Descemet's Stripping Automated Endothelial Keratoplasty (DSAEK)

ESSAY

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By

Abd Ullrahman Abd Ullkader Ali

M.B., B.Ch.

Faculty of Medicine – Ain Shams University

Under Supervision of

Prof.Dr.Magda Mohammed Mahmoud Samy

Professor of Ophthalmology

Faculty of Medicine - Ain Shams University

Dr.Sameh Hany Abdullrahman

Lecturer of Ophthalmology

Faculty of Medicine - Ain Shams University

Faculty of Medicine

Ain Shams University

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مقدمــة من

عبد الرحمن عبد القادر علي نعمان

بكالوريوس الطب والجراحة - جامعة عين شمس

تحت إشراف

الأستاذ الدكتور/ ماجدة محمد محمود سامي

أستاذ طب وجراحة العيون
كلية الطب - جامعة عين شمس

الدكتور/ سامح هاني عبد الرحمن

مدرس طب وجراحة العيون
كلية الطب - جامعة عين شمس

كلية الطب
جامعة عين شمس
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SUMMARY

The history of lamellar keratoplasty (LK) surgery spans over 100 years, and the advantages of lamellar surgery have long been known. The surgery is usually used for tectonic purposes; however, new techniques and technology over the past 25 years have expanded the applications of LK in optical rehabilitation. Instrumentation such as viscoelastics, diamond knives, ultrasonic pachymetry, artificial anterior chambers, advanced microkeratomes, and the excimer laser have enhanced our ability to work more safely in the tedious microsurgical environment of the lamellar procedure.

Advances in surgical techniques such as deep lamellar anterior keratoplasty and deep lamellar endothelial keratoplasty have expanded. The application of Lamellar surgery to endothelial replacement have achieved visual results approaching those of penetrating keratoplasty while reducing the rate of rejection and improving the long-term graft stability. As research continue. LK promises to be increasingly important option for the corneal surgeon.

In 1998, Melles and coworkers first described a new technique in human subjects and called it 'posterior lamellar keratoplasty' or PLK. Terry and Ouslay performed a series of newly designed similar posterior lamellar transplantation surgery with technical modifications and termed them as 'deep lamellar endothelial keratoplasty' or DLEK in 2000. All this work represents a radical change from the conventional PK technique in

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LIST OF ABBREVIATIONS

ABZ	Anterior Banded Zone
ACE	Aphakic Corneal Edema
ACIOL	Anterior Chamber Intraocular Lens
ALTK	Automated Lamellar Therapeutic Keratoplasty
ATP	Adenosine Triphosphate
BSS	Balanced Salt Solution
CHED	Congenital Hereditary Endothelial Dystrophy
D	Diopter
DALK	Deep Anterior Lamellar Keratoplasty
DLEK	Deep Lamellar Endothelial Keratoplasty
DM	Descemet's Membrane
DMEK	Descemet's Membrane Endothelial Keratoplasty
DSAEK	Descemet's Stripping Automated Endothelial Keratoplasty
DSEK	Descemet's Stripping Endothelial Keratoplasty
DXEK	Descemetorhexis+ Endothelial Keratoplasty
ECM	Extra Cellular Matrix
EK	Endothelial Keratoplasty
ELK	Endothelial Lamellar Keratoplasty
FED	Fuchs' Endothelial Dystrophy
ICE	Iridocorneal Endothelial Syndrome
IGF-I	Insulin-like Growth Factor I
IOL	Intraocular Lens
IOP	Intraocular Pressure
LASIK	Laser In SituKeratomileusis
LKP	Lamellar Keratoplasty
MMP	Matrix Metalloproteinase
OCT	Optic Coherence Topography

PAS	Periodic Acid–Schiff Stain
PCE	Pseudophakic Corneal Edema
PCL	Posterior Collagenous Layer
PKP	Penetrating Keratoplasty
PLK	Posterior Lamellar Keratoplasty
PLL	Posterior Limiting Lamina
PNBZ	Posterior No Banded Zone
TCA	Tricarboxylic Acid
TGF-β	Transforming Growth Factor Beta
TN-C	Tenascin C

INTRODUCTION

Endothelial dysfunction remains the leading indication for penetrating keratoplasty (PKP) in USA. More than half of nearly 40,000 corneal transplants performed each year are to treat either Fuchs' corneal endothelial dystrophy or pseudophakic bullous keratopathy. In the past endothelial replacement was accomplished by PKP. (1)

Until recently, penetrating keratoplasty (PKP) was the standard procedure for the surgical treatment of vision loss associated with Fuchs' dystrophy or pseudophakic/aphakiccorneal edema. Major problems that have remained with this procedure since its development have been unpredictable astigmatic changes, risk of traumatic wound dehiscence, and long-term endothelial cell loss.(2)

In the developing world, these problems are compounded as there is a high rate suture related complications and corneal transplant failure.(3)

The field of corneal transplantation has undergone significant advancements in the treatment of endothelial failure, most notably since 1998, when Gerrit Melles first described his method of replacing the posterior corneal surface using only the posterior portion of the donor tissue, which he named posterior lamellar keratoplasty. Endothelial keratoplasty was again modified and further developed, initially as deep lamellar endothelial keratoplasty surgery by Terry and then as Descemet's

stripping endothelial keratoplasty surgery by Price. The procedure was then renamed Descemet's stripping automated endothelial keratoplasty (DSAEK) by Gorovoy to distinguish the use of a microkeratome to prepare the donor tissue.(4)

The original technique, called posterior lamellar keratoplasty (PLK), consisted of manually dissecting the recipient and donor corneas at 80% to 90% depth using curved blades, then excising the posterior recipient stroma and endothelium with small curved scissors and trephine. (5)

In 2005 Terry and Ousley developed a line of instruments and renamed the procedure deep lamellar endothelial keratoplasty (DLEK) Descemet's stripping with Endothelial keratoplasty (DSEK) is potentially less traumatic to anterior chamber structures than recipient lamellar dissection and tissue excision with trephine and scissors.(6)

However, In 2006 Price and colleagues initially found donor tissue attachment to be more challenging with (DSEK) than with PLK/DLEK, because the recipient stromal surface exposed by stripping Descemet's membrane is smoother than a hand – dissected surface. Using techniques to remove fluid from the donor/recipient graft interface, the authors have reduced the incidence of donor tissue dislocation to 1%. Additionally, they have found that EK may be performed without stripping Descemet's membrane to restore clarity to failed penetrating grafts when Descemet's has no guttata, opacities or other abnormalities.(6)

Gorovoy, Goosey, Aronsky and others have popularized theuse of a mechanical microkeratome to simplify the donor tissue dissection, a technique known as Descemet's tripping with automated EK (DSAEK). However, microkeratomes are an expense that some corneal surgeons can't justify, so several eye banks now supply predissected donor tissue for EK. Femtosecond lasers are also being evaluated for donor tissue dissection. [(6)]

AIM OF THE WORK

The aim of this work is to emphasis on ***DESCEMET STRIPPING AUTOMATED ENDOTHELIAL KERATOPLASTY (DSAEK)*** as a novel technique of endothelial keratoplasty regarding its indications, techniques, advantages, disadvantages and complications.

ANATOMY

The cornea is a unique portion of the outer fibrous ocular tunic that is transparent and serves a refractive function while maintaining a mechanically tough and chemically impermeable barrier between the eye and the environment. The cornea becomes structurally and functionally specialized to achieve the required optical properties. [7]

The cornea is highly rich with sensitive nerves which rely on free nerve endings because specialized neural receptors would compromise corneal transparency. [8]

General features:

The cornea is derived from two embryonic layers-surface ectoderm, which becomes the epithelium, and neural crest, which gives rise to the stroma, endothelium, and nerve cells . At birth, average corneal diameter is less than 10mm. This increases in adulthood to a vertical diameter of 9 to 11mm and a horizontal diameter of 11 to 12mm.[9]

In the adult, central corneal thickness is 0.6mm and peripheral thickness is 1.0mm.[10]

The cornea has an aspheric anterior surface and contributes the majority of the eye’s refractive power. It is also the main source of astigmatism. Average corneal power is 43.25 diopters, average radius of curvature is 7.8mm, and the corneal index of refraction is 1.37.[9]

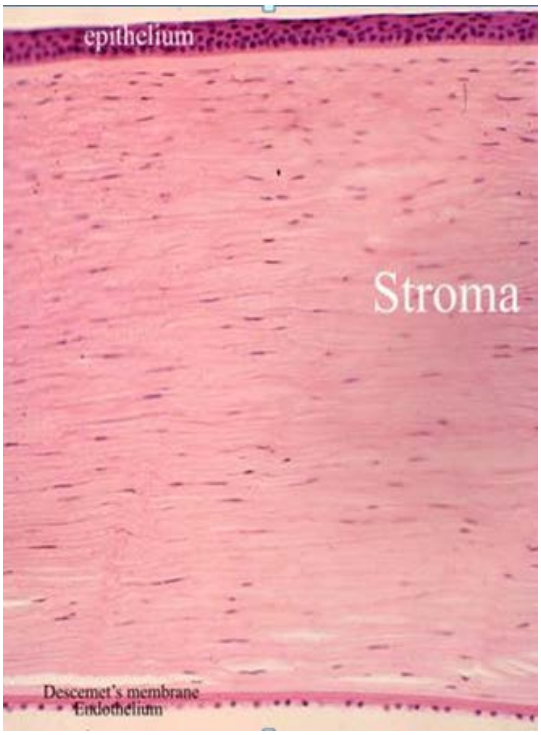

Figure (1): layers of Cornea.[11]

Epithelium:

The corneal epithelium has a number of important functions. It is specialized to transmit and refract light, to survive over an avascular bed, and to resist abrasive pressure from eye rubbing or blinking. Like other stratified epithelia, it performs barrier functions, preventing the loss of fluid and protecting against pathogen invasion. [10]

The stratified squamous, nonkeratinized epithlium has 5 to 7 layers and is 50 to 52 microns thick. Its outer surface is composed of three to four layers of flattened squamous cells or squames. A mid-epithelial layer contains one to three layers of wing cells, so termed because these rounded cells have thin, lateral, wing-like cellular processes. The basal layer consists of a row of columnar cells.[10]

Sensory nerves form a dense network in the basal and suprabasal layers of the epithelium.[12]

This neural plexus helps support and protect the epithelium. Cells of the corneal epithelium have a relatively sparse distribution of cytoplasmic organelles and have high concentrations of water-soluble proteins. It is thought that these feature may contribute to cellular transparency.[10]

The basal cells are the only epithelial cells that undergo mitosis, the daughter cells thus formed push anteriorly and change their shape, conforming to the wing cells. As the cells continue to move anteriorly, they become the superficial cells, after which they disintegrate and are shed into the tear film in a process known as desquamation. The superficial cells represent the highest level of differentiation and are chronologically, the oldest epithelial cells. The epithelium turns over approximately every 7 days. [13]

Stroma and Bowmen's membrane:

The stroma is the thickest layer of the cornea, measuring approximately 500 microns. The extracellular matrix, which comprises the major mass of the stroma, is composed of collagen, proteoglycans, and glycoproteins secreted and maintained by the keratocyte, a fibroblast-like cell. The anterior portion of the stroma, Bowman's membrane, is the thin acellular region that is 8 to 10 microns thick .The posterior stroma is called the lamellar stroma, so termed because of the orderly stacking of layers of collagen fibers. Collagen organization in the stroma is crucial to