Presby-LASIK: A Corneal Approach To Correct Presbyopia

Essay

Submitted for Partial Fulfillment of Master Degree in Ophthalmology

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LIST OF ABBREVIATIONS

ACS: Anterior Ciliary Sclerotomy

AMO: Allergan Medical Optics

ArF: Argon Fluoride

BCVA: Best Corrected Visual Acuity

CK: Conductive Keratoplasty

D: Dioptre

FDA: Food and Drug Administration

HOA: High Order Aberrations

IOL: Intraocular Lens

IOP: Intraocular Pressure

J: Jaeger

LASEK: Laser Epithelial Keratomileusis

LASIK: Laser In Situ Keratomiluesis

LED: Light Emitting Diode

LRK: Laser Refractive Keratoplasty

MAR: Minimum Angle of Resolution

NBCVA: Near Best Corrected Visual Acuity

Nd YAG: Neodymium Yttrium-Aluminium-Garnet

NUVCA: Near Uncorrected Visual Acuity

NVA: Near Visual Acuity

OZ: Optical Zone

PAC: Pseudoaccommodative Cornea

List of abbreviations

PARM: Presbyopic Avalos Rozakis Method

PCO: Posterior Capsule Opacification

PML: Presbyopia Multifocal LASIK

PMMA: Polymethylmethacrylate

PRELEX: Presbyopic Lens Exchange

PresbyLASIK: Presbyopia Laser in situ Keratomileusis

PRK: Photrefractive Keratectomy

PTK: Phototherapeutic Keratectomy

Q: Quotient of asphericity

RD: Retinal Detachment

SA: Spherical Aberration

SEB: Scleral Expansion Band

SEP: Silicone Expansion Plug

UCVA: Uncorrected Visual Acuity

YAG: Yttrium-aluminium-garnate

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INTRODUCTION

Presbyopia is the most common refractive error. It is an age-related visual impairment, resulting from the gradual decrease in accommodation. Without optical correction, presbyopia results in an inability to perform once were effortless near tasks at a customary working distance without experiencing visual symptoms ***(Patorgis, 1987).***

Because the need to read and work at near and intermediate distances is important in all industrial societies, presbyopia has both clinical and social significance ***(Mancil, 1998).***

A variety of options are available for correction of presbyopia. These options could be optical correction as; *spectacle lenses, contact lenses*. Or they could be surgical correction as; *scleral expansion, conductive keratoplasty, small diameter corneal inlays, multifocal IOL implants* and finally the use of *excimer laser.*

Conductive keratoplasty is an effective and safe procedure for the treatment of presbyopia, but it is limited by its monocular application ***(McDonald, 2005).*** *Scleral expansion* is another surgical approach to correct presbyopia but it is prone to regression ***.(Malecaze, 2001)*** *Corneal inlays* are not popular and are not recommended in current practice due its dangerous surgical technique and potential complications such as epithelial opacification, flap complications, and infections ***.(Alió 2004)*** The performance of different types of *multifocal*

IOLs is constantly being improved, but the IOLs cuase a decrease in near vision contrast sensitivity ***.(Montés-Micó, 2003)***

Researchers are increasingly optimistic about the potential of multifocal LASIK as a treatment for presbyopia. The concept first attracted attention when some presbyopic hyperopic patients reported both improved near and distance vision after undergoing LASIK for far vision correction. Careful corneal analysis of those cases led to the appreciation that it might be possible to use excimer laser to intentionally create a multifocal cornea. Studies show the multifocal ablation procedure is very safe and is able to provide reasonable reading vision without compromising distance outcomes ***(Guttman, 2003)***.

Various presbyopic strategies using the excimer laser have also been brought forward. Beside monovision, the creation of multifocal cornea represents an attractive option. This procedure is also called ***" Presby-LASIK" .(Becker, 2007)***

Presby-LASIK treatment uses the principles of LASIK surgery to create multifocal corneal surface aimed at reducing near vision spectacle dependence in presbyopic patients. There are two main different techniques for presby-LASIK treatment. In the first technique, known as *central presby-lasik*, a central area is created for near vision and a peripheral area is created for central vision. Whereas in the second technique, known as *peripheral presby-LASIK*, the central area is for distance vision and the mid peripheral area is for

near vision. Both techniques create a multifocal pseudoaccommodative corneal surface ***(Pinelli, 2008).***

While the data are limited, the excimer laser offers some potential advantages over other methods to manage presbyopia. The procedure is less invasive than scleral expansion or a multifocal IOL, it can concomitantly correct the near and distance refractive errors. One of the advantages of this type of treatment is that it is centered on the visual axis of the eye rather than on the corneal apex like many multifocal contact lenses and in this way, decreases the induced loss of optical performance due to axis mismatching ***.(Cheng et al, 2004)***

Continued improvement of the multifocal pattern, using computer modeling that considers patient's pupil size, treatment diameter and corneal shape, along with data from long term studies, may further improve this treatment ***(AAO, 2006).***

AIM OF WORK

The aim of this essay is to review and study the use of presby-LASIK as a new technique for treatment of presbyopia. Its various advantages and drawbacks will be portrayed, in comparison to other techniques.

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Abstract

Presbyopia is the most common refractive error. It is an age-related visual impairment, resulting from the gradual decrease in accommodation. Without optical correction, presbyopia results in an inability to perform once were effortless near tasks at a customary working distance without experiencing visual symptoms.

A variety of options are available for correction of presbyopia. These options could be optical correction as; *spectacle lenses*, *contact lenses*. Or they could be surgical correction as; *scleral expansion*, *conductive keratoplasty*, *small diameter corneal inlays*, *multifocal IOL implants* and finally the use of *excimer laser.*

Researchers are increasingly optimistic about the potential of multifocal LASIK as a treatment for presbyopia. The concept first attracted attention when some presbyopic hyperopic patients reported both improved near and distance vision after undergoing LASIK for far vision correction. Careful corneal analysis of those cases led to the appreciation that it might be possible to use excimer laser to intentionally create a multifocal cornea. Studies show the multifocal ablation procedure is very safe and is able to provide reasonable reading vision without compromising distance outcomes.

Various presbyopic strategies using the excimer laser have also been brought forward. Beside monovision, the creation of multifocal cornea represents an attractive option. This procedure is also called ***" Presby-LASIK".***

Presby-LASIK treatment uses the principles of LASIK surgery to create multifocal corneal surface aimed at reducing near vision spectacle dependence in presbyopic patients. There are two main different techniques for presby-LASIK treatment. In the first technique, known as *central presby-lasik*, a central area is created for near vision and a peripheral area is created for central vision. Whereas in the second technique, known as *peripheral presby-LASIK*, the central area is for distance vision and the mid peripheral area is for near vision. Both techniques create a multifocal pseudoaccommodative corneal surface.

While the data are limited, the excimer laser offers some potential advantages over other methods to manage presbyopia. The procedure is less invasive than scleral expansion or a multifocal IOL, it can concomitantly correct the near and distance refractive errors. One of the advantages of this type of treatment is that it is centered on the visual axis of the eye rather than on the corneal apex like many multifocal contact lenses and in this way, decreases the induced loss of optical performance due to axis mismatching.

Despite encouraging initial clinical results, various questions are unsolved. There are no long-term results, and most trials include hyperopic patients. PresbyLASIK was often performed on relatively young patients, with no or little presbyopia (fewer than 2.00). It is unknown whether or not a retreatment is needed later. Safety issues including impairment of contrast sensitivity and unwanted optical aberrations with appearance of glare and halos should be addressed in future studies.

Chapter one

ANATOMY & OPTICS OF THE CORNEA

A-Anatomy of the cornea

The cornea is a transparent avascular tissue that forms together with the precorneal tear film the major refracting surface for the eye .The diameter of the corner is 11.6 to 12.6 mm horizontally and 10.6 to 11.7 mm vertically .The thickness of the cornea varies from 0.50 to 0.56 mm centrally to 0.63 to 0.67 mm peripherally. The radius of curvature of the anterior surface of the cornea ranges from 7.2 to 8.4 mm, the radius of curvature of the posterior surface ranges from 6.2 to 6.8 mm ***(Snell 1998).***