Phototherapeutic Keratectomy in Treatment of Corneal Lesions

ESSAY

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List of Abbreviations

ArF	:	Argon Fluoride
EDTA	:	Ethyl-diamine-tetra-acetic acid
ev	:	electron volt
F_2	:	Flourine
FDA	:	Food and Drug Administration
HPMC	:	Hydroxy Propyl Methyl Cellulose
Kr Cl	:	Krypton Chloride
KrF	:	Krypton fluoride
mm	:	micrometer
MMC	:	Mitomycin-C
N	:	Nitrogen
(Nd: YAG):		Neodymium-ythrium-aluminum-garnet
nm	:	nanometer
PRK	:	Photo Refractive Keratectomy
PTK	:	Phototherapeutic Keratectomy
Xe Cl	:	Xenon Chloride
XeF	:	Xenon Fluoride

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كشط القرنية باستخدام الليزر العلاجي
في علاج أمراض القرنية

رسالة

توطئة للحصول على درجة الماجستير في **طب وجراحة العيون**

مقدمه من

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الملخص العربي

منذ عام ١٩٨٨ استخدم الإكزيمر ليزر لعلاج أمراض قرنية العين. كان الهدف من استخدام هذا النوع من العلاج هو كشط المناطق المصابة من القرنية باستخدام أشعة الليزر ذات الطول الموجي (١٩٣ نانو ميتر) بدون إصابة الأجزاء السليمة من القرنية وسريعا ما تبين أن استخدام الإكزيمر ليزر لكشط القرنية له مزايا عديدة تفوق مثيلاتها من الطرق الميكانيكية لكشط القرنية.

إن الأكزيمر ليزر له دقة قطع متميزة، كما أنه يترك حداً فاصلاً منتظماً بين الجزء المعالج والجزء السليم ويمتاز جرح القرنية الناتج عنه بسرعة الالتئام وسلاستة وذلك بأقل تفاعلات نسيجية مقارنة بالجرح الناتج عن استخدام المشارط الجراحية التي ينتج عنها أنسجة غير طبيعية وغير منظمة.

تتضمن الأغراض العديدة التي يستخدم فيها الإكزيمر ليزر علاج سحابات القرنية الناتجة عن الإصابات الجراحية وغير الجراحية، التهابات القرنية وأمراض تحلل القرنية المتواجدة فى الأجزاء الأمامية لقرنية العين وكذلك علاج المشاكل الناتجة عن علاج عيوب الإبصار باستخدام الإكزيمر ليزر.

لكن تسطح الأجزاء المركزية لقرنية العين الذى يؤدي إلى بعد النظر يعتبر من أهم مضاعفات هذا النوع من العلاج، أما بعض المضاعفات الأخرى الأقل أهمية فهي تشمل آلام ما بعد الجراحة، بعض الحالات المسجلة لعودة نشاط الالتهابات الفيروسية.

äÅ الإكزيمر ليزر فى الوقت الحاضر أكثر استخداماً فى علاج أمراض القرنية لذلك فإنه من المتوقع أن تقل الحاجة لجراحات ترقيع القرنية إلى مستويات أدني مما هي عليه الآن.

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First, thanks are all due to Allah for Blessing this work until it has reached its end, as a part of his generous help throughout our life.

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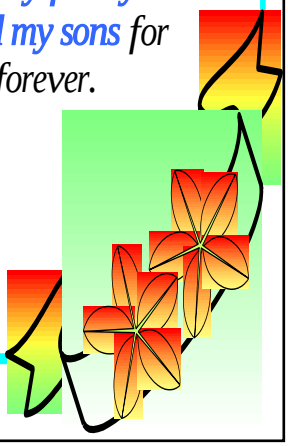
Mai Mahmoud Abd El Fatah



Introduction

Phototherapeutic keratectomy (PTK) involves the use of the excimer laser to treat visual impairment or irritative symptoms relating to diseases of the anterior cornea by sequentially ablating uniformly thin layers of corneal tissue. it is performed by using topical anesthesia. PTK must be distinguished from photorefractive keratectomy, which involves the use of the excimer laser to correct refractive errors of the eye (e.g., myopia, astigmatism, hyperopia, and presbyopia). Phototherapeutic keratectomy functions by removing anterior stromal opacities or eliminating elevated corneal lesions while maintaining a smooth corneal surface **(Maloney et al., 1996).**

The U.S. Food and Drug Administration (FDA) identifies the following ophthalmologic therapeutic indications for the excimer laser:

- Superficial corneal dystrophies (including granular, lattice, and Reis-Buckler's dystrophies)
- Epithelial basement membrane dystrophy, irregular corneal surfaces (secondary to Salzmann's degeneration, keratoconus nodules or other irregular surfaces)
- Corneal scars and opacities (due to trauma, surgery, infection and pathology).

Although not included in the FDA labeling, there has been interest in PTK as a treatment of recurrent corneal erosions in patients who have not responded to conservative therapy with patching, cycloplegia, topical antibiotics, and lubricants **(Jain and Austin, 1999).** Such investigational applications of phototherapeutic keratectomy include, but are not limited to, treatment of recurrent corneal erosions and infectious keratitis **(Pogorelov et al., 2006).**

Candidates for PTK should first exhaust medical approaches. For example, recurrent corneal erosions can be treated conservatively with lubricants, patching, bandage contact lenses, or anterior stromal punctures **(Cavanaugh et al., 1999).**

Alternatives to PTK include mechanical superficial keratectomy, i.e., corneal scraping, when used to remove only the epithelial surface of the cornea. And when the pathology extends to Bowman's layer competing technologies include lamellar keratoplasty. Complications of PTK include refractive errors, most commonly hyperopia, corneal scarring, and glare **(Zaidman, 2006).**

Aim of work

To discuss in details the phototherapeutic keratectomy as a treatment of corneal lesions.

Anatomy of The Cornea

Epithelium:

The corneal epithelium is a stratified squamous, nonkeratinizing epithelium of about 5 cell layers and 30-50 micrometer thickness. It is composed of three types of cells: basal, wing and superficial cells.

The flat superficial cells are recognized in two layers with junctional complex between them obliterating the intercellular space and, therefore, serving as anatomic barrier to the passage of substance into the cornea.

The polygonal wing cells are two to three cell deep with an intensive interdigitations of each cell with numerous desmosomal attachments.

The basal cells are aligned perpendicular to the corneal surface and are tightly adherent to the uniform, 50 nm thick basement membrane, basal epithelium cells progressively deform into wing cells and thereafter into surface cells, with a total transit time of around 7 days. Most mitotic divisions occur in an annular zone extending 2 mm from the limbus. Central cells are replaced by migration from this germinative zone **(Corbett et al.,1996).**

The basement membrane is composed largely of type **VI** collagen, laminin,heparin,and some amount of fibronectin.

This basement membrane has two important functions:

(1) It forms a scaffold for the organization of the epithelium.
(2) It is the boundary that separates epithelium from the stroma.

Anchoring fibrils,composed of collagen type **VII** , attach the basement membrane to bowman's layer **(Gipson et al., 1987).**

Bowman's layer :

Bowman's layer is acellular zone about 8-10 micrometer thick and contain collagen fibrils arranged randomly.

It is synthesized by both epithelial and stromal keratocytes. Posteriorly it merges into the anterior stroma. The function of Bowman's layer is unknown but it acts as a barrier to corneal invasion by microorganisms.

Stroma :

The corneal stroma comprises 90% of the normal thickness and consists primarily of collagen, stromal cells, and proteoglycans. It is composed of approximately 78% water.

The collagen fibrils are arranged into 200-300 lamellae parallel to the outer surface, and each lamella extends across the entire breadth of the cornea. Interlacing lamellae cross each other in highly regular fashion, at less than 90 degrees. In the anterior stroma, and at nearly right angels in the posterior stroma. Type **I** collagen is the predominant collagen found in the cornea and only small amount of type **III (10%)**, type **V(5%),** and type **VI** (not quantified) collagen may be present. The collagen fibrils are surrounded by polyanionic extracellular matrix, which is important in maintaining the fairly constant separation distance of about 60 nanometer between the centers of the fibrils.

The stromal matrix of the human cornea contains mainly keratin sulfate and chondroitin sulfate, which occur in a ratio of approximately **3:1.** Other proteoglycans, such as dermaitn sulfate and heparan sulfate are also found in the human cornea and associated mainly with scar tissue **(Lohmann, 1997).**

Descemet's Membrane

Descemet's membrane is an elastic membrane approximately 3 micrometer thick. It increases in thickness throughout life. In adult this membrane consists of two layers:

(1) An anterior banded layer, synthetized during fetal development and is formed of highly organized collagen lamellae and proteoglycans, and

(2) A more amorphous posterior collagenous layer which is synthetized after birth by the endothelial cells and gradually becoming thicker with age. It measures 2 micrometers in young adults.

Histologically, Descemet's membrane is an acellular basal membrane of the corneal endothelium. In adults, Descemet's membrane composed of type **IV** and **VIII** collagen, heparan sulfate, dermatin sulfate, and fibroectin. In contrast to Bowman's membrane is easily detached from the stroma **(Trudo et al., 1997).**

Endothelium :

The corneal endothelium ia a monolayer flat hexagonal cells, the density of which decreases throughout life, from approximately 3500 cells/mm^2 at birth to 2500 cells/mm^2 in adult cornea. Generally there is no mitotic activity in the human endothelium after birth. As cell loss occurs, such as through trouma or aging, the neighboring cells spread out to cover the vacancy **(Sperling et al., 1982).**