



**ORTHOKERATOLOGY AS A TEMPORARY NON-INVASIVE
METHOD OF OVERNIGHT CORRECTION OF MYOPIA IN
EGYPTIANS**

Thesis

Submitted for partial fulfillment of Master Degree in Ophthalmology

Presented by

Ahmed Muhammed ElMoomen

M.B.B.Ch. Ain Shams University

Supervised by

Prof. Dr. Hussein Shaker El Marqaby

Professor of Ophthalmology

Faculty of Medicine, Ain Shams University

Dr. Hassan Wafik Hefny

Lecturer of Ophthalmology

Faculty of Medicine, Ain Shams University

Dr. Rabab Abo Elmaaty Mahmoud

Lecturer of Ophthalmology

Faculty of Medicine, Ain Shams University

Faculty of Medicine

Ain Shams University

2019



تقويم القرنية كوسيلة مؤقتة غير جراحية لإصلاح قصر النظر في المصريين خلال النوم

رسالة

توطئة للحصول علي درجة الماجستير في طب وجراحة العيون

مقدمة من

أحمد محمد المؤمن سعداوي/الطبيب

بكالوريوس الطب و الجراحة- جامعة عين شمس

تحت إشراف

أ.د/ حسين شاكر المرقبي

أستاذ طب و جراحة العيون

كلية الطب- جامعة عين شمس

د/ حسن وفيق حفني

مدرس طب و جراحة العيون

كلية الطب- جامعة عين شمس

د/ رباب أبو المعاطي محمود

مدرس طب و جراحة العيون

كلية الطب- جامعة عين شمس

كلية الطب

جامعة عين شمس

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

لسببائك لا علم لنا
إلا ما علمتنا إنك أنت
العليم العظيم

صدق الله العظيم

سورة البقرة الآية: ٣٢



Acknowledgement

*First and foremost thanks to **ALLAH**, the Most Merciful.*

*I am deeply indebted to **Prof. Dr. Hussein Shaker El Marqaby** professor of Ophthalmology, Faculty of Medicine, Ainshams University, for his most valuable guidance and continuous encouragement, which paved the path towards the accomplishment of this work.*

*I would also like to express my profound gratitude to **Dr. Hassan Wafik Hefny** lecturer of Ophthalmology, Faculty of Medicine, Ainshams University, and **Dr. Rabab Abo Elmaaty Mahmoud** for their sincere efforts, valuable advice and devoted assistance in the completion of this study.*

Finally, words will not be enough to express my sincere gratitude and appreciation to my family for continuous care, support and helping me to accomplish this study.

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LIST OF ABBREVIATIONS

ACLW	: Adapted contact lens wearers
AOK	: Accelerated Ortho-keratology
D	: Diopter
GP	: Gas permeable
NCLW	: Non-Contact Lens Wearers
NS	: Not-significant
Ok	: Orthokeratology
Ortho-K	: Orthokeratology
PMNs	: Polymorph-nucleus
RGP	: Rigid Gas Permeable
S	: Significant
SD	: Standard deviation
Sph	: Sphere
TBUT	: Tear break up time
TSCM	: Tandem scanning confocal microscopy

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ABSTRACT

Background: Orthokeratology is the a Non Invasive Corneal Correction Therapy, also referred to as Ortho-K or Corneal Refractive Therapy, it involves the use of a rigid gas permeable contact lens worn for only specific number of hours (6-8 hours) throughout the day or at night to improve visual acuity through the reshaping of the patient's cornea.

Objective: The purpose of this study is to evaluate the efficacy and safety and duration of effect of Orthokeratology technique as a method of overnight correction of myopia in Egyptian Patients with Myopia of up to 6 Diopters.

Patients and Methods: This study included 15 patients (30 eyes) presented with various degrees of Myopia from 8th of January 2018 to 8th of January 2019. In outpatients clinic of Helwan University Hospitals.

Aim of Study: Evaluate the efficacy and safety and duration of effect of Orthokeratology technique as a method of overnight correction of myopia in Egyptian Patients with Myopia of up to 6 Diopters.

Results: Along With the improvement of unaided visual acuity, the lower order aberrations, which are the major component of the ocular total aberration, reduced. Therefore, unaided visual acuity could be 6/6 or better after orthokeratology, as demonstrated in this study that most patients whose best corrected visual acuity were 6/6 with spectacles before Orthokeratology achieved 6/6 or better unaided visual acuity after 1 month of Orthokeratology being used steadily and daily for 6 to 8 hours per day noting that if it is over worn for more than 8 hours might lead to over correction and transform the error into hyperopia.

The corrective effect of the lens lasts for up to 12 hours and then gradually starts to fade away and the cornea starts to gradually regain its original shape , hence its initial refraction and error. From here comes the need of the lens to be worn daily and steadily.

Lower degrees of Myopia tend to reach the full correction faster than higher degrees. With lower degrees reaching full correction in about 3 to 4 days while higher degrees of Myopia might reach up to a week for full and steady correction.

The Ortho Keratology lenses had a limited effect on Myopic correction of more than 6 Diopters and more than 1.5 degrees of Astigmatism. Also it had no role in correction of Hypermetropia.

Conclusion: This study demonstrated a relatively high level of patient satisfaction following overnight Ortho Keratology as Ortho Keratology showed to be an effective method of temporary decreasing the amount of myopia and improving unaided visual acuity.

Keywords: Orthokeratology, Myopia

INTRODUCTION

Orthokeratology (also known as OrthoK, OK, corneal reshaping, corneal refractive therapy, and vision shaping treatment) is an alternative method to correct refractive errors using custom-designed rigid lenses to temporarily modify the curvature of cornea^(1,2). Modern OrthoK technology uses breathable rigid lens material and reverse geometry designs to allow faster and more effective corneal reshaping.⁽³⁾ Contrasting to the traditional OrthoK designs, which use a series of progressively flattening concentric curves surrounding a central base curve fitting in alignment with the central cornea, the modern reverse geometry designs for myopia correction are characterized by a central base curve, that is, fitted significantly flatter relative to the central corneal curvature and one or more surrounding steeper secondary or “reverse” curves that enable a smooth transitioning from the flat-fitting base curve to the alignment-fitting landing curve. The unique reverse geometry design significantly improves the overall centration of OrthoK lenses despite their flatter-fitting base curves, and more efficient distribution of the hydraulic pressure underneath the lenses, allowing faster and more significant central corneal flattening.^{1,3} Currently, the most common clinical application of OrthoK is for the reduction of myopia through corneal flattening.

AIM OF THE WORK

The purpose of this study is to evaluate the efficacy and safety and duration of effect of Orthokeratology technique as a method of overnight correction of myopia in Egyptian Patients with Myopia of up to 6 Dioptres.

ANATOMY AND PHYSIOLOGY OF CORNEA

A healthy cornea, together with the overlying tear film, is necessary to provide a proper anterior refractive surface and to protect the eye against infection and structural damage to the deeper components of the eye. In adults, the cornea has a horizontal diameter of 11.0–12.0 mm, a vertical diameter of 10.0 – 11.0 mm, and a thickness of approximately 500– 550 μm at the centre, which gradually increases to 600–800 μm toward the periphery. Average refractive power is 43.25 diopters, average radius of curvature is 7.8mm, and the corneal index of refraction is 1.376.⁽⁴⁾

It is composed of five anatomical layers, i.e., corneal epithelium, Bowman's layer, corneal stroma, Descemet's membrane, and corneal endothelium (**Fig.1**)⁽⁵⁾

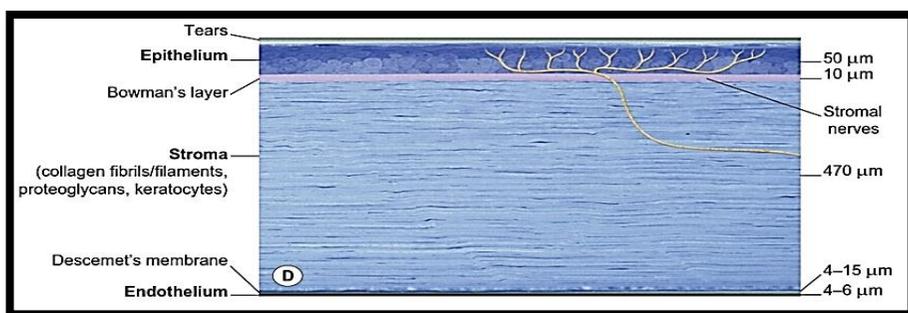


Fig.1: Histologic section of the human cornea (*Dawson GD, 2011*).

1-Corneal Epithelium:

The epithelial surface of the cornea represents the physical barrier to the outer environment and an integral part of the smooth tear film–cornea interface that is critical for the refractive power of the eye.⁽⁶⁾

The corneal surface is covered by a stratified, non-keratinizing squamous epithelium, about 50 μm in thickness, comprising 5–7 cell layers collectively. It can be structured into three layers, the superficial or squamous cell layer, the suprabasal wing cell layer, and the basal columnar cell layer (**Fig.2**).⁽⁶⁾

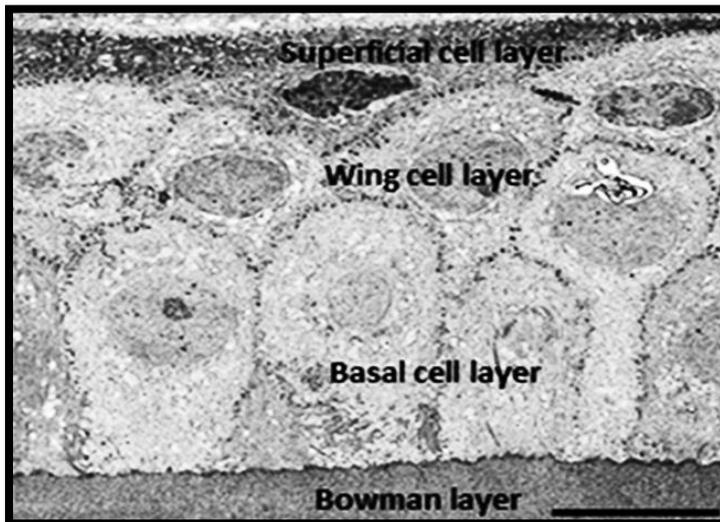


Fig.2: Cross sectional view of the corneal epithelium by transmission electron micrographs (*DelMonte DW, 2011*).

The superficial layer is formed by 2–3 layers of flat polygonal cells, which form intercellular tight junctions to provide an effective barrier and numerous surface

microvilli, which increase the cellular surface area and enhance oxygen and nutrient uptake from the tear film.⁽⁷⁾

The wing cell layer is formed by 2–3 layers of wing shaped cells which have laterally inter-digitated cell membranes with numerous desmosomes. The basal layer consists of a single layer of columnar cells. Corneal epithelial adhesion to Bowman's layer is maintained by an anchoring complex including anchoring fibrils (type VII collagen) and anchoring plaques (type VI collagen) (Fig.3).⁽⁸⁾

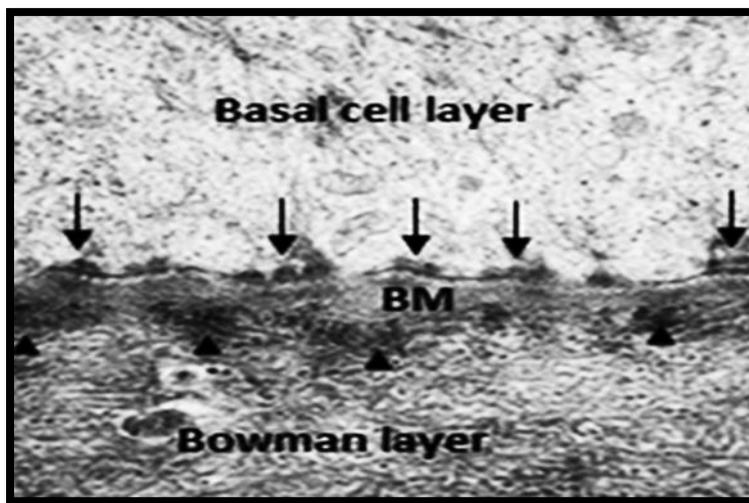


Fig. 3: Anchoring complexes formed by hemi desmosomes (Schlotzer, 2015).

The epithelial basement membrane has a critical role in corneal wound healing, by allowing penetration of growth factors from the epithelium into the stroma. Besides epithelial cells, there are numerous nerve endings in between the cells which have been estimated to amount to a

density of 7000 receptors per mm, which is 400 times more than in the skin. Mechanical stress to these nerves, such as in bullous keratopathy, can therefore cause tremendous pain.^(9, 10)

Corneal epithelial cells routinely undergo apoptosis and desquamation from the surface. This process results in complete turnover of the corneal epithelial layer every 5–7 days as deeper cells replace the desquamating superficial cells in an orderly, apically directed fashion. Two populations of cells, the basal epithelial cells and limbal stem cells, help renew the epithelial surface.⁽¹¹⁾

The corneal epithelium responds to injury in three phases, i.e., migration, proliferation, and differentiation with reattachment to the basement membrane. Following injury, cells adjacent to an epithelial defect migrate to cover the wound within few hours.⁽¹²⁾

2-Bowman's Layer:

Bowman's layer represents the most anterior, acellular portion of the corneal stroma. It is approximately 8–12 μm thick and structurally composed of randomly oriented collagen fibrils, 20–25 nm in diameter, consisting of collagen types I, III, V, and VI (**Fig.4**). Its thickness has been reported to decline with age by 0.06 μm per year. Unmyelinated nerve axons penetrate Bowman's layer to terminate within the epithelium.⁽¹³⁾