

## Goniometry

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### Abstract

Goniometry was done on 290 cases of emmetropia, hypermetropia, myopia, closed angle glaucoma and open angle glaucoma (290 cases) by a plastic goniometer.

**Keywords:** Micrometer; Emmetropia; Hypermetropia; Myopia

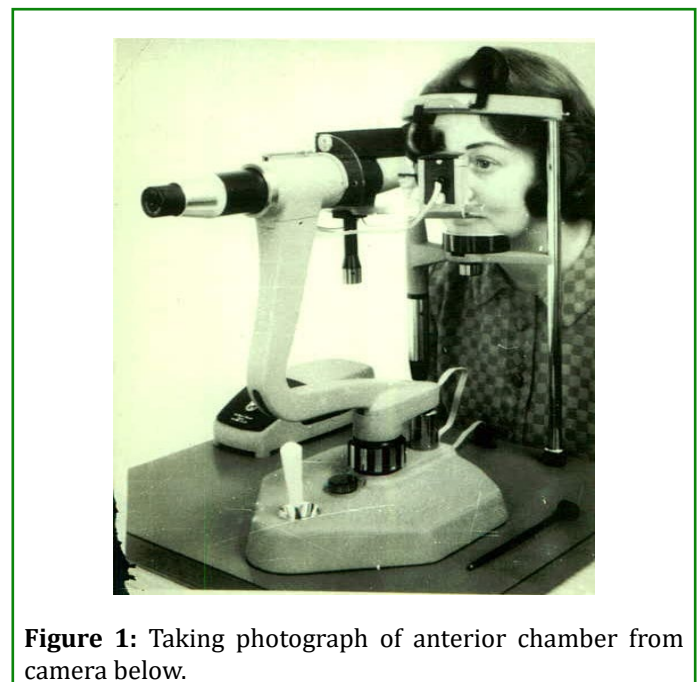
**Abbreviations:** OCT: Optical Coherence Tomography; OPD: Outpatient Department.

### Introduction

Measurement is the basis of all scientific studies. In the human body eye ball is a small structure yet so many measurements have been performed that many general doctors would not imagine. The posterior segment is  $5/6^{\text{th}}$  of the eye ball and is almost spherical. The anterior segment is like reverse D of which the front curved part is formed by the cornea and the posterior straight part by the iris diaphragm. The space between the two is termed the anterior chamber which is filled by a watery fluid known as the aqueous humor (Figure 1).

The anterior chamber is deepest in the Centre and is known as the depth of the anterior chamber which is about 2.5 to 3.5 mm. Moving towards periphery the chambers becomes narrower till cornea and iris meet at the extreme periphery and form the angle of the anterior chamber. However there are a few more fine structures between iris and cornea. It is difficult to measure the angle quantitatively and hence it is usually described qualitatively as normal, narrow, very narrow or closed. This angle is visualized by an instrument known as gonioscope and the procedure is known as

gonioscopy. It is very useful in many cases of glaucoma where the angle may become narrow or get closed. Goniometry is a procedure to measure the angle of the anterior chamber in degrees.



**Figure 1:** Taking photograph of anterior chamber from camera below.

## Goniometry

To an ophthalmologist goniometry means measuring the angle of the anterior chamber. Gonio means angle and metry implies measurement. However initially this procedure was applied for measuring the angulation between the long bones of the body in health and disease. In ophthalmology Gradle and Sugar [1-4] were the first to use a goniometer for measuring the angle of the anterior chamber. A micrometer graticule etched in tenths of a millimeter was placed in one of the oculars. The length of an imaginary line between the end of the Descemet's membrane and the opposite perpendicular point on the iris was measured directly in millimeters. This value was then corrected by using the reticule microscope magnification factor and the magnification factor of the contact lens. However they assessed only 10 cases by this method. Schaffer [5] also made a reference to the angle of the anterior chamber and considered narrow angle when they were less than  $20^{\circ}$  and wide when they were between  $20^{\circ}$  to  $45^{\circ}$ . Jones and Maurice [6] measured the angle and the volume of the anterior chamber by a photographic method. Present study of goniometry is based on this method which would be described later.

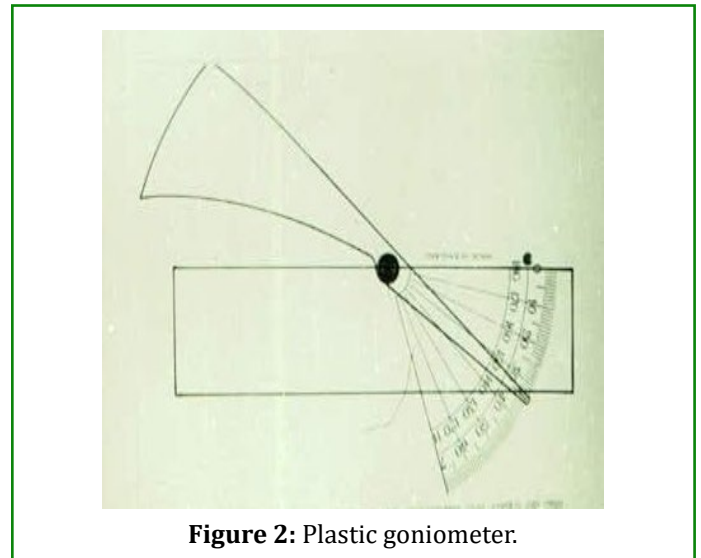
Currently many studies have been reported of evaluation of the anterior chamber angle by anterior segment Optical Coherence Tomography (O.C.T.) for its role in angle closure glaucoma [7-10].

## Gonioscopy

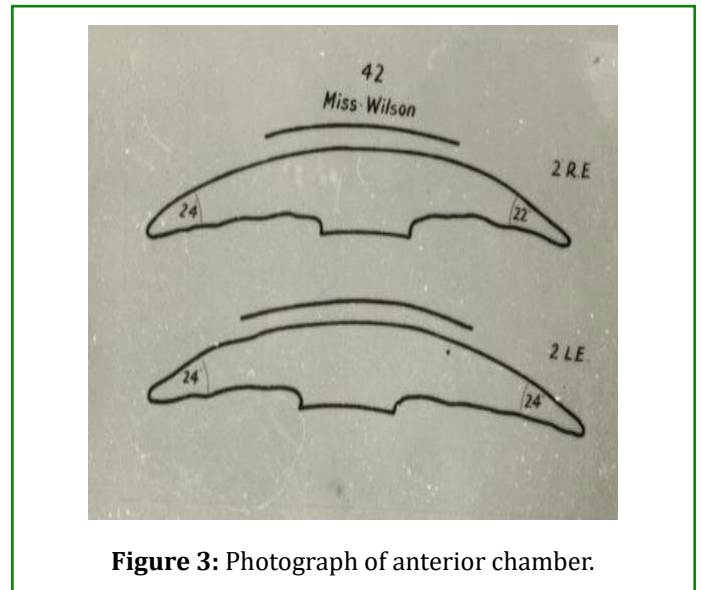
Gonioscopy is a well-established technique of directly visualizing the angle of the anterior chamber and evaluating its width and other anomalies. Basically the angle of anterior chamber is formed by junction of the peripheral end of the cornea and the peripheral end of iris. However many finer structures intervene between them such as Schwalbe's line, Trabecular meshwork, scleral spur and ciliary body. By and large the angle of the anterior chamber is graded upon the visibility and width of the structures forming the angle. Various types of gonioscopes have been described like Goldman, Zeiss, Barkan Schaffer etc. Grading of the angle of anterior chamber has also been described by various systems by authors like Goldman, Zeiss, Posner and R.P.C. system. Gonioscopy is a simple technique and gives a good amount of information about the angle. With indentation closure by adhesion or apposition can be distinguished (Forbes M) [11-14]. However, being a subjective evaluation it needs considerable experience for the reliability of assessment. Individual variations are also likely to occur. Different types of gonioscopes may give different results which may not be comparable.

## Material & Methods

In the present study 250 cases consisting of emmetropia, hypermetropia, myopia, closed angle glaucoma and open angle glaucoma was examined who had no other eye disease. It was done in some pathological cases also. Goniometry was performed using a technique devised by Jones and Maurice [6]. A cross sectional photograph of the anterior chamber was taken by a 35 mm camera mounted on the central pillar of Haag Streit slit lamp pointing vertically upwards. The patient was asked to look straight into the light and the photograph was taken focusing on the anterior corneal surface (Figure 1). The outline of the anterior chamber was projected and traced on a white paper (Figure 2).



**Figure 2:** Plastic goniometer.



**Figure 3:** Photograph of anterior chamber.

To measure the angle of the anterior chamber a plastic instrument, a goniometer was got constructed (Figure 3).

It has one arm with parallel sides and another arm with a radius of curvature of 7.33 mm. The angle of separation between the two arms can be measured in degrees by means of a protractor attached to the straight arm. The radius of curvature of the curved arm is mean of the radii of curvature of the inner corneal surfaces of the first 57 cases. The straight arm of the goniometer is placed horizontally on the outer third of the iris and the upper curves arm is aligned to the inner surface of the cornea. The degree of opening

is directly recorded in degrees on the attached protractor which corresponds approximately to the angle of the anterior chamber. Gonioscopy was also performed in all the cases by Goldman three mirror gonioscope and graded from Grade 0 to Grade 4. Grade 0 is totally closed angle and Grade 4 is wide open angle.

### Observations

In Table 1 and Table 2 goniometric values are shown in cases of emmetropia, Hypermetropia, myopia, closed angle glaucoma and open angle glaucoma.

No	Group	No. of eyes	Mean angle	S.D	Range
1	Emmetropia	122	24.69	3.74	18 - 36
2	Hypermetropia	51	24.42	4.01	17 - 33
3	Myopia	81	27.09	4.72	18 -40
4	Closed angle gl.	95	21.75	2.68	14—30
5	Open angle gl.	103	24.41	4.15	16—19

**Table 1:** Angle of the anterior chamber.

- Mean angle is denoted in degrees

Number of cases	Grade of angle	Mean angle
7	Gr. 0	19.7 <sup>0</sup>
17	Gr. 1	20.3 <sup>0</sup>
21	Gr. 2	21.8 <sup>0</sup>
36	Gr. 3	23.55 <sup>0</sup>
32	Gr. 4	25.25 <sup>0</sup>

**Table 2:** Correlation of goniometry and gonioscopy.

### Discussion

Study of the angle of the anterior chamber is of paramount importance not only in cases of glaucoma but also in many other conditions. As there is a correlation of angle with the width of the anterior chamber (Tables 3-5)

No.	Group	Correlation value	pvalue
1.	Emmetropia	0.75	0.325
2.	Hypermetropia	0.545	0.487
3.	Myopia	0.763	0.393
4.	Closed angle glaucoma	+0.377	0.372
5.	Open angle glaucoma	0.48	0.354

**Table 3:** Correlation of depth with angle of anterior chamber.

1.	Simple technique
2.	Inexpensive
3.	Quick method
4.	Other defects visualized
5.	Possible in recumbent position

**Table 4:** Advantages of Gonioscopy over Goniometry.

1.	Angle can be measured quantitatively
2.	Angle can be seen even with corneal haze
3.	Angle recess can be visualized
4.	Iris bulge seen more easily
5.	Shape of anterior chamber can be visualized

**Table 5:** Advantages of Goniometry over Gonioscopy.

It can be broadly said that in all cases where the depth of the anterior chamber is altered there is likely to be a similar change in the angle of the anterior chamber also. Such conditions include closed angle glaucoma, corneal perforation, plateau iris, in tumescence of the lens, malignant glaucoma, cornea plane, peripheral anterior synechiae etc. In all such conditions the anterior chamber is shallow and the angle of the anterior chamber is narrow. Conversely in open angle glaucoma, keratoconus, aphakia and posterior dislocation of lens the anterior chamber is deep and the angle of the anterior chamber is usually widely open. Rarely if after peripheral synechiaethe lens gets posteriorly dislocated there may be a deep anterior chamber with narrow angle

of the anterior chamber. The depth of the anterior chamber is usually uniformly shallow or deep as it is measured only from the central point on the cornea to the corresponding central point of lens, the angle of the anterior chamber may not be uniformly narrow or open as they have to be measured at the four cardinal points (upper, lower, medial, nasal). The evaluation by gonioscopy is very subjective and depends on the experience of the observer. This fallacy is much less in gonimetry though it is a time taking procedure and hence not very suitable for a very busy clinic.

## Conclusion

Gonimetry is a relatively a time taking procedure. With O.C.T. it becomes an expensive procedure. It is good for research purposes and for selective cases. For a busy O.P.D. gonimetry cannot replace gonioscopy which is a quick and fairly reliable procedure with an experienced observer. With experience, however, gonimetry may also become a routine procedure in future

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