Investigative Study of the Relationship between Central Corneal Thickness and Axial Errors of Refraction

Thesis

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List of Abbreviations

Abb.	Full term
AC	*Anterior Chamber Depth*
AL	*Axial Length*
AS-OCT	*Anterior Segment Optical Coherence Tomography*
BZ	*Bowman's Zone / Banded Zone*
CCT	*Central Corneal Thickness*
CH	*Corneal Hysteresis*
CNV	*Choroidal Neovascularization*
CRF	*Corneal Resistance Factor*
CT	*Computed Tomography*
D	*Diopter*
DM	*Descemet's Membrane*
EP	*Epithelium*
En	*Endothelium*
FD-OCT	*Fourier-Domain OCT*
HR	*High Resolution*
IMT	*Implantable Miniature Telescope*
IOL	*Intra-Ocular Lens*
IOP	*Intra-Ocular Pressure*
IQR	*Interquartile range*
K	*Keratocyte*
LASIK	*Laser-assisted in situ Keratomileusis*
LS-CM	*Laser-Scanning Confocal Microscopy*
MHz	*Mega hertz*
Mm	*Millimeter*
MRI	*Magnetic Resonance Imaging*
N	*Nucleus*
Nm	*Nanometer*
NBZ	*Non-Banded Zone*

List of Abbreviations (Cont...)

Abb.	Full term

OCT .....Optical Coherence Tomography
ORA .....Ocular Response Analyzer
RD .....Retinal Detachment
RI .....Refractive Index
ROC .....Receiver Operating Characteristic
RPE .....Retinal Pigment Epithelium
S .....Stroma
SD .....Standard Deviation
SD-OCT .....Spectral-Domain OCT
SE .....Spherical Equivalence
SSCM .....Slit-Scanning Confocal Microscopy
TD-OCT .....Time-Domain OCT
TSCM.....Tandem Scanning Confocal Microscopy
UBM .....Ultrasonic Biomicroscopy
US .....Ultrasound
VHF .....Very High Frequency

INTRODUCTION

The cornea is a transparent, avascular tissue that measures 11–12 mm horizontally and 10–11 mm vertically [(1)]. It is thinnest centrally (around 535 microns) and thickest peripherally (660 microns) [(2)]. It is a complex structure that has a protective role and is responsible for 74% of the optical power of the eye contributing 43.25 diopters (D) of the total 58.60 dioptric power of a normal human eye [(1)].

The normal cornea is free of blood vessels. For its nutrition, it depends on glucose diffusing from the aqueous humor and oxygen diffusing through the tear film. In addition, the peripheral cornea is supplied with oxygen from the limbal circulation. The cornea is composed of six layers, which are epithelium, Bowman's layer, stroma, Dua's layer, Descemet's membrane and endothelium. [(3)]

The average axial length of newborn's eyeball is about 16 millimeters. In an infant, the eye grows slightly to a length of approximately 19.5 millimeters. The eye continues to grow, gradually, to the length of about 24-25 millimeters. [(4)]

An interplay among corneal power, lens power, anterior chamber depth, and axial length determines an individual's refractive status. All four elements change continuously as the eye grows. [(5)]

On average, babies are born with about 3.00 D of hyperopia. In the first few months of life, this hyperopia may increase slightly, but it then declines to an average of about 1.00 D of hyperopia by the end of the first year because of marked changes in corneal and lenticular powers, as well as axial length growth. By the end of the second year, the anterior segment attains adult proportions; however, the curvatures of the refracting surfaces continue to change measurably. (5)

One study found that average corneal power decreased 0.10–0.20 D and lens power decreased about 1.80 D between ages 3 years and 14 years. From birth to age 6 years, the axial length of the eye grows by approximately 5 mm; thus, one might expect a high prevalence of myopia in children. However, most children's eyes are actually emmetropic, with only a 2% incidence of myopia at 6 years. This phenomenon is due to a still undetermined mechanism called emmetropization. During this period of eye growth, a compensatory loss of 4.00 D of corneal power and 2.00 D of lens power keeps most eyes close to emmetropia. It appears that the immature human eye develops so as to reduce refractive errors. (6)

Central corneal thickness (CCT) is an important indicator of corneal health status and is an essential tool in the assessment and management of corneal diseases and helps to estimate the corneal barrier and endothelial pump function. (7)