بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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جامعة عين شمس

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Endothelial Cell Loss Rate Following Penetrating Keratoplasty: Optical versus Therapeutic Grafts

Thesis

Submitted for Partial Fulfillment
of MD Degree in ***Ophthalmology***

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2021

سورة البقرة الآية: ٣٢

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List of Abbreviations

Abbreviation	Full term
ALK	Anterior lamellar keratoplasty
BCVA	Best corrected visual acuity
CDS	Cornea Donor Study
CT	Corneal thickness
CV	Coefficient of variation
ECD	Endothelial cell density
ECL	Endothelial cell loss
ECM	Extracellular matrix
HEX	Hexagonal cells
IOP	Intra ocular pressure
PKP	Penetrating keratoplasty
PT	Preservation time
SMAS	Specular Microscopy Ancillary Study
SMILE	Small incision lenticule extraction
UCVA	Uncorrected visual acuity

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INTRODUCTION

The importance of corneal disease as a major cause of blindness in the world today remains second only to cataract, but its epidemiology is complicated and encompasses a wide variety of infectious and inflammatory eye diseases. In addition, the prevalence of corneal blindness varies from country to country and even from one population to another, depending on many factors, including availability and general standards of eye care ***(Boruchoff &Thoft, 2005).***

Penetrating keratoplasty (PKP) involves surgical removal of diseased or damaged cornea from the host and replacement with a full-thickness donor cornea. The major goals of PKP are to improve visual acuity, to maintain the integrity of the eye, and to treat various infections ***(Claesson et al., 2002).***

Optical PKP is to improve visual acuity by replacing the opaque or distorted host tissue by clear healthy donor tissue. The most common indication in this category is pseudophakic bullous keratopathy, followed by keratoconus, corneal degeneration, keratoglobus and dystrophy, as well as scarring due to keratitis and trauma ***(Shi et al., 2008).***

Tectonic PKP is to preserve corneal anatomy and integrity in patients with stromal thinning and descemetoceles, or to reconstruct the anatomy of the eye, e.g. after corneal perforation ***(Viestenz et al., 2018).***

Therapeutic PKP is to remove inflamed corneal tissue unresponsive to treatment by antibiotics or anti-virals ***(Bouazza et al., 2015).***

The fundamental aim of a successful keratoplasty surgery is to obtain a clear corneal graft and maintain its survival. Previous studies have demonstrated the importance of endothelial cell density (ECD) for maintaining graft transparency and survival after keratoplasty. The mean annual rate of endothelial cell loss during the first 3 to 5 years after penetrating keratoplasty is higher than the physiological endothelial cell loss. The cumulative endothelial cell loss 10 years after PK rises to above 50% and the resulting decrease in cell density constitutes the most important reason for late graft failure ***(Patel et al., 2005).***

The underlying reasons for this observed cell loss several years after surgery are poorly understood, although factors which have been shown to be connected with this loss include pre-operative donor ECD, death-to preservation time of the donor tissue, preservation time, the donor's age, storage media, surgical trauma, glaucoma and rejection ***(Ishii et al., 2016).***

Specular microscopy is used to view and record non-invasively the image of the corneal endothelial cell layer. The clinical specular microscopes are all based on the laboratory microscope designed by Maurice to provide a high magnification view of specular reflected light from the corneal endothelium ***(Bernard et al., 2008).***

Aim of the Work

To compare the rate of endothelial cell loss following penetrating keratoplasty for optical and therapeutic indications, and to evaluate the survival rates of optical and therapeutic corneal grafts.

ANATOMY OF THE CORNEA

General Characteristics

The cornea and the sclera constitute the outer coat of the eyeball. The main function of this coat is to protect structures inside the eye. The cornea is a transparent avascular tissue that acts as a structural barrier and protects the eye against infections. Along with the tear film, it contributes to two thirds of the refractive power of the eye ***(DelMonte & Kim, 2011).***

The cornea is horizontally oval, measuring 11–12 mm horizontally and 10–11 mm vertically. The limbus widest at the superior and inferior quadrants of the cornea. As an optical surface, the cornea is convex and aspheric. The anterior curvature is 7.8 mm and the posterior curvature is about 6.5 mm. It contributes to about 40–44 D of the refractive power of the globe. The refractive index of the cornea is 1.376. There is a gradual increase in thickness from the central cornea to the periphery ***(Fares et al., 2012).***

Alteration in corneal tissue thickness is mostly attributed to the gradual increase in the amount of collagen in the peripheral stroma. With different methods of evaluation, the central corneal thickness in normal eyes was found to range between 551 and 565 μ, while the peripheral corneal thickness ranges from 612 to 640 μ ***(Feizi et al., 2014).***

The corneal thickness is found to decrease with age. The anterior corneal stromal rigidity appears to be particularly important in maintaining the corneal curvature, which resists changes to stromal hydration much more than the posterior stroma ***(DelMonte & Kim, 2011).***

The cornea is made up of cellular and acellular components. The cellular components include the epithelial cells, keratocytes, and endothelial cells, while the acellular components include the stromal collagen and glycosaminoglycans. The epithelial cells are derived from epidermal ectoderm. Both the keratocytes and the endothelial cells are derived from the neural crest. The corneal layers include the epithelium, Bowman's layer, stroma, Dua's layer Descemet's membrane, and endothelium ***(Dua et al., 2013).***

Normal human cornea is avascular. The aqueous humor is the main source of nutrients to the cornea. Blood supply reaches the cornea through tiny vessels at the outer edge of the cornea as well as components supplied by the aqueous humor and the tear film ***(Fares et al., 2012).***

The cornea is one of the most heavily innervated and most sensitive tissues in the body. The sensation is derived from the nasociliary branch of the first division (ophthalmic) of the trigeminal nerve. Thick and straight stromal nerve trunks extend laterally and anteriorly from the trigeminal ganglion to give rise to plexiform arrangements of progressively thin nerve

fibers at several levels within the stroma ***(Oliveira-Soto & Efron, 2001).***

The nerve fibers perforate the Bowman's layer and eventually form a dense nerve plexus just beneath the basal epithelial cell layer. This nerve plexus is characterized by tortuous, thin beaded nerve fibers interconnected by numerous nerve elements. The cornea also contains autonomic sympathetic nerve fibers ***(Feizi et al., 2014).***

Corneal Epithelium

The epithelial surface (figure 1) of the cornea creates the first barrier to the outside environment and is an integral part of the tear film-cornea interface that is critical to the refractive power of the eye. It is a stratified, non-keratinizing squamous layer characterized by outstanding uniformity from limbus to limbus ***(DelMonte & Kim, 2011).***

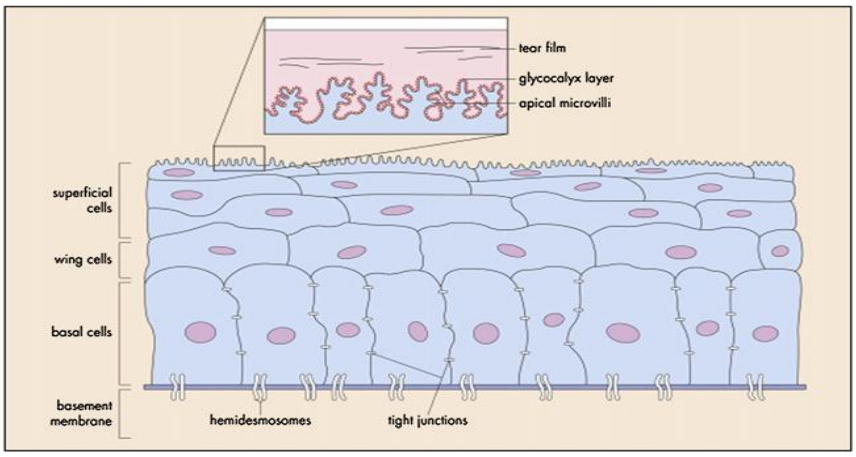

Figure 1: Cross-sectional view of the corneal epithelial cell layer ***(DelMonte & Kim, 2011).***