DIFFERENT ABLATION PROFILES
IN
REFRACTIVE SURGERY

Essay submitted by:

Marwa Ahmed El-Biomey Mansour
In partial fulfillment of the M.Sc. degree in
Ophthalmology

Supervised by

Prof. Dr. Mahmoud Abou Steit
Professor of Ophthalmology
Faculty of Medicine
Cairo University

Prof. Dr. Mohamad Saad Mostafa El-Balkini
Professor of Ophthalmology
Research Institute of Ophthalmology

Dr. Ahmed EL-Sawy Mahmoud Habib
Lecturer of Ophthalmology
Faculty of Medicine
Cairo University

Faculty of Medicine
Cairo University Kasr El-Ainy
Cairo-Egypt
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Abstract

Laser vision correction (LVC) has grown with tremendous speed over the past decade. In addition to the choice of surface (photorefractive keratectomy, laser-assisted epithelial keratectomy, epi-laser in situ keratomileusis) or lamellar (LASIK, femto-LASIK) treatments, the surgeon now has to select a laser profile for myopic, hyperopic, or astigmatic treatment.

Wavefront-guided, wavefront-optimized, topography-guided and Q-factor adjusted ablation are the most advanced and frequently used profiles in current practice. Technical developments, clinical studies, and surgeon experience should help in selecting the best profile.

This study characterizes distinctly the various ablation profiles with the use of comparative studies emphasizing the advantages and disadvantages of each in correlation to their outcome, safety and predictability. Thus highlighting the prudent use of the different profiles to ensure optimum optical and visual outcome of the refractive procedure.

Key Words:

- **Optical quality**
- **Aberrations – Higher order aberrations**
- **Excimer laser**
- **Laser surgery in vision correction**
- **Wavefront**
- **Topography**
- **Munnerlyn´s formula**
- **Q-factor**

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List of Abbreviations

ACD: Anterior Chamber Depth

ALK: Automated Lamellar Keratoplasty

ArF: Argon Fluoride

ASA: Advanced Surface Ablation

BMP: Bone Morphogenic Proteins

BSCVA: Best Spectacle Corrected Visual Acuity

DWA: Dresden Wavefront Analyzer

EGF: Epidermal Growth Factor

Epi-LASIK: Epipolis Laser Assisted Stromal In situ Keratomileusis

FDA: Food & Drug administration

HOAs: Higher Order Aberrations

IL: Interleukin

IROC: Institut fur Refraktive und Ophthalmochirurgie Centre

LASEK: Laser Subepithelial Keratomileusis

LASER: Light Amplification by Stimulated Emission of Radiation

LASIK: Laser Assisted Stromal In situ Keratomileusis

LOAs: Lower Order Aberrations

LRT: Laser Ray Tracing

LSF: Line Spread Function

MMC: Mitomycin-C

MTF: Modulation Transfer Function

OCT: Optical Coherence Tomography

OPD: Optical Path Difference

OTF: Optical Transfer Function

PDGF: Platelet Derived Growth Factor

PERK: Prospective Evaluation of Radial Keratotomy

PMNL: Polymorph nuclear leukocyte

PRK: Photorefractive Keratectomy

PSF: Point Spread Function

PTF: Phase Transfer Function

PTK: Phototherapeutic Keratectomy

RK: Refractive Keratotomy

RMS: Root Mean Square

SA: Spherical aberrations

SMA: Smooth Muscle Actin

SRR: Spatially Resolved Refractometer

TNF: Tumor Necrosis Factor

TGF: Transforming Growth Factor

TSA: Topographical System Ablation

UCVA: Uncorrected Visual Acuity

VHF: Very High Frequency

WF: Wavefront

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Introduction

Excimer laser corneal refractive surgery

The subspecialty of refractive surgery is responsible for many of the innovations in the field of ophthalmology. Acceptance of these advancements has come from the incorporation of science and technology to increase the safety, accuracy, and predictability of altering the refractive error of the human eye. These developments offer new tools for the ophthalmologist to improve and enhance vision for our current patients as well as the patients of the future. Eye surgeons are able to correct ametropia by using different surgical techniques in a variety of anatomical locations. Historically, the cornea has been the primary interest of the refractive surgeon because of its anatomical accessibility. Excimer Laser Corneal refractive surgery is the ablation of corneal tissue by the development of light amplification by stimulated emission of radiation (LASER) technology. By the early1980s, the precision of the 193 nm excimer laser was seen as a useful tool to reshape the corneal stroma. It has since become the basis for current corneal refractive surgery. The excimer laser has been a major innovation in ophthalmology because of its precise ability to remove tissue with negligible damage to the surrounding structures **(Jacqueline et al, 2005)**.

Different methods of excimer laser corneal tissue ablation can be classified into:

1-Surface ablation and advanced surface ablation (ASA): (PRK- LASEK- Epi-LASIK- Epi-LASEK)

a. Photorefractive keratectomy (PRK)

Which carries the disadvantage of postoperative pain while the cornea heals. But still it remains an excellent option for mild to moderate corrections, particularly for cases associated with thin corneas, recurrent corneal erosions, or a predisposition to trauma **(Ambrossio and Wilson, 2003).**

b. Laser subepithelial keratomileusis (LASEK)

LASEK theoretically offers the advantages of avoiding the flap complications of LASIK and also, addresses the drawbacks of discomfort and delayed recovery associated with conventional PRK. LASEK may be a viable alternative for patients with low myopia, thin corneas and life styles that predispose them to flap trauma **(Chen and Azar, 2005)**.

c. Epipolis Laser Assisted Stromal In situ Keratomileusis (Epi-LASIK)

Was recently introduced as a technique in which an epithelial flap is created with a microkeratome-like device. Preliminary studies suggest that this procedure may be less harmful to the basement membrane **(Naoumidi et al, 2003)**.

2-Lamellar ablation: (LASIK)

Burrato and Pallikaris are credited with combining lamellar surgical techniques developed by Barraquer, and excimer laser technology in a procedure they termed laser assisted stromal in situ keratomileusis (LASIK). This technique allows for precise sculpting and subtraction of corneal stroma under a protective corneal flap, facilitating broad range correction of hyperopia, myopia and astigmatism while avoiding many of the disadvantages