

REVIEW

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Corneal topography in keratoconus: state of the art

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and D. G. Fernández-Pacheco^{1*}

Abstract

The morphological characterization of the cornea using corneal topographers is a widespread clinical practice that is essential for the diagnosis of keratoconus. The current state of this non-invasive exploratory technique has evolved with the possibility of achieving a great number of measuring points of both anterior and posterior corneal surfaces, which is possible due to the development of new and advanced measurement devices. All these data are later used to extract a series of topographic valuation indices that permit to offer the most exact and reliable clinical diagnosis. This paper describes the technologies in which current corneal topographers are based on, being possible to define the main morphological characteristics that the keratoconus pathology produces on corneal surface. Finally, the main valuation indices, which are provided by the corneal topographers and used for the diagnosis of keratoconus, are also defined.

Keywords: Placido disc, Detection system, Topographer, Diagnosis

Background

Despite earlier works in the study of the human cornea, the first morphological characterizations for clinical diagnosis were made through the simple observation of the external appearance of the ocular surface [1]. At the beginning of the XVII century, Schiøner [2] proposed the first device for the characterization of corneal morphology, comparing the reflection of the image generated by the corneal anterior shape with different calibrated spheres. Later, in the mid-nineteenth century, the Goode keratoscope appeared and enabled a corneal examination using the lateral reflection of a bright square object projected onto the patient's cornea. Current corneal topography is based on the development of the Goode keratoscope by Antonio Placido da Costa [3], who developed it in 1880. This device was a variant that allowed a precise measurement of the anterior corneal surface through the projection of a circular plate onto the cornea. This plate, supported by a handle, contains a series of concentric rings and a hole in its center, allowing the doctor to see the reflected catoptries

image of the corneal surface of a patient located back to the light incidence. In the late nineteenth century, Javal performed the first qualitative analysis of the corneal morphology, joining Placido discs to his ophthalmometer and installing a viewer to obtain a wider field of the corneal image; he also proposed to photograph the image generated and to represent it on a diagram, which was aimed to analyze the variations in the curvature observed in the corneal surface. In 1896, Gullstrand [4, 5] presented the first quantitative assessment of the Placido discs' images. He joined the discs to his photokeratoscope and examined the corneal photographs using a microscope in order to calculate the corneal curvature by a numerical algorithm.

In the early 80s, images were digitalized by hand and later computationally analyzed. Then, with the development of new computer equipment, the automation of this process appeared by capturing the image with a digital camera and its immediate computational analysis. The first fully automated corneal topographer was called Corneal Modeling System (CMS-1), developed by Computed Anatomy Inc. (New York, USA).

This article discusses the current technologies of corneal topographers and is aimed at: i) describing how they enable the main morphological measurements that

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Corneal Topography The State Of The Art

James P. Gills

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Corneal Topography James P. Gills, 1995 This text shows how corneal topography can be used in radial and astigmatic keratotomy cataract surgery penetrating keratoplasty and several combined procedures It focuses on the quality of the images methods of analysis and the required accuracy of corneal topography **Corneal Topography** Ming

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Azar, Barbara A. Blodi, 2008-02-27 Inside the 3rd edition of this esteemed masterwork hundreds of the most distinguished authorities from around the world provide today's best answers to every question that arises in your practice They deliver in depth guidance on new diagnostic approaches operative technique and treatment option as well as cogent explanations of every new scientific concept and its clinical importance With its new streamlined more user friendly full color format this 3rd edition makes reference much faster easier and more versatile More than ever it's the source you need to efficiently and confidently overcome any clinical challenge you may face Comprehensive authoritative and richly illustrated coverage of

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Corneal Topography Melanie Corbett, David O'Brart, Emanuel Rosen, Ronnie Stevenson, 1999-06-02. This state of the art text atlas describes both the principles and uses of corneal topography, a fast growing technique in ophthalmology for assessing the eye in corneal disease.

surgery and contact lens fitting Superbly illustrated with full colour topographic maps this will be an invaluable reference for all coming new to this important development in ophthalmology **Gems of Ophthalmology: Cornea & Sclera** HV

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Diagnostic and Imaging Techniques in Ophthalmology Amar Agarwal,Samuel Boyd,Robert C Drews,2011-03-31 Advances made in diagnostic and imaging techniques within the past years have revolutionized the clinical approach to and the management of many ophthalmic diseases Wavefront and Optical Coherence Tomography OCT have been incorporated as basic tools of refractive surgery in the assessment of vitreoretinal disorders optic nerve pathologies ocular tumors and ocular trauma This book presents a comprehensive evaluation of current and emerging technologies used for clinical assessment in ophthalmology as well as an in depth discussion of retinal angiography both anterior and exterior segments OCT VHF ultrasound and other advanced imaging methods and techniques *Principles and Practice of Refractive Surgery*

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Dimitri T. Azar,Douglas Koch,2002-11-26 LASIK is a timely and authoritative source for refractive corneal and cataract surgeons ophthalmologists optometrists ophthalmic surgeons and upper level undergraduate graduate and medical students in these disciplines This guide emphasizes the latest tools and step by step procedures to increase the safety predictability and long term success **Keratoconus & Keratoectasia** Ming Wang,Ming X. Wang,Tracy Schroeder

Swartz,2010 Over the recent years keratoconus and keratoectasia have become increasingly important diseases in ophthalmic practice due to the increasing number of keratorefractive surgery cases and the availability of new treatment modalities other than corneal transplantation For both the genetic form of the disease keratoconus and the acquired form keratoectasia new modalities of diagnosis and treatments have become available enabling physicians to treat these two ectatic corneal diseases earlier and effectively delaying or even avoiding major surgeries such as corneal transplantation This book is a concise well illustrated and clinically indispensable guide for treating these two important corneal diseases

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Ophthalmology Charles N. J. McGhee, 1997 American ophthalmologists who have only recently been given FDA approval to perform Photorefractive Keratectomy for low myopia will find this resource especially valuable The contributors are primarily British and Australian researchers and clinicians who have been working to develop this instrument and refine its clinical applications Scientific principles and current clinical and research trends are covered along with practical information on patient assessment surgical techniques clinical results and the identification avoidance and management of complications Clinical images of both normal and rare sequelae of excimer laser surgery illustrate the text Annotation copyrighted by Book News Inc Portland OR

Corneal Topography in the Wavefront Era Ming Wang (MD.), Ming X. Wang, 2006 Comprehensive review of the scientific principles of major corneal topography and clinical application of all major topographic imaging systems currently available Emphasis is placed on the understanding of the principles and clinical guidance in the use of these technologies for addressing important clinical issues such as an in depth discussion and practical topography guide for recognition of forme fruste keratoconus

101 Pearls in Refractive, Cataract, and Corneal Surgery Samir A. Melki, Dimitri T. Azar, 2001 This text serves as a condensed summary of surgical tips acquired through the years from the personal experiences of Drs Azar and Melki as well as interactions with other colleagues in the fields of refractive cataract and corneal surgery The book teaches how to enhance surgical outcomes reduce surgical time minimize complications or make a complicated step easier to perform The focus is on practical tips rather than the theoretical aspects of the procedures Chapters include pearl on LASIK complications PRK PTK PARK hyperopia treatment topography corneal lacerations repair posterior vitreous pressure during keratoplasty and pterygium excision

Journal of the Optical Society of America, 1998

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Ophthalmic Lasers Charles M. Wormington, 2003 Reflecting the recent fundamental revolution in the field of ophthalmic lasers this book responds to the need for a comprehensive practical understanding of clinical ophthalmic lasers and their diagnostic and therapeutic uses It emphasizes the important new diagnostic uses of lasers for both the anterior and posterior segments and the therapeutic uses for the anterior segment It details how lasers are used to treat a variety of ocular conditions such as cataract and glaucoma addressing the optometrist's role in laser applications such as referrals and post procedure complication management

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