Gonioscopy
A Text and Atlas

Salient Features

- A Comprehensive Text and Atlas on Gonioscopy including:
  - Over 600 goniosphotographs
  - Principle, indications, techniques, classification and types of gonioscopes
  - Dynamic gonioscopy
  - Normal gonioanatomy and developmental anormalities
  - Angle closure and open angle glaucoma
  - Intraoperative gonioscopy
  - RetCam gonioscopy
  - Gonioscopy after glaucoma surgery
  - Tumors, foreign bodies, surgical complications and systemic diseases
  - Self-assessment questionnaire.

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Shelving Recommendation
OPHTHALMOLOGY

Tanuj Dada
Talvir Sidhu

2nd Edition

Foreword
Robert N Weinreb
Dedicated to
Our Beloved Parents

Dr Mrs Kamlesh Dada and Dr Mr Vijay Kumar Dada
—Dr Tanuj Dada

Mrs Nirmala Sidhu and Mr Balram Sidhu
—Dr Talvir Sidhu
Foreword

Poorly taught and often forgotten, gonioscopy remains within the core of the ophthalmologic examination of any patient who has glaucoma or is suspected of having it. Cost-effective and often diagnostic, gonioscopy can provide crucial information for diagnosis and management. Even though newer technology is attractive because it can provide objective and accurate data about the angle structures, such information cannot replace yet an examination by a clinician who is well trained and experienced with standard gonioscopy.

Although only a slit-lamp biomicroscope and gonioscopic lens are required to perform the examination, but education and practice are also required to accurately visualize the angle structures. Any clinician will understand well the underlying science and rational clinical application of this technique after assimilating the well described and beautifully illustrated didactic information in this wonderful text from Professor Tanuj Dada and Dr Talvir Sidhu. With such an understanding, one then would be well prepared to master the art of gonioscopy through practice and use in clinical care.

Robert N Weinreb MD
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Preface to the Second Edition

Gonioscopy is the gold standard for diagnosis and evaluation of all forms of glaucoma. It allows the examiner to actually see any obstruction to the aqueous drainage in the anterior chamber angle by direct visualization of the trabecular meshwork and its adjacent structures. A number of congenital and acquired diseases affecting the eye can be picked up by performing a detailed gonioscopic evaluation and the primary diagnostic use of gonioscopy is to distinguish open angle versus closed angle mechanisms for glaucoma. Other critical uses of gonioscopy are picking up neovascularization of the angle in eyes with posterior segment ischemia, detection of abnormal pigmentation and anomalies associated with closed globe injuries. In addition to the diagnostic utility of gonioscopy, with recent advances in glaucoma surgery, a number of microsurgical techniques now require intraoperative gonioscopy to be used for inserting glaucoma implants into the Schlemm’s canal or supraciliary space. The current text and atlas on gonioscopy is a comprehensive compilation of our experience and documentation of glaucoma patients over the last two decades. It includes the principle, indications and types of gonioscopy, the techniques for dynamic gonioscopy, classification systems, evaluation of normal anterior chamber angles and clinical findings in various forms of congenital and acquired glaucomas. Additionally, conditions such as ocular tumors, foreign bodies, post-surgical complications, systemic disorders with angle anomalies, etc. have been incorporated. There is a special section on RetCam gonioscopy, intraoperative gonioscopy and gonioscopy after glaucoma surgery including minimally invasive glaucoma surgery. The atlas has over 600 photographs and gives the readers a clear visual understanding of the disease process. We hope that this text and atlas will help in imparting the trainees an in-depth knowledge of gonioscopy, and help in the correct diagnosis and treatment of glaucoma.

Tanuj Dada
Talvir Sidhu
Preface to the First Edition

Gonioscopy is the current “Gold Standard” for viewing and imaging the anterior chamber angle. It is a simple technique of vital importance for the correct diagnosis of various forms of glaucoma.

In ideal situations, a gonioscopic view of the angle may be obtained at least once in all patients visiting the outpatient services of an ophthalmology clinic, like other routine eye examinations including direct ophthalmoscopy and slit-lamp biomicroscopy. However, it is mandatory to perform gonioscopy in all cases of suspected or established glaucomatous pathology.

The ground reality is that gonioscopy is seldom performed by the general ophthalmologists, and glaucoma treatment is often started without documentation of the anterior chamber angle. A lack of adequate training in gonioscopy in residency programs is perhaps an important cause for this lapse.

The current text and atlas offers a unique learning source to the readers as it covers basic principles, indications and techniques for performing gonioscopy, highlights goniopathologies in congenital and acquired conditions, and includes goniovideos to give a near “hands on” experience to the trainee ophthalmologists.

We hope that this book will impart practical training which can be put to immediate use in the clinic and help in improving the standard of care of glaucoma patients worldwide.

Tanuj Dada
Reetika Sharma
Amit Sobti
Acknowledgments

I would like to thank Professor Atul Kumar, Chief, Dr Rajendra Prasad Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi, India, for his precious guidance and constant encouragement. Words are not enough to thank Dr Talvir Sidhu, an exceptional and dedicated Senior Resident with an unmatched compassion for patients. This project has only been possible because of her sincere efforts. I wish to thank my dear friends and international collaborators—Keith Barton, Mermoud André, Michael Coote and Shamira Perera for contributing excellent goniophotographs. I would like to thank the faculty of the glaucoma services at Dr Rajendra Prasad Centre for Ophthalmic Sciences, Professor Ramanjit Sihota, Professor Viney Gupta, Dr Sunil Choudhary, Dr Shikha Gupta, Dr Dewang Angmo, and our optometry staff who run the Glaucoma Clinical Research Lab, Mr Ajay Sharma, Mrs Amisha Gupta and Mr Suresh Yadav. This work has been possible due to the time and effort put in by several residents of Dr Rajendra Prasad Centre for Ophthalmic Sciences, and I wish to express my humble gratitude for Dr Neha Midha, Dr Neha Kamble, Dr Rohit Agrawal, Dr Tarun Arora, Dr Abdul Shamir, Dr Ankit Singh Tomar, Dr Srikanta Padhy, Dr Yogita Gupta, Dr Mritika Sen and Dr Nimi Raj. I would like to especially thank two junior residents—Dr Pooja Shah and Dr Saurabh Verma, who have put in a lot of effort in the collection of goniophotographs and helping in the written text.

I would like to thank my soulmate Geeta and little angel Josya for the most lovable companionship in the journey of life. The most important thing, I have learnt in life is connecting with our divine core through meditation.

My special thanks to Shri Jitendar P Vij (Group Chairman), Mr Ankit Vij (Group President), Ms Chetna Malhotra (Associate Director), Ms Samina Khan (Executive Assistant to Director—Content Strategy), Mr Sunil Dogra (Production Coordinator) and Payal Bharti (Project Manager).

I would like to offer my humble salutations to my spiritual teacher who taught me the art and science of Yoga and meditation—Saint Dr Gurmeet Ram Rahim Singh Ji, Dera Sacha Sauda Ashram, Sirsa, Haryana, India (www.derasachasauda.org).

Tanuj Dada
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The skill to perform gonioscopy and correctly interpret the angle pathology is critical for diagnosis and management of glaucoma. The ophthalmologist should perform tonometry before the gonioscopic evaluation because pressure on the eye can artificially lower the intraocular pressure (IOP). A general examination should be performed on the slit lamp before inserting the gonioscope to view the cornea, iris, evidence of new vessels, inflammation, previous surgery or trauma.

The physical positioning of patient and examiner during indirect gonioscopy is critical to avoid excessive body or head movement by the patient and to avoid fatigue-related hand tremor by the examiner. The table height of the slit-lamp must be adjusted so that the patient is seated comfortably with optimal chinrest and headrest support. The patients must be instructed to keep their forehead firmly against the head rest and not back away when the gonioscope is being inserted. The patient’s eye should be positioned in such a fashion to allow maximal vertical range of the slit lamp microscope movement via the joystick as this allows the superior and inferior angles to be viewed without having to adjust the chinrest during examination. The examiner should sit at a comfortable height for viewing and for supporting the elbow and holding the goniolens. An elbow rest must be used to avoid fatigue. Topical anesthetics and 0.5–1% carboxymethyl cellulose (or any other coupling fluid) must be kept ready before positioning the patient. Bottles of methylcellulose should be stored upside down to ensure that no air bubbles come out while pouring the solution on to the lens.

The examiner must take a history of the medications being used by the patient as any drug causing mydriasis or miosis can influence the gonioscopic findings. An important point to remember while examining patients with diabetes and vascular occlusions is that they should never be dilated before doing gonioscopy.

INDIRECT GONIOSCOPY WITH SCLERAL LENSES (GOLDMANN)

Preparation
- Patient is positioned at the slit lamp. The illumination is made coaxial and the magnification is kept low (10x). The patient’s lateral canthus is aligned with the canthal marker. A support for the elbow of the examiner is desirable.
- It is preferable to dim the room lights as bright light can cause miosis and open up an ‘occludable angle’.
- Topical anesthetic is instilled in both the eyes (4% xylocaine or 0.5% proparacaine eye drops).
- The lens surface is cleaned and disinfected.
- The concave surface is filled with a viscoelastic gonioscopic solution or tear substitutes such as carboxymethyl cellulose.
- Care should be taken to avoid air bubbles in the solution used as a coupling agent. This can be simply achieved by squeezing the solution on a tissue first to express out any air bubbles and then transferring the stream onto the goniolens without releasing the pressure on the bottle.

Lens Insertion (Figs 5.1 to 5.5)
- The patient is asked to look up. The upper and lower lids are parted with the left hand while the right hand uses the rim of the gonioscope to push the lower lid down. Alternatively, the lower lid can be retracted with the help of a swab stick and lens can be inserted while the patient is looking upwards.
• The gonioscope is then quickly rotated onto the eye.
• Ask the patient to slowly look straight ahead.
• The examiner now uses the left hand to stabilize the gonioscope while the right hand is free to control the slit lamp joystick. The thumb, index and middle fingers hold the lens, while the other two fingers stabilize the head of the patient.
• Blood reflux into the Schlemm's canal indicates excessive pressure.
Goniolens Handling
- This may be done with three finger technique (thumb and index and middle fingers) or two finger technique (thumb and index finger).
- Hold lens between thumb and 2nd finger (first finger should be free).
- Rotate lens by placing 1st finger on the front of lens and using finger and thumb to rotate lens (this method allows freedom of the other hand to manipulate the slit lamp thereby facilitating an efficient examination where the examiner need not leave the eyepiece).
- The remaining fingers may be rested on the patient’s cheek, the slit lamp headrest, or the vertical bar attached to the slit lamp headrest. Air bubbles that slip under the lens may be removed by tilting and turning the lens.
- The wrist should be kept straight and forearm as vertical as possible. The elbow should be supported either by the table top of slit lamp or else on an elbow rest. This will prevent fatigue-related tremor of muscles.

Viewing
- Once the lens has been stabilized in patient’s eye, the slit-lamp should be switched on with a preset vertical parallelepiped beam which is 2–3 mm long. The slit beam should not cross the pupil.
- The examiner must remember that he is viewing the opposite quadrant.
- Examine first the inferior angle/superior mirror of the goniolens, as it is the widest and most pigmented, which implies that the structures are easy to recognize.
- The mirror is rotated to inspect the other quadrants usually in 90° steps.
- The slit beam is turned horizontal to view the nasal and temporal quadrants.
- Examine each quadrant and note the findings.
- Ask the patient to look towards the examining mirror for performing manipulation gonioscopy and viewing over a steep iris.

Lens Removal
- For removal, the patient is asked to look nasally and squeeze his lids forcefully.
- Pressure is applied to nudge the lens on the temporal side and introduce air.
- Should this fail, the procedure may be repeated on the temporal side.
- The lens may also be rotated to loosen seal. If the lens is tightly stuck on the patient’s eye, gentle pressure on the globe with a finger/swab stick can be used to facilitate lens removal.
- It is important not to forcefully pull the lens away from the globe.

Irrigation
- Rinse the superior and inferior cul-de-sacs with saline to prevent blurred vision or discomfort.
- Topical antibiotic drop should be used after the procedure.

INDIRECT GONIOSCOPY WITH CORNEAL LENSES (POSNER/ZEISS)

Preparation
- Position patient at slit lamp with illumination coaxial with viewing system and at low magnification (10x–16x).
- Ensure appropriate alignment with lateral canthal marker to center vertical range of slit lamp.
- The lens surface is cleaned and disinfected.
- No coupling fluid is required.
- The lens surface may be lubricated with artificial tears.
- Apply topical anaesthesia.

Lens Insertion (Figs 5.6 to 5.8)
- While patient looks straight ahead the lens is gently guided onto the corneal apex so that the edges do not indent the cornea.
- The Zeiss type lenses should be applied with the eye in primary gaze and should touch the corneal surface sufficiently to create a fluid level without producing folds in Descemet’s membrane.
- These lenses may be applied in either square or a diamond configuration. For the square configuration the flat surfaces of the fork are grasped with the thumb on one side and the second and the third fingers on the other. The other two fingers rest on patient’s cheek and examiner’s palm faces the patient. The fork is oriented at a 45° angle to the eye.
- In diamond configuration the fork is oriented horizontally and grasped between the thumb and second finger on the top flat surface and third finger on the bottom flat surface. The back of examiner’s fingers rest on the patient’s cheek.

Fig. 5.6: Insertion of Posner corneal gonioscope
Gonioscopy Techniques

• The square configuration is preferable as it fits better in the palpebral aperture and if contact occurs between the lens and upper eyelid a flat surface is comfortable than a corner presented in diamond configuration. Furthermore, the hand and forearm position used in the square configuration allows one to keep the wrist straight and the forearm vertical for better support and control.
• Use fingers to achieve stability by resting them on the patient’s cheek.
• The mirrors should be placed in the 12, 6, 3 and 9'O clock positions.
• Maintain minimal contact, to just eliminate air beneath the surface.

• If air bubbles accumulate during gonioscopy, they are easily eliminated by slight rocking, rotation, or removal and reapplication of the lens.
• Watch for folds in the Descemet’s which indicate excessive pressure.

Goniolens Handling
• Manipulation is not as necessary as with scleral-type lenses due to the four mirror configuration as only the slit lamp beam needs to be moved.
• To view the area between the lenses the lens may be rotated slightly to either side by using the handle.
• The patient must be instructed to keep his eyes steady, otherwise a clear view is not obtained.
• Minimal lens tilting can be used to visualize structures. Excessive tilt can obscure view.
• Indentation (or compression) gonioscopy can be performed in eyes with primary angle closure glaucoma to differentiate an appositional from synechial angle closure.

Viewing
• The procedure is similar to the Goldmann lens except that the lens is not rotated.
• Viewing over a convex iris is more difficult as lens tilting puts the edge of the lens in contact with the cornea. This problem may be circumvented partially by indentation gonioscopy.

Lens Removal
Simply release the gonioscope from eye as there is no suction adherence between the cornea and the goniolens.

Irrigation
No irrigation is required as the lens does not blur vision on removal and no coupling viscoelastic is used.

DIRECT GONIOSCOPY TECHNIQUE
Direct gonioscopy is performed with dome-shaped lenses that eliminate the critical angle of cornea, e.g. Koepp’s lens. These lenses come in a range of diameters 12 mm to 19 mm, to suit variable corneal diameter. They provide an erect panoramic view of the angle with image magnification of 1.5–1.7x. Direct gonioscopy is helpful in assessing the angle anatomy in congenital glaucoma cases before glaucoma surgery or bedridden patients (Figs 5.9 and 5.10).

Preparation
• Position patient in supine position on OT table or bedside. In case of a small child, examination can be done under general anesthesia.
The lens surface is cleaned and disinfected.
- Saline is used as coupling fluid.
- The lens surface may be lubricated with saline on concave surface.
- Apply topical anesthesia with 4% xylocaine or 0.5% proparacaine eye drops.

**Lens Insertion**
- While patient looks straight above, the eyelids are separated with a speculum.
- The lens is gently guided onto the corneal apex so that the lens covers the limbus.
- The lens rests over the scleral flange creating a vault over cornea.
- The space between the cornea and lens is filled with saline.
- The angle is viewed using operating microscope or the hand-held illumination (Barkan illuminator) with hand-held slit lamp.
- The angle can be viewed 360° by moving around the patient.

**Goniolens Handling**
- The lens rests over the eyeball and gives an erect and panoramic view of the angle.
- The eye may need to be tilted towards the side where the angle is being viewed. This may be done with the help of a nontraumatic forceps or the lens may be tilted into the opposite fornix. Some lenses have a dimple in the center for manipulation.

**INTRAOPERATIVE GONIOSCOPY TECHNIQUE**

Intraoperative gonioscopy has become a very important tool in current management of glaucoma with the evolution of minimally invasive glaucoma surgery, which is mostly dependent on gonioscopic guidance. Intraoperative gonioscopy is performed with direct surgical goniolenses. The most commonly used surgical goniolenses are Swan Jacob lens or new modified lenses like Volk TVG lens, which has a scleral ring with a floating lens. These lenses are smaller than the traditional direct gonioscopy lenses, allowing easy manipulation inside the anterior chamber without disturbing the angle view. These lenses are supported with a metal handle, which allows easy manipulation without disturbing the operating field view (Figs 5.11 to 5.14).

**Preparation**
- Position patient in supine position on OT table or bedside.
  - In case of a small child, examination can be done under general anesthesia.
- The lens surface is cleaned and disinfected.
**Fig. 5.11:** Mechanism of direct gonioscopy using Swan Jacob lens with eye and microscope tilt to make plane of iris co-axial with the viewing arm of microscope.

**Fig. 5.12:** Swan Jacob lens placed over an eye.

**Figs 5.13A and B:** (A) Angle view using Swan Jacob goniolens; (B) Magnified view.

**Figs 5.14A and B:** (A) Angle view using Swan Jacob goniolens; (B) Magnified view.
• Coupling fluid is not needed, but it is wise to keep it over a well lubricated corneal surface to avoid epithelial damage.
• Apply topical anesthesia with 4% xylocaine or 0.5% proparacaine eye drops.

Lens Insertion
• While patient looks straight above, the eyelids are separated with a speculum.
• The lens is gently guided onto the corneal apex so that the lens rests over the center of cornea with the thinner edge of lens opposite to the angle being viewed.
• The fundamental is to make the illumination beam of microscope co-axial to the angle being viewed; therefore both the patient head and the microscope need to be tilted about 30–40°.
• The head/eye of the patient is tilted towards the angle being viewed and the microscope is tilted towards the examiner to make the illumination beam co-axial to the iris plane. The examiner sits opposite to the angle being viewed. Intraoperative angle can also be viewed using intraoperative endoscopy.

RETCAM GONIOSCOPY TECHNIQUE
RetCam/EyeCam can be used to view the angle structures with anterior focus of the lens. RetCam provides a nondistorted angle view using an optical fiber connected to light emitting control unit and a video camera. It provides advantages of clear view of angle even at high magnification. The oblique placement of the probe also bypasses the central corneal opacity in primary congenital glaucoma (Figs 5.15 and 5.16).

Preparation
• Position patient in supine position on OT table or bedside. Examination can be done under general anesthesia in a child.
• The lens surface is cleaned and disinfected.
• Apply topical anesthesia with 4% xylocaine or 0.5% proparacaine eye drops.
• Coupling gel is applied to the cornea.

Lens Insertion
• While patient looks straight above, the eyelids are separated with a speculum.
• The probe is placed in oblique fashion opposite to the angle being viewed.
• Coupling gel is applied to the probe and cornea interface.
• The focus of the lens is changed until a clear picture of the angle is viewed.

Fig. 5.15: RetCam gonioscopy being done under general anesthesia in a child. Note the obliquity of the probe to view the angle structures

Fig. 5.16: Magnified and detailed angle view seen on RetCam gonioscopy, in a case of primary congenital glaucoma

DOCUMENTATION OF GONIOSCOPY/RECORDING-GONIOGRAM (FIG 5.17)
A. Angles
   i. Use a goniogram
   ii. Record the most posterior structure seen in primary position—CBB, SS, TM, SL or none
   iii. Record the effect of manipulation or indentation
   iv. Mention the iris configuration, recess and insertion
B. Interpretation of angles
   i. If less than 1/2 of the TM is visible, the patient is at risk for angle closure
   ii. If CBB is seen, the angle is wide open
   iii. If no structures are visible, the angle is closed
C. Pigmentation—Grade 0 to 4
   4: dense, 3: moderate, 2: light, 1: trace, 0: none
   Estimate an average if pigmentation is varying in different
   quadrants.
D. Record presence of iris processes in the appropriate
   quadrant
E. Record any anomalies in the appropriate quadrant.

**Difficulties and Artefacts in Gonioscopy**

An error during the performance of gonioscopy most often results from lack of training on the part of the observer or misinterpretation of poorly visualized structures. The following points should be kept in mind while doing gonioscopy:

1. A slightly different view of the angle topography is achieved when the same eye is examined with a different lens.
2. Angles may look wider with the Koepppe lens.
3. The scleral lip of the Koepppe and Goldmann lenses can press on the outer sclera and indent it towards the iris, narrowing the angle.
4. Pressure by the Zeiss lens on the central cornea can artificially widen the angle.
5. Pressure with the Zeiss lens can produce folds in the Descemet’s membrane and obscure angle view.
6. Tiny air bubbles may adhere to oil secretions on the gonioscopic surface and impede the normal view. They require removal with soap and water.
7. Residues of methylcellulose can dry and adhere to the surface of the gonioscope, clouding the gonioscopic view. All lenses must be cleaned after use.
8. Pigment anterior to the Schwalbe’s line may be mistaken for the trabecular meshwork and the angle reported as narrow.
   The corneal wedge technique is used to identify the Schwalbe’s line.
9. With the Koepppe lens, the patient’s nose sometimes prevents adequate visualization of the upper temporal angle. In such cases, a view of the angle can be obtained by asking the patient to look up and temporally.
10. An edematous corneal epithelium due to raised IOP does not permit visualization of the angle. The IOP should be reduced and the edema cleared by the use of topical anhydrous glycerol drops.

**CLINICAL SUMMARY**

Gonioscopy is usually performed in conjunction with slit lamp biomicroscopy to get a magnified view of the angle structures. The procedure is performed in a dark room with a small slit beam which should not cross the pupil. Goniolenses are placed on the cornea after application of topical anesthesia, with or without a coupling fluid depending on the type of gonioscope used. Excessive pressure can lead to corneal folds and distort the angle structures.

A diagramatic goniogram is ideal for recording the gonioscopic findings and the posterior most structure.
visible in primary position should be reported, in addition to iris insertion/configuration, degree of pigmentation and any pathological abnormalities visible in a particular clock hour. Intraoperative gonioscopy requires the use of special gonioscopes and the angle structures are viewed through the microscope.

REFERENCES