Comparative study between Pentacam and IOL master in measuring anterior segment parameters in eyes of Egyptian individuals

Thesis

Submitted For Fulfilment Of Master Degree In Ophthalmology

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List of Abbreviations

Abbr.	Full term
ACA	Anterior chamber angle
ACD	Anterior chamber depth
ACW	Anterior chamber width
AL	Axial length
BFS	Best fit sphere
CCT	Central corneal thickness
D	Diopter
ICP	Iris camera photo method
IOL	Intraocular lens
K-readings	Keratometry readings
LED	Light emitting diode
PCI	Partial coherence interferometry
Pof	Plane of focus
QS	Quality specification
SD	Standard deviation
U/S	Ultra-sonography
UV	Ultraviolet rays
V.A	Visual acuity
WTW	White-to-white

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INTRODUCTION

Measuring parameters of anterior segment of the eye accurately is important for diagnosing variety of diseases and for cataract surgeries, glaucoma, refractive surgeries and postoperative follow up. The true values of anterior chamber depth (ACD), corneal power (K-readings), corneal astigmatism and white -to -white (WTW) are essential in calculating the intraocular lens (IOL) power, specially with the newer generations of biometric formulas[(1)]. The measurement of the ACD and WTW is essential for the success of phakic IOL implantation in patients with high refractive errors asking for refractive surgery. Errors in evaluating these parameters before surgery may result in postoperative unwanted errors of refraction. Reducing these postoperative refractive errors depends on accurate preoperative evaluation of the anterior segment parameters values[(2).]

Different technologies are used in measurement of the structures of the anterior segment. In recent years, technologies used for anterior segment imaging have developed rapidly. New devices based on Scheimpflug imaging, such as the Pentacam and Galilei Dual Scheimpflug Analyzer (GDSA), or high speed anterior segment optical

coherence tomography(ant. Segment OCT), or partial coherence interferometry based devices as IOL Master, Zeiss, or very high frequency ultrasound. These devices provide qualitative and quantitative information about the anterior segment. In addition to corneal parameters, these devices also have the ability to measure the ACD, anterior chamber angle and WTW , and they are now being routinely used in ophthalmological practice. Also they have the advantage of being noncontact devices and easy to use [(3)].

Also, accurate values of anterior segment parameters are mostly indicated in preoperative evaluation of cataract surgeries. Modern cataract surgery can be considered a form of refractive surgery, aiming to improve visual clarity and to provide excellent vision in refractive terms. When certain IOL is planned to be implanted, it's given to achieve a certain refractive status of the eye unlike what was obtainable in the past when refractive errors were corrected only after the surgery. This is now possible because of the development of new, accurate diagnostic and surgical tools[(3)].

Because of this, we felt that it is important to study the agreement between the Pentacam and the IOL master systems regarding ACD, WTW, and corneal keratometry measurements.

AIM OF THE WORK

In this study we aim to compare values of anterior segment parameters (ACD , K-reading , WTW) obtained by Pentacam and IOL master to know if there are significant differences in measurement results between both devices or only minimal differences which can be neglected.

Chapter (1)

Anatomy of the Anterior Segment of The Eye

General shape and parameters of the eye :

The eye actually isn't a true sphere but an oblate spheroid as it represents parts of two spheres, a smaller anterior part which is the cornea and a larger posterior part which is the sclera [(4)].

The cornea forms one-sixth of the circumference of the eye ball and its radius of curvature is 7.8 mm. The other five-sixths is formed by sclera, which has a radius of curvature 11.5 mm. The average axial length (AL) of the eye is 24 mm. The eye ball diameter is almost 23 mm and the horizontal length is approximately 23.5 mm. Small eyes with AL <20 mm are hyperopic, while large eyes with AL more than 26mm are myopic [(4)].

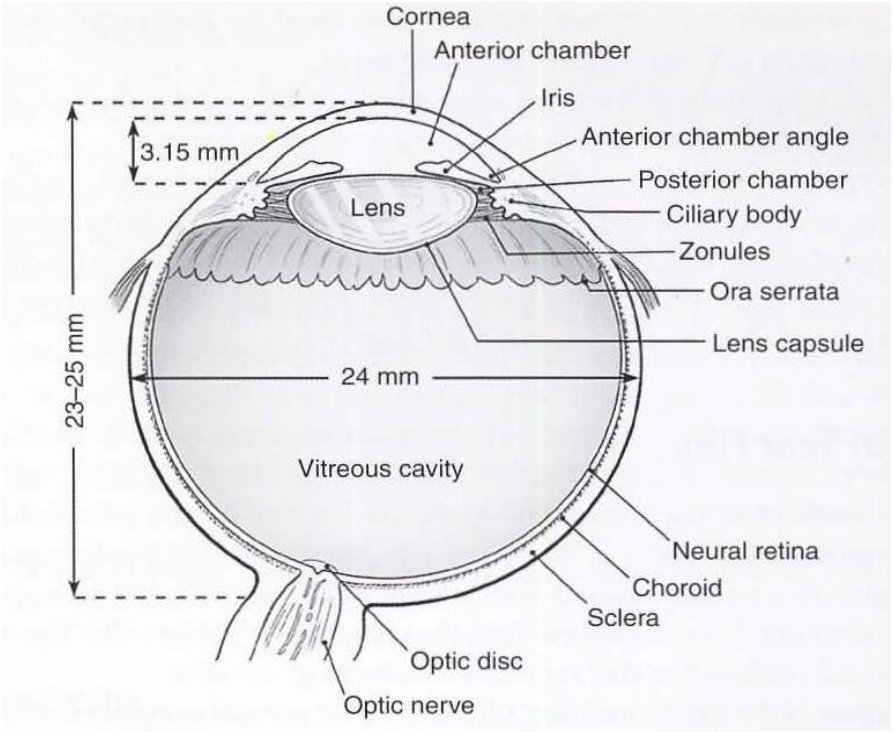

Figure (1): Diagram of the adult human eye [5]

The eye contains 3 compartments: the anterior chamber, the posterior chamber and the vitreous cavity. The anterior chamber, which is the portion posterior to the cornea and anterior to the iris, is filled with aqueous humor. The posterior chamber is the portion of the eye posterior to the iris and anterior to the lens and vitreous face. It is also filled with aqueous fluid. The largest compartment of the eye is the vitreous cavity, which forms more than two thirds of the

volume of the eye ball (5-6 cml) and contains the vitreous gel[5].

The eye globe is composed of 3 concentric layers. The outermost layer consists of the transparent cornea anteriorly and the opaque white sclera posteriorly. This corneo-scleral layer is composed of tough and protective tissues. The middle layer of the globe is the uvea, which consists of the choroid, ciliary body and the iris. The uveal layer is highly vascular layer. The innermost layer of the globe is the retina, which is a photosensitive layer contains the photo receptors and neural cells and nerve fibers that responsible of the processing of visual information[5].

Components of the anterior segment of the eye :

The Cornea:

The cornea normally is a clear transparent avascular tissue with a smooth, convex outer surface and concave inner surface. Its anterior surface is elliptical in shape with vertical diameter of 10.6 mm and horizontal diameter 11.7 mm; however, when viewed from behind, the circumference appears circular. The central radius of curvature is 7.8 mm.

The thickness of the cornea is more at the periphery (approximately 0.67 mm) than in the centre (approximately 0.52 mm). The central third of the cornea is nearly spherical and measures about 4 mm in diameter in the normal eye. The normal cornea is generally prolate, with steeper curvature centrally and relatively flatter peripherally.[5]

The cornea consists of 6 layers (fig. 2):

- Corneal epithelium
- Stroma
- Descemet's membrane
- Bowman's layer
- Dua's layer
- Corneal endothelium [4] [6]

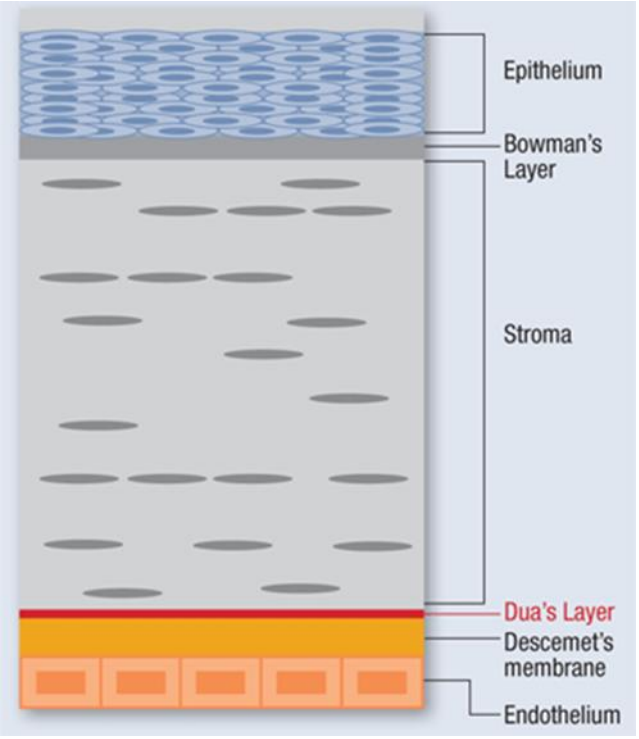

Figure (2): Layers of the cornea (7)

The Limbus:

The limbus is known as the transition zone between the cornea and the anterior sclera. It's classified differently as anatomical limbus and surgical limbus. The limbus is important due to its relationship to the anterior chamber angle and its use as a surgical landmark. The following structures are included in the limbus:

- Conjunctiva and palisades of Vogt
- Tenon's capsule
- Episclera
- Corneo-scleral stroma
- Aqueous outflow system[5]

Anterior Chamber:

The anterior chamber is bordered anteriorly by the cornea and posteriorly by the anterior surface of the iris and the pupil (fig. 3). The angle of the anterior chamber, which lies at the junction of the cornea and the iris, consists of :

- Schwalbe's line
- Canal of Schlemm
- Trabecular meshwork
- Scleral spur
- Anterior border of the ciliary body.[5]