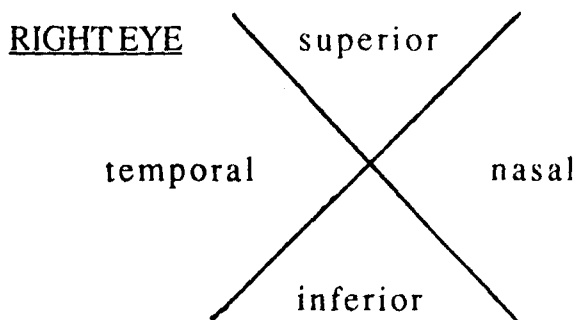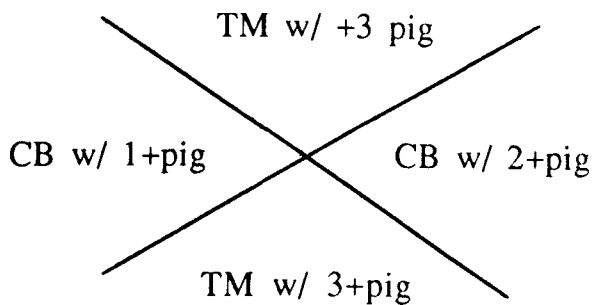
Posterior insertion of iris, flat angular approach

This would represent an open angle in which the most posterior structure visible was ciliary body in the nasal and temporal quadrants and trabecular meshwork in the inferior and superior quadrants. The posterior insertion reflects a wide open angle. Pigmentation present in variable amounts.

It is the examiner's responsibility to determine first whether an angle is open or closed. If the examiner determines that the angle is open, the examiner must determine the degree to which it is open. Narrow angles may be at risk for closure following pupillary dilation. If an angle is estimated to be narrow according to a screening technique such as the Van Herick slit lamp estimation method, limbal glow or shadow method, gonioscopy is mandatory to assess more accurately whether this angle is at risk for angle closure during dilation.

There are some general assumptions to follow when determining angle width. As discussed previously, with an essentially flat iris approach, a wide angle is expected. With an iris

that is bowed forward or cancave, some narrowing of the angle is expected. A posterior insertion of the iris root into the ciliary body also reflects an open angle. An anterior insertion into the ciliary body also represents an open angle. An iris that inserts anterior to the scleral spur onto the trabecular meshwork or schwalbe's line is always considered pathological.

If in reaching the angle, one sees trabecular meshwork, it can be stated that the anterior chamber angle is not closed. The degree to which it is open as well as the risk of potential closure must still be determined.

GRADING SYSTEM:
(SHAFFER SYSTEM)4

When grading the anterior chamber angle, it is important to evaluate the most posterior structure visible. The iris approach and insertion into the angle must also be evaluated. Furthermore, an estimate of the width of the angle based on the angle that the iris makes with the ciliary body and trabecular meshwork. The width of the iridocorneal angle can be estimated in degrees. Combining all these factors, the angle can be graded on a scale of 4 to 0.

> **Grade 4:** Wide open angle- all angle structures are easily
> visualized. The iris appears flat and inserts
> into the posterior ciliary body band.
> Angular width 35-45 degrees

Grade 3: Open angle- all angle structures are visible. The iris appears slightly convex and may insert somewhat more anterior into the ciliary body. Angular width 20-35 degrees

Grade 2: Moderately narrow angle- the trabeculum is visible and manipulation of the goniolens may allow more structures to be visualized. The iris is convex and inserts anterior. Angular width 10-20 degrees

Grade 1: Extremely narrow angle- very thin, slit like appearance of angle and manipulation of the goniolens may allow visualization of some of the trabecular meshwork. The iris is extremely convex. Angular width equal to or less than 10 degrees

Grade 0: Closed angle- no visible angle structures. The peripheral iris surface is in contact with the corneal endothelium. No angular width- pupillary block

Based on this system, a grade 2 or less is capable of closure. This is based on any portion of the angle being graded as a 2 or less. A moderately narrow angle such as a grade 2 can potentially close. An extremely narrow angle such as a grade 1 in which the angle

appears "slit-like", this angle would close with iris edema or pupillary block. A closed angle as with a grade 0 would have an iris surface that is in contact with the peripheral corneal endothelium.

COMPRESSION GONIOSCOPY

An eye with an apparently narrow anterior chamber angle may have structures that are difficult to identify. Indentation or compression gonioscopy may help to reveal further angle details with the absence or presence of peripheral anterior synechia. If an angle appears to be closed, it may be possible to artificially open the angle by applying pressure on the central cornea. A 4- Mirror goniolens may be used to apply this pressure. This pressure may force aqueous fluid into the peripheral anterior chamber angle driving the peripheral iris base back from the angle; hence widening the angle. In the case of peripheral anterior synechia, the angle structures will not be exposed by this procedure.

GONIOSCOPY AND PATHOLOGICAL FINDINGS

There are many pathological conditions in which gonioscopy is indicated. See table 5 for listing of indications. Gonioscopy can provide diagnostic information about many pathological conditions most commonly with regard to the glaucomas. Gonioscopy helps in the differentiation of the type of glaucoma and in turn affects the treatment strategy. Gonioscopy should, therefore, be performed on all patients with elevated intraocular pressure as well as other suspicious signs and symptoms of open or closed angle glaucoma.

Gonioscopy can provide valuable information about conditions associated with secondary glaucomas. Many structural and mechanical abnormalities associated with these conditions can be detected within the anterior chamber angle with the use of gonioscopy. Some of the conditions associated with secondary glaucomas include the following:

1. Pigmentary Dispersion syndrome
2. Pseudoexfoliation syndrome
3. Previous ocular trauma
4. Uveitis
5. Rubeosis irides
6. Iridocorneal endothelial syndromes
7. Anterior cleavage syndrome

TABLE 5:

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│                                                             │
│              INDICATIONS FOR GONIOSCOPY:                    │
│                                                             │
│  1.   Narrow anterior chamber angles prior to dilation      │
│  2.   Open or closed angle glaucoma patients or those at risk│
│  3.   Conditions associated with secondary glaucoma         │
│           -Pigmentary Dispersion Syndrome                   │
│           -Pseudoexfoliation syndrome                       │
│           -Previous ocular trauma                           │
│           -Anterior or posterior uveitis                    │
│           -Iridocorneal endothelial syndromes              │
│           -Rubeosis irides                                  │
│           -Peripheral Anterior Synechia                     │
│  4.   Developmental Anomalies & Anterior Cleavage           │
│  Syndromes                                                  │
│           -Aniridia                                         │
│           -Posterior Embryotoxon                            │
│           -Reiger's Anomaly                                 │
│           -Axenfeld's Syndrome                              │
│           -Peter's Anomaly                                  │
│  5.   Intraocular foreign bodies                            │
│  6.   Intraocular tumors                                    │
│  7.   Dislocated or subluxated crystalline lens             │
│  8.  Malignant glaucoma                                     │
└─────────────────────────────────────────────────────────────┘
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The following is a brief description of these conditions associated with secondary glaucomas along with some gonioscopic findings.

PIGMENTARY DISPERSION SYNDROME

Pigmentary dispersion syndrome is diagnosed based on mid-peripheral iris transillumination as well as the presence of pigment deposition on the corneal endothelium (Krukenberg's spindle), trabecular meshwork, and anterior iris surface. The significance of detecting pigmentary dispersion syndrome is that it can occassionally result in pigmentary open angle glaucoma. There is a loss of pigment from the pigmented epithelium of the posterior iris surface. The pigment may lead to an obstruction of the filtration process of aqueous from the anterior chamber, this can result in an increase in the intraocular pressure.

Gonioscopic examination would reveal a dense, dark band usually within the mid-portion of the trabecular meshwork. The pigment band would be present 360 degrees of the angle. The anterior chamber angle would be open. In some cases, there may be pigment deposition on Schwalbe's line. The anterior iris may appear concave toward the periphery. Other signs include spoke-like transillumination defect of the mid-peripheral iris, vertical pigment band on the corneal endothelium (Krukenberg's spindle), large fluctuations in intraocular pressure, and pigment in the anterior chamber during IOP spikes.

Patients with pigmentary dispersion syndrome are usually asymptomatic but may have episodes of blurred vision and eye pain. Colored halos may be visible around lights preceding exercise or pupillary dilation. It typically occurs bilaterally in young myopic males.

If pigmentary dispersion syndrome is suspected, then it becomes necessary to treat this patient as a glaucoma suspect. IOPs must be carefully monitored. Since dilation and mydriasis seems to exacerbate the release of pigment, pressures should be monitored afterwards. Furthermore, it is known that following strenuous exercise especially basketball, that an IOP spike may occur. IOPs should be monitored following vigorous exercise.

The reported occurrence of pigmentary glaucoma in patient's with pigmentary dispersion varies from approximately 12 to 50%[5]. It has been recently theorized that a reverse pupillary block is the main mechanism causing the posterior peripheral iris bowing, iris-zonular touch, and pigment release[6]. Treatment of pigmentary glaucoma is aimed at reducing the irido-zonular contact. Miotic agents such as pilocarpine and possibly other antiglaucoma medications may be effective. The prognosis can be excellent especially if it is diagnosed early. It has been reported that in some cases the pigmentary dispersion spontaneously remits. It is believed that this is a result of the iris being lifted away from the lens zonule as the patient's lens ages and thickens and the pupil becomes more miotic.

PSEUDOEXFOLIATION SYNDROME

Pseudoexfoliation syndrome is characterized by the accumulation of whitish dandruff-like flakes present along the pupillary margin, anterior lens capsule, trabecular meshwork, and ciliary processes. The significance of detecting patients with this syndrome is the increased incidence of open angle glaucoma

occurring in patients with pseudoexfoliation. Pseudoexfoliation glaucoma occurs when the fibrillar material obstructs the trabecular meshwork. The outflow of aqueous becomes obstructed and an increase in IOP results.

The source of the dandruff-like material is not clearly understood. It is believed to arise from the pigmented epithelium of the iris. This gives way to iris transillumination defects.

Clinical signs include the presence of white flaky material on the pupillary margin. Following dilation, anterior lens capsular changes may be more evident. The peripheral lens may have a scalloped appearance. Gonioscopic findings may reveal the presence of irregular pigment deposition on the trabecular meshwork and along Schwalbe's line termed then as Sampaolesi's line. The anterior chamber angle will be open.

Pseudoexfoliation syndrome seems to occur more frequently in patients between the age 60-80. It may present unilateral or bilateral. It is commonly associated with higher levels of IOP with open anterior chamber angles. The occurrence of psuedoexfoliation syndrome developing into open angle glaucoma is not clearly defined in the literature although it has been suggested that pseudoexfoliation represents 12 percent of the glaucoma clinic population[7]. Based on this rate of occurrence, if pseudoexfoliation syndrome is detected, this patient should be treated as a glaucoma suspect.

PREVIOUS OCULAR TRAUMA

Secondary glaucoma can occur following ocular trauma based on several mechanisms. Blunt trauma can cause an intraocular inflammatory response which may lead to formation of a hypema in the anterior chamber. Furthermore posterior and peripheral anterior synechiae can form subsequent to trauma to the eye as well as microscrarring of the trabecular meshwork and endothelial cell growth. These factors can impair the functioning of the anterior chamber angle structures and consequently can impinge upon the outflow of aqueous from the anterior chamber. Glaucoma may result shortly following the trauma as well as years later. Late onset glaucoma following blunt trauma has a reported incidence of 2-10%[8].

Any previous blunt injury to the eye can result in a traumatic angle recession. Gonioscopy is important in detecting areas of angle recession. The importance of identifying areas of angle recession is its associated risk for post-traumatic glaucoma.

A blunt injury to the eye causes compression of the globe and a shock wave to be transmitted through the anterior chamber. This results in a tear of the ciliary body at its insertion into the scleral spur. Gonioscopic examination will reveal a posteriorly displaced widened ciliary body band. The angle will appear very wide and deep. White fibrotic tissue may be present at the iris root at the site of the angle recession. Iris processes may appear torn. The scleral spur may appear abnormally white. Furthermore, clumps of pigment may be present at the area of recession indicative of previous anterior chamber trauma. Iris sphincter tears may be present.

In diagnosing angle recession, it is important to evaluate and compare 360 degrees of the anterior chamber of both eyes. This comparison will be of tremendous aid when diagnosing areas of angle recession.

An area of angle recession represents a disruption of the normal anatomical structure of the trabecular meshwork. Glaucoma may result secondary to the trauma. If glaucoma occurs soon after the trauma, then its occurrence is probably related to the presence of uveitis or hyphema within the anterior chamber angle. Glaucoma may occur years after the initial trauma if the angle recession is extensive. In this event, the glaucoma appears to be secondary to a degeneration of the trabecular meshwork.

Patients with angle recession without glaucoma should be treated as glaucoma suspects due to the substantial increased risk of developing glaucoma. Approximately 2-20% of patients with angle recession develop open angle glaucoma9. Patients with angle recession glaucoma should be treated as primary open angle glaucoma patients; however, miotics may not be effective. Both eyes should be carefully monitored. There is a high incidence of open-angle glaucoma occurring in the uninvolved eye as well as the traumatized eye.

INTRAOCULAR INFLAMMATIONS: UVEITIS

Uveitis is a term used to describe an intraocular inflammation affecting the structures of the uvea. There are many ocular and systemic causes of uveitis. If the uveitis is severe and/or longstanding without any treatment, the inflammation may result in

a decreased aqueous outflow which can lead to increased intraocular pressure and, in turn, secondary uveitic glaucoma.

Gonioscopy should be performed to evaluate the integrity of the anterior chamber angle. Closed angle glaucoma can result if the inflammatory debris consolidates in the drainage angle and results in the adherence of the peripheral iris to the trabecular meshwork. Gonioscopy in this event may reveal peripheral anterior synechiae. An open angle glaucoma can result if the inflammatory debris clogs the trabecular meshwork and decreases the aqueous outflow. Gonioscopy is necessary to evaluate the anterior chamber angle and to guide in the treatment strategy.

PERIPHERAL ANTERIOR SYNECHIA

This is a term used to describe the configuration when the peripheral iris attaches to the anterior chamber angle wall. It can occur at any level of the angle. It usually occurs post-surgically or following intraocular inflammation. It can be localized or can be extensive and cover the entire circumference of the angle. Compression gonioscopy is necessary to differentiate peripheral anterior syndechia from iris processes. Peripheral anterior synechia will not break during compression gonioscopy.

RUBEOSIS IRIDES

Rubeosis irides refers to neovascularization of the iris and the anterior chamber angle. It occurs most frequently in diabetics, central retinal vein occlusion. Other causes include branch retinal vein occlusion, central retinal artery occlusion, thrombic uveitis, and

retinal detachment. With regard to diabetic patients, rubeosis irides is usually only seen in eyes with proliferative diabetic retinopathy[10].

Gonioscopic examination will reveal neovascularization initially around the pupillary margin. The neovascularization may extend over the iris to the iris root and to the trabecular meshwork. The fine vessels may climb the angle wall.

Rubeosis irides or angle neovascularization may cause angle occlusion, impede aqueous outflow and result in an elevate intraocular pressure. Thrombotic or neovascular glaucoma is likely to result. Treatment for rubeosis irides involves panretinal photocoagulation or retinal cryoablation when ischemic retinopathy is the identified etiology. Goniophotocoagulation which is direct photocoagulation of iris neovascularization may be used in addition to panretinal photocoagulation to help reduce the neovacular growth.

IRIDOCORNEAL ENDOTHELIAL SYNDROME

This refers to a defect of the anterior chamber angle in which there is a cellular proliferation of the corneal endothelium spreading across the anterior chamber angle and onto the anterior iris surface. The variations of this condition include Essential Iris Atrophy, Chandler's syndrome, and the Cogan-Reese syndrome. All forms generally have some iris atrophy, iris pigmentation, and corneal edema.

ESSENTIAL IRIS ATROPHY

This is a rare disorder in which thinning and stretching of the iris pulls the pupil toward one part of the angle resulting in corectopia and ectopion uveae. Peripheral anterior synechiae and partial to full thickness iris holes are characteristically present as well as unilateral glaucoma.

CHANDLER'S SYNDROME

This is a syndrome characterized by bullous keratopathy, peripheral anterior synechiae, corectopia,and iris atrophy without hole formation. The signs are less marked than essential iris atrophy.

COGAN-REESE SYNDROME (Iris-naevus syndrome)

This syndrome is characterized by corneal oedema, ectopion uveae, and fibrovascular mass on anterior iris surface.

ANTERIOR CHAMBER CLEAVAGE SYNDROMES

This refers to a group of developmental defects of the anterior chamber angle. These are congenital malformations of the iris, iridocorneal angle, and the cornea. Described here are the following: posterior embryotoxon, Axenfeld's anomaly, Reiger's syndrome, Peter's anomaly and Aniridia.

POSTERIOR EMBRYOTOXON

This refers to an unusually prominent Schwalbe's line. It appears a a white band inside the limbus. It is considered to be a hyperplasia of tissue on the posterior peripheral cornea. It is of no pathological significance.

AXENFELD'S ANOMALY

This refers to a prominent Schwalbe's line when it is associated with large peripheral anterior synechia. It is characterized by abnormal iris processes that extend anteriorly to be inserted into Schwalbe's line.

REIGER'S SYNDROME

This is a syndrome which includes hypoplasia of the iris, iris atrophy, peripheral iris anomalies, posterior embryotoxon and glaucoma. Other nonocular abnormalities include dental deformaties and maxillary hypoplasia.

PETER'S ANOMALY

This is a syndrome which includes central corneal opacity or leukoma with iridocorneal adhesions at the edge of the central leukoma.

ANIRIDIA

This is a bilateral developmental anomaly in which the iris is completely or partially absent. Aniridia occurs in 1/50,000 to 1/100,000 of the population[1]. The lens equator and zonules may

be visible. Peripheral anterior synechia may form and occlude the angle resulting in glaucoma. Other ocular findings associated with aniridia include hyperplastic optic disc and macula, corneal scarring, corneal pannus, nystagmus, and cataracts. It may be a part of a triad of genitourinary abnormalities and mental retardation.

MALIGNANT GLAUCOMA

Malignant glaucoma is a condition in which there is a very high intraocular pressure and occluded or shallow anterior chamber angle. It occurs postoperatively after glaucoma filtration surgery or other intraocular surgical procedures. It appears that there is an increase in the total vitreous volume with subsequent obstruction in the forward movement of the aqueous. This vitreous expansion causes a flattening of the anterior chamber and closure of the angle without pupillary block.

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APPENDIX A

VIDEO SCRIPT

Assessment of the structures of the anterior chamber angle is extremely important to the assessment of the health of the eye. Screening techniques such as the limbal glow method, van Herick technique, and the shadow method are useful to estimate the depth of the anterior chamber angle but these methods fail when confronted with suspicious structures which require a more thorough evaluation. It is impossible to visualize these structures without the use of GONIOSCOPY!

GONIOSCOPY: TO VIEW THE ANGLE

Due to the phenomena of internal reflection, viewing of the anterior chamber angle is not possible without the use of a contact gonioscopic lens. The structures of the angle are seen reflected and illuminated by a mirror contained within the goniolens.

INDICATIONS:

For the primary care optometrist, gonioscopy has many clinical indications. It is commonly used to evaluate potentially narrow angles that are at risk of producing angle-closure glaucoma during a dilated examination. It is used to provide diagnostic information about patients with open or closed angle glaucoma or those at risk for glaucoma. Gonioscopy is indicated for conditions associated with secondary glaucomas such as pseudoexfoliation syndrome and pigmentary dispersion syndrome. Other indications include previous ocular trauma, iridocorneal endothelial syndromes, history of intraocular foreign body, blunt ocular trauma, intraocular tumors, anterior uveitis, rubeosis irides, subluxated crystalline lens, and developmental anomalies such as the anterior chamber cleavage syndrome and aniridia.

FOUR TYPES OF GONIOLENSES

The four primary types of goniolenses include on the upper left, the Goldman single mirror, the Sussman, Universal 3 Mirror, and the Posner 4 Mirror. The Universal 3 Mirror has a contact surface of 12 or 18 mm with a 64D central base curve. Anterior chamber structures are viewed using the A-shaped mirror which is inclined at

an angle of 62 degrees. This lens is versatile because it permits stereoscopic viewing of the posterior pole, mid and far peripheral retina as well as the anterior chamber angle. Another advantage is that it permits a stable view of the structures due to the direct adherence of the lens to the cornea. To view the entire circumference of the angle, this lens must be rotated 360 degrees around the eye. The Sussman, Posner and similar Zeiss goniolenses have 4 equally angled mirrors which allow for examination of 360 degrees of the angle with minimal rotation of the lens. Because the contact surface of these lenses is smaller with a 9.0 mm diameter and flatter with a 41.50 D base curve, the lens aligns with the central curvature of the cornea. As a result, this method tends to be quicker and less traumatic to the globe than the 3 Mirror. A viscous solution may not be required since this lens approximates corneal alignment. The Posner and Zeiss lenses are mounted on a handle. The Sussman is not. A disadvantage of the 4 Mirror lens design is that it can be somewhat more difficult to maintain a stable position on the cornea for the novist gonioscopist. These non-faulting lenses allow viewing only of the anterior chamber and the posterior pole. 4 mirror designs can be useful for dynamic or compression gonioscopy due to the smaller contact surface on the cornea.

Since it is most commonly used, we'll illustrate the procedure for using the 3 mirror lens. Prior to inserting the goniolens, it must be adequately cleaned and disinfected. After the examiner has washed his hands, we recommend the following procedure for effective cleaning and disinfecting. First clean the lens with a rigid contact lens cleaning solution then rinse with tap water. The contact surface is then disinfected with a 1:10 dilution of bleach or glutaldehyde solution for 10 minutes. The use of alcohol or hydrogen peroxide solution to disinfect the lens is not recommended as this may damage the goniolens. Following disinfection, the goniolens must be rinsed thoroughly with saline. The initial slit lamp set-up includes the mirror in clickstop, a zero degree angle between the illumination and magnification systems, beam at maximum height, slit width of a medium parallelpiped, medium illumination, and 10-

15X magnification. It may be necessary to modify the magnification and illumination systems to enhance view of the angle structures and to reduce glare.

ASSEMBLED SUPPLIES:
GONIOSOL OR CELLUVISC, ANESTHETIC, GONIOLENS, TISSUES

Supplies have been assembled. The lens is positioned so that the A-shaped mirror is in a known position usually the 12 or 6 o'clock position to begin with. The lens is partially filled with a cushioning solution, traditionally goniosol but many practitioners currently prefer a viscous artificial tear solution such as Celluvisc. This is less traumatic to the cornea than the goniosol and more comfortable to the patient after the procedure. The lens is filled 1/3 to 1/2 full, being careful to avoid bubbles. Anesthetic is instilled in both the patient's eyes to reduce discomfort and the blink reflex. Both the patient and the examiner should be comfortably positioned. The examiner's elbow should be stabilized on the table or a small tissue box. The examiner's hand should be stabilized on the forehead of the patient or on the headrest of the slit lamp. The lens is held securely between the index finger and the thumb. The patient is instructed to look up while the examiner pulls down on the lower lid with the third or fourth finger. The lens is then smoothly rotated on the the fornix and the patient is instructed to look straight ahead and relax. Patients will often be more comfortable with a procedure if a preset is given such as in this procedure, I am simply going to place a contact lens on your eye. Here the examiner is demonstrating the rotation of the lens which is necessary to examine 360 degrees of the angle. It may be necessary to have the patient open their eyes wider while rotating or gently pull on their lower lid to allow smooth rotation. To remove the lens, simply have the patient look up. The suction between the lens and the eye will most often be easily broken. If the patient is apprehensive, a 2 handed technique most be employed. One hand controls the upper lid while the hand holding the lens controls the lower lid. The lens is then placed on the eye in a similar fashion. Here from within the slit lamp, we see the lens placed on the fornix then unto the eye. Now we'll see the beam

being rotated unto the proper mirror. As we look into the slit lamp to find the angle view. Once found we increase the magnification to suit our particular needs and the lens can be rotated to different positions to appreciate 360 degree of the angle. This lens is versatile because it permits stereoscopic viewing of the posterior pole as well as the mid and far peripheral retina using other mirrors on the lens. Here again removal is illustrated , most often a straight forward matter but if suction is high, slight pressure can be applied to the globe and the lens is easily removed. Here a Posner lens is placed on the patient's eye. With this lens, it is important to have a stable grip on the patient's lids and a firm grip on the handle as close to the lens as possible to increase stability of this lens. For increased patient comfort, it is suggested that the superior and inferior mirrors be parallel to the palpebral fissure. The patient is instructed to look straight ahead while the lens is gently place on the cornea. The handle can be held up or down depending on which position provides the most stability for the examiner. The advantage of a 4 mirror lens is that the entire 360 degree angle can be evaluated quickly by rotating the lens only 10-12 degrees and moving the beam from mirror to mirror. Here corneal endothelial folds are shown which are commonly seen with 4 mirror lenses due to improper pressure on the cornea. This can be utilized to advantage in compressive or dynamic gonioscopy in the evaluation for possible peripheral anterior synechia in patient's with angle closure or narrow angles. Removal is always straight forward as no suction is generated.

THE VIEWS:
STRUCTURES OF THE ANGLE: "FLOOR TO CEILING"
1. CILIARY BODY 2. SCLERAL SPUR 3. TRABECULAR MESHWORK 4. SCHWALBE'S LINE

Structures of the angle are identified from posterior to anterior and can be observed in order from peripheral iris, ciliary body, scleral spur, trabecular meshwork, and schwalbe's line. The first structure to observe is the iris and its approach to the angle. The structure and contour of the iris should be observed. It should be

examined for elevations and abnormalities such as iris nevi, iris cysts, presence of tumors or intraocular foreign bodies and also for dandruff-like material found in pseudoexfoliation syndrome and sphincter atrophy. The iris approach should be evaluated. A convex approach or plateau iris configuration could mean a narrowed angle.

The next structure to view is the ciliary body. This is the deepest, most posterior structure and often hidden by the last roll of the iris or by iris processes. The color of the ciliary body band can vary from dull brown to pale gray. The width of the ciliary body depends on the position of the iris insertion. A posterior iris insertion will result in a thicker ciliary body band. It is typically narrow in hyperopes and wide in myopes.

The next structure to observe is the scleral spur. It appears as a white, opaque band. Scleral fibers which form the insertion of the ciliary muscle. The scleral spur may be partially obstructed by iris pigment or by numerous dense iris process.

Anterior to the scleral spur is the trabecular meshwork. It is usually transparent dull gray band. The width of the trabeculum can vary. A speckled textured appearance of pigment is frequently noted in the posterior portion. Certain disease states such as pigmentary dispersion syndrome, pseudoexfoliation syndrome, previous ocular trauma, and previous uveitis can also lead to pigmentation of the trabecular meshwork.

The next structure to observe is Schwalbe's line. It is the most anterior structure of the angle. It represents the peripheral limit of descemets membrane. It appears as a thin, opaque, white line. If a narrow beam is placed perpendicular to the angle the beam will appear to split into two at this juncture of cornea and limbus. This technique is known as the corneal wedge and is useful for identifying structures in the angle.

Note as we look at this first group of angles that the iris approach is flat. Visualize the ciliary body, scleral spur, trabecular meshwork, and Schwalbe's line. In this normal angle all those structures are visible. Here Schwalbe's line stands out nicely. This is another wide open angle with all 4 structures easily visible.

NORMAL ANGLE STRUCTURES: PROMINENT VESSELS

Blood vessels may normally be visible within the anterior chamber angle. Normal angle vessels do not extend anterior to the scleral spur. They include the circular and radial ciliary body vessels as well as the radial iris vessels. Vessels of the major arterial circle are commonly visible. The importance of examining vessels within the angle is to determine the presence of any new vascular growth. Here again is part of the major circle of iris. Schwalbe's line stands out quite clearly in this shot. The radial collage fibers of the iris stand out quite clearly here. Again part of the major circle.

EXCESSIVE PRESSURE WITH VAULTING LENS (3 MIRROR) CREATES BLOOD IN SCHLEMM'S CANAL

A darker gray line can sometimes be observed between the anterior 2/3 and posterior 1/3 of trabecular meshwork. This is Schlemm's canal. The major volume of aqueous fluid passes through the trabecular spaces into the canal of Schlemm. If excess pressure is applied to the eye, Sclemm's canal will fill with blood and appear red in color. In some instances valuable structure and positional information may be provided by inducing the canal to fill with blood.

NORMAL ANGLE STRUCTURES: PROMINENT IRIS PROCESS

The ciliary body may be hidden by iris process. Iris process appear in approximately 1/3 of normal eyes. They are usually few in number and more commonly nasally. In lightly pigmented irides, the iris process may appear gray while in darkly pigmented irides the iris process appear dark brown. They are extensions of the iris root and tend to follow the contour of the angle. It is important for the examiner to distinguish iris process from anterior synechia.

ROTATING LENS TO EXAMINE 360 DEGREES OF THE ANGLE

This sequence illustrates the technique that is used to view 350 degrees of the angle. As you can see, the appearance can vary greatly throughout the rotation. Some areas appear perfectly normal while in other areas you can see signs of angle recession. Or the very least, a very posterior iris insertion into the ciliary body.

ATYPICAL FINDINGS: PIGMENTED TRABECULUM

When pigmentation is seen unilaterally in the angle, it can be an indication of former ocular trauma or disease. For this reason it is important to again look at 360 degrees of the angle and to examine the fellow eye.

This is the eye of a 24 year old who as a child had a BB injury. This injury also caused some angle recession which we will be looking at shortly.

ATYPICAL FINDINGS: PIGMENTED TRABECULUM

This bilateral presentation of pigment in the trabeculum is that of a 24 year old Ugandan male. In heavily pigmented individuals, pigment in the trabeculum may be a normal finding.

This is a unilateral presentation of pigment in the trabeculum with no history of trauma with no signs of pseudoexfoliation or pigmentary dispersion syndrome. Sampaolesi's line which is a pigment deposition on Schwalbe's line, is clearly visible. Whenever pigment is seen the angle, one should rule out the presence of pseudoexfoliation syndrome and pigmentary dispersion syndrome, the angle of both eyes should be examined in their entirety. The eye should be transilluminated to check for iris thinning and the lens and cornea should be examined for pigment and exfoliative material. Of course, IOP should be monitored closely.

ATYPICAL FINDINGS: IRIS NEVUS

This young Hispanic male has a suspicious lesion just under the limbus. Without gonioscopy it is impossible to tell its true extent if it encroaches in the angle structures or whether its appearance is malignant. With gonioscopy its appearance of a normal iris nevus is apparent. Prominent iris process as well as all the other normal angle structures are apparent here as well. This is a small iris nevus which sits right on the trabeculum.

ATYPICAL FINDINGS: ANGLE RECESSION

Angle recession is a separation of longitudinal and circular ciliary muscle fibers. Its appearance should be judged by relative ciliary body size in both eyes as well as a history of trauma. These white fibrotic areas visible in the ciliary body band are a hallmark for angle recession.

This concave approach to an apparently normal angle is shown as a contrast for something which can be confused as angle recession.

POST TRAUMATIC EYE: PENETRATING FOREIGN BODY INJURY
SEQUELLAE: MALIGNANT GLAUCOMA

This 27 year old white male suffered a penetrating foreign body injury while splitting wood which resulted in retinal detachment. Post-surgically he developed malignant glaucoma resulting in the anterior chamber conditions seen here. Angle recession with pigment clumping, iridodonesis, iridectomy, peripheral anterior synechia.

Blunt injury to the eye compresses the globe and the shock wave transmitted through the anterior chamber tears the ciliary muscle at its insertion into the scleral spur. Gonioscopic examination shows the recession of the angle as a posterior displacement of the ciliary body band. These injuries are common after blunt trauma especially if a hyphema is present. Angle recession may be the only visible sequal to such a contusion injury. Glaucoma occurring soon after the trauma is probably related to hyphema or uveitis. Extensive angle recession can be followed by glaucoma years later and is thought to be a nonspecific trabecular degeneration from the initial trauma. Such eyes require prolonged follow up. The possibility of a retinal dialysis or subsequent traumatic cataract must also be considered.

This patient was concerned that his irregular pupil was the result of a haptic from his anterior chamber IOL being caught in the iridectomy. As we easily see with gonioscopy, this was not the case.

Gonioscopy is a valuable tool for the primary care optometrists. We hope that by way of this introduction, you will adopt gonioscopy as a routine office procedure.