

# The invention of gonioscopy by Alexios Trantas and his contribution to ophthalmology

<sup>1,2</sup>G Kalantzis, <sup>3</sup>I Georgalas, <sup>4</sup>C Tsiamis, <sup>1</sup>N El-Hindy, <sup>2</sup>E Poulakou-Rebelakou

<sup>1</sup>Department of Ophthalmology, St James University Hospital, Leeds, UK; <sup>2</sup>Department of History of Medicine, Medical School, Athens University, Greece; <sup>3</sup>Department of Ophthalmology, Athens General Hospital, Athens, Greece; <sup>4</sup>Department of Microbiology, Medical School, Athens University, Greece

**ABSTRACT** Gonioscopy is a technique used to examine structures in the anterior chamber angle (the fluid filled space inside the eye between the iris and the innermost layer of the cornea, the endothelium). It is an essential tool in ophthalmic practice, particularly in the diagnosis of glaucoma. In 1899, the Greek ophthalmologist Alexios Trantas was the first to visualise the angle in vivo and coined the term 'gonioscopy'. He made a number of other important contributions to ophthalmology.

**KEYWORDS** anterior chamber angle, Alexios Trantas, glaucoma, gonioscopy, Trantas dots

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**Correspondence to C Tsiamis**  
 Department of Microbiology  
 Athens Medical School  
 University of Athens  
 Mikras Asias 75  
 Athens 115-27  
 Greece

**e-mail** [ctsiamis@med.uoa.gr](mailto:ctsiamis@med.uoa.gr)

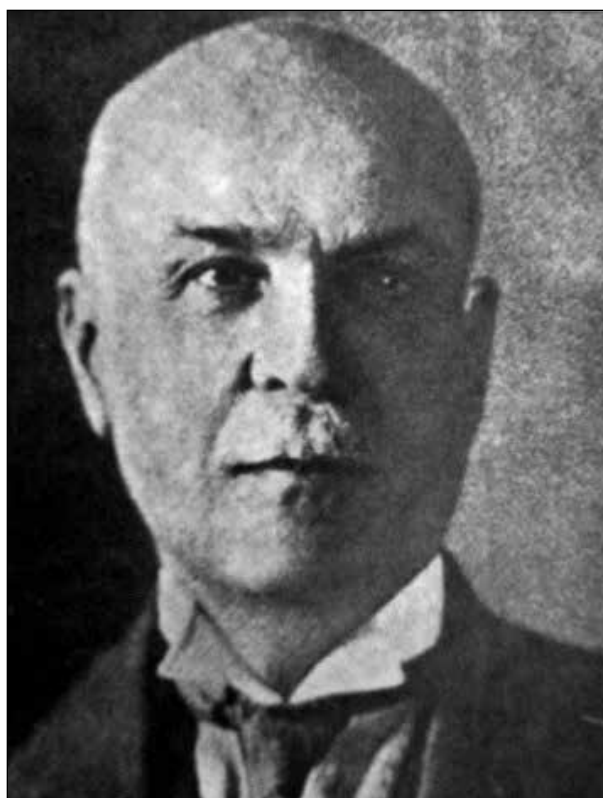
## INTRODUCTION

The term glaucoma is derived from the Greek word 'glaukos', which means 'watery blue'. It is first mentioned in the Hippocratic Aphorisms in the 5th century BC. However, it was considered a disease of the crystalline lens for the following several hundred years.<sup>1</sup> 'The scientific history of glaucoma began the day on which cataracts were put in their correct place' (Albert Terson, 1867-1935, French ophthalmologist).<sup>2</sup> Nowadays, glaucoma is defined as an optic neuropathy with characteristic appearances of the optic disc and specific pattern of visual field defects that are associated frequently, but not invariably, with raised intraocular pressure.<sup>3</sup>

The prevalence of glaucoma varies in different studies, but it is around 2% in Caucasians over 40 years of age and four times higher in African-Americans and African-Caribbeans of the same age. The prevalence and incidence of the disease rises dramatically in older people and is the leading cause of irreversible blindness throughout the world.<sup>4</sup>

## THE INVENTION AND EVOLUTION OF GONIOSCOPY

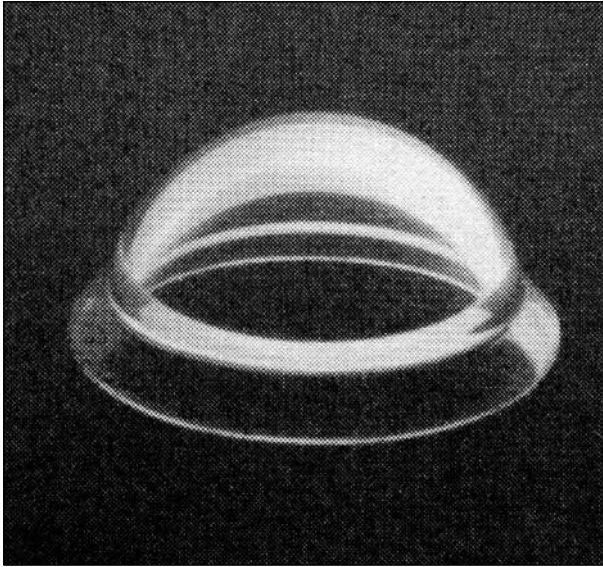
Gonioscopy is a clinical technique that is used to examine structures in the anterior chamber angle (the fluid filled space inside the eye between the iris and the innermost layer of the cornea, the endothelium) and it constitutes an essential diagnostic tool in everyday ophthalmic practice. The introduction of gonioscopy and the clinical recognition of synechial angle-closure, as well as wide-open angles in previously unoperated eyes (as opposed to previous histopathologic findings



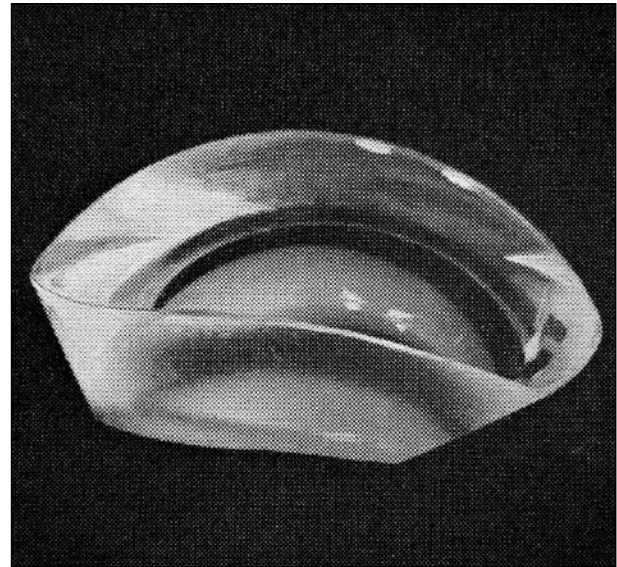
**FIGURE 1** Alexios Trantas (1867–1961)

from surgically treated and end-stage eyes), provided a basis for the differentiation of open-angle from angle-closure glaucomas.<sup>5</sup>

The first person to observe the angle in vivo was the Greek ophthalmologist Alexios Trantas (Figure 1) in 1899 in an eye with keratoglobus (a rare non-inflammatory corneal thinning disorder characterised by



**FIGURE 2** Troncoso's diagnostic lens for examination of anterior chamber angle



**FIGURE 3** Otto Barkan's goniotomy lens for surgery of the anterior chamber angle

globular protrusion of the cornea). He devised a method using direct ophthalmoscopy combined with digital pressure on the limbus (anatomically, the area at the union of the cornea and sclera); with this method he examined the ciliary body, the ora serrata and the anterior retina.<sup>6</sup> In 1900 he described the ophthalmoscopic appearance of the normal and the abnormal angle and was the first to use the term 'gonioscopy', noting instances of dense pigmentation of the trabecular meshwork, iris processes and cyclodialysis clefts.<sup>7,8</sup> He also described the retrociliary region following his observations on human anterior chamber angle.<sup>9</sup> Trantas continued to make further observations and described the angle of the anterior chamber as seen with and without digital pressure with the direct ophthalmoscope, and the assistance of a +4D to +15D lens on a patient suffering of congenital keratoglobus.<sup>9</sup> Over almost two decades, Trantas recorded a wealth of valuable clinical observations regarding the appearance of the angle in various conditions. The gonioscopic appearance of the anterior chamber angle in his drawings was surprisingly accurate. His work and its potential usefulness went largely unrecognised as others devised and improved techniques of examining the angle.<sup>10</sup>

Although Trantas was the first to see the angle, Salzmann was the first to really study it.<sup>11</sup> Without indentation, the anterior chamber of the eye cannot normally be visualised due to total internal reflection of light rays at the inner aspect of the cornea. In 1913, Salzmann solved this problem and indirectly visualised the angle using a modified contact lens made for the correction of keratoconus (a non-inflammatory condition causing progressive bulging and thinning of the cornea). He described various pathologic conditions including angle recession. He was also the first to describe blood in the

Schlemm's canal (the drainage canal of aqueous humour from the anterior chamber).<sup>12</sup> In 1920, Koeppel developed his direct-view gonioscopy lens and used it in conjunction with the newly developed Zeiss slit lamp.<sup>13</sup> Ascher was the first to use the Koeppel lens with the patient supine, giving him a view of the entire angle.<sup>14</sup>

In 1925, Troncoso designed a handheld microscope with a light source to overcome the lack of magnification with the Koeppel lens, and published the first book devoted to gonioscopy in 1947 (Figure 2).<sup>15,16</sup> Others involved in developing techniques of gonioscopy and examining the angle included Thorburn, Werner, Elschmig and Vannas.<sup>17</sup>

In the 1930s, Otto Barkan, a dominant figure in glaucoma in the USA for a decade, initiated major advances in clinical gonioscopy. He used a Koeppel lens with the patient in a supine position and devised the Barkan illuminator to enhance his view of the angle. This device incorporated binocular microscopy using articulated arms on floor and ceiling supports. He termed this method 'microgonioscopy' because of the magnification obtained. Barkan invented goniotomy for congenital glaucoma and devised a gonioscopy lens with a slatted-off face to allow insertion of instruments at the limbus. (Figure 3)<sup>18,19</sup> Leading ophthalmologists in Europe, including Duke-Elder, refused to accept gonioscopy as a necessary diagnostic tool in glaucoma as late as the early 1960s. It was Goldmann, finally, who popularised it in Europe, convincing François of the concept of pupillary block. Thus, the introduction of indentation gonioscopy in 1966 by Forbes was the most important diagnostic advance since the development of the mirrored goniolens, as it enabled clinical differentiation of relative pupillary block from other angle-closure glaucomas.<sup>17</sup>

## TRANTAS' SCIENTIFIC WORK

Alexios Trantas was born in Epirus, Greece, in 1867 and studied medicine in Athens, where he received his doctorate in 1891, under the supervision of the eminent Professor Andreas Anagnostakis. Between 1891 and 1893 he undertook further education in ophthalmology in Paris under Photinos Panas (1832–1903), Louis de Wecker (1832–1906) and Xavier Galezowski (1832–1907), and in 1894 established an ophthalmological clinic at the Greek hospital Saint George in Constantinople. He was director of this institute until 1922. From 1924 he was chief ophthalmologist at the Therapeutrion of St Spyridion in Piraeus. He was also founder and director of the first special pavilion for trachomatous patients in Constantinople, the so-called 'Skouloudeion ophthalmiatreion'.<sup>20</sup>

His work covers a wide scope of eye disorders. He wrote mainly about eye symptoms in systemic diseases (leprosy, syphilis, tuberculosis etc.) and recognised the white dots in vernal keratoconjunctivitis as pathognomonic. These small, white-yellow chalky concretions of the conjunctiva around the limbus are known today as the Horner-Trantas spots or Trantas dots.<sup>21</sup> He also re-established the Hippocratic treatment of night

blindness and in 1895 described an operation for treating trichiasis and entropion (conditions causing misdirection of lashes), which was the evolution of the surgical technique used before by Panas and Anagnostakis.<sup>22</sup> Trantas was recognised in 1948 by the Belgian Society of Ophthalmology as the 'Father of Gonioscopy', although the majority of his colleagues believed that Manuel Troncoso was the founder of this method as he had established, in numerous publications, the importance of the method in 1925.<sup>22</sup> Although Trantas's technique, involving direct digital pressure on the limbus, is quite different to modern day prismatic examination of the anterior chamber angle, the wealth of information from his investigations undoubtedly paved the way to modern gonioscopic examination methods.

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## REFERENCES

- Hirschberg J. *The History of Ophthalmology*. Bonn: Wayenborgh; 1982. p.88–91.
- Rhee DJ. *Glaucoma*. Philadelphia: McGraw-Hill; 2003. p.1.
- Kanski JJ. *Clinical Ophthalmology: A Systematic Approach*. London: Butterworth Heinemann; 2003. p.194–5.
- Yanoff M, Duker JS. *Ophthalmology*. Philadelphia: Mosby; 2004. p. 1413–7.
- Van Buskirk ME, Shields BM. *100 years of progress in glaucoma*. Philadelphia: Lippincott-Raven; 1997. p. 190–1.
- Trantas A. Keratoglobes congenital. *Soc. Imp. de med. De Constantinople a la séance du 22 Decembre 1899*.
- Trantas A. Moyens d'explorer par l'ophtalmoscope – et par transparence – la partie antérieure du fond oculaire, le cercle ciliaire y compris. *Arch Ophthalmol (Paris)* 1900; 20: 314.
- Trantas N. Gonioscopy. *Bull Hellenic Soc Ophthalmol* 1963; 31: 5–24.
- Trantas A. L'ophtalmoscopie de l'angle irido-corneen. *Arch Ophthalmol (Paris)* 1918; 36: 257–76.
- Ritch R, Caronia RM. *Classic papers in glaucoma*. Hague: Kugler; 2000. p. 245.
- Alward WLM. A history of gonioscopy. *Optom Vis Sci* 2011; 88: 29–35.
- Salzmann M. Die Ophthalmoskopie der Kammerbucht. *Z Augenheilk* 1914; 31: 1–19.
- Koeppel L. Das stereo-mikroskopische Bild des lebenden Kammerwinkels an der Nernstspaltlampe beim Glaucom. *Klin Monatsbl Augenheilk* 1920; 65: 389–91.
- Ascher Kw. Mikroskopie des lebenden Auges. *Klin Monatsbl Augenheilk* 1924; 27: 628.
- Troncoso MU. Gonioscopy and its clinical implications. *Am J Ophthalmol* 1925; 8: 433–49.
- Troncoso MU. Treatise on gonioscopy. Philadelphia: FA Davis; 1947.
- Dellaporta A. Historical notes on gonioscopy. *Surv Ophthalmol* 1975; 20: 137–49.
- Barkan O, Boyle JF, Maisler S. On the genesis of glaucoma. An improved method based on slit-lamp microscopy of the angle of the anterior chamber. *Am J Ophthalmol* 1936; 19: 209–15.
- Barkan O. Contact lens for gonioscopy and ophthalmoscopy. *Am J Ophthalmol* 1952; 35: 18–21.
- Hirschberg J. *The History of Ophthalmology*. Bonn: Wayenborgh; 1991. p. 300.
- Trantas A. Sur le catarrhe printanier. *Archives d'ophtalmologie* 1910; 30: 593–621.
- Lascaratos J. *History of Medicine*. Athens: Paschalides; 2004. p. 870.