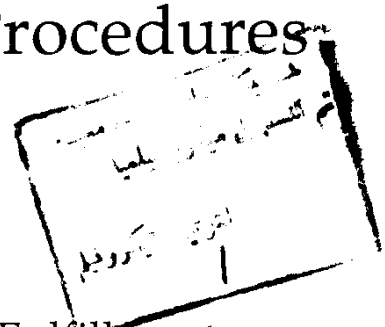
Refractive Surgical Procedures



Essay

Submitted for the Partial Fulfillment
Of The M.S. Degree in Ophthalmology

Presented By

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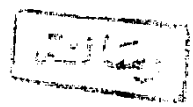

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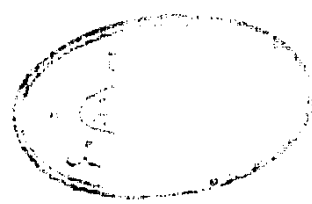
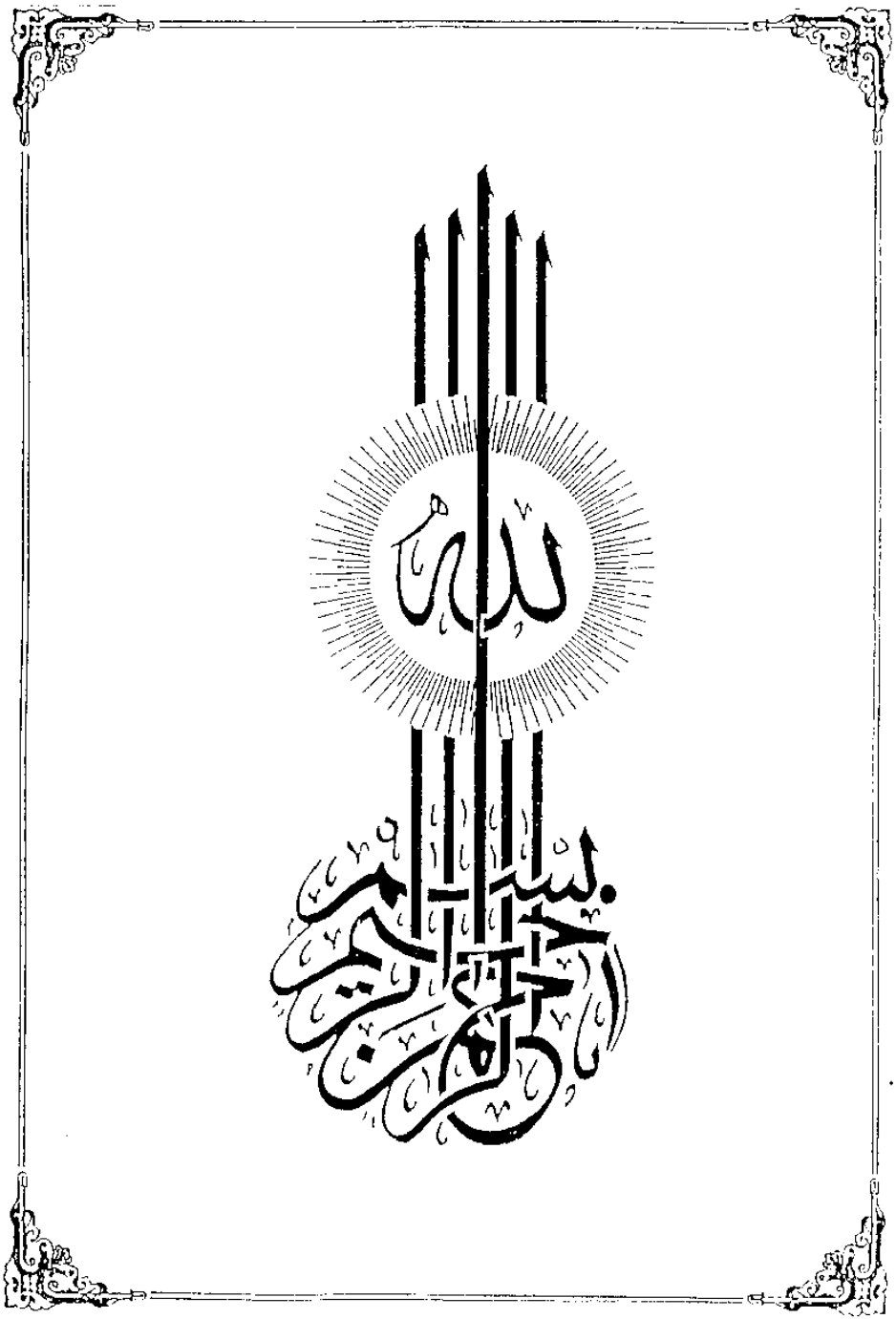


Dedicated to Those
Whom I Love



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Introduction

Introduction

The cornea is the most important refractive element of the eye providing two thirds of its refractive power, that's why alterations of the corneal curvature can affect the refractive state of the eye, in a more pronounced way than interference with any other refractive medium. **(Maguire, 1983).**

Refractive corneal surgical procedures are designed operations, aiming at altering the refractive state of the eye, in order to correct refractive errors, achieve emmetropia, and free the patient from spectacle or contact lens correction. It is here that small changes in the corneal shape can have great effects on refraction **(Rowsey and Hays, 1993).**

As these procedures are elective, the criteria for their success are more stringent. Because to be considered successful, refractive surgery must result in much comfort, and improved visual acuity, as could be achieved with spectacles or contact lenses and even more **(Waring, 1992).**

Being not the only solution for refractive errors, it was very difficult convincing the ophthalmologists that the shape of the cornea can be modified, to reduce refractive errors (not to correct) by performing surgery on a healthy cornea. That is why refractive surgery has taken so many years to be accepted **(Villasenor, 1983).**

Rules of keratorefractive surgery are:

1. The normal cornea flattens over any incision.

2. Radial corneal incisions flatten the adjacent cornea and cornea 90 degrees away.

3. The cornea flattening effect increases as incisions approach the visual axis.

4. The cornea flattens directly over any sutured incision.

5. The limbal cornea flattens adjacent to loose sutures.

6. The limbal cornea steepens adjacent to tight sutures.

7. The cornea flattens over a wedge resection or a tuck.

8. The cornea steepens anterior to wedge resection or tucks.

9. Tissue removal produces corneal flattening over the site of tissue removal, whether traumatic or surgically induced.

10. Full-thickness corneal tissue addition produces corneal steepening over the site of the tissue addition and flattens the adjacent cornea (**Rowsey and Hays, 1993**).

Types of refractive surgical procedures :

Most keratorefractive operations consist in one or more of the following four components:

1. Corneal incisions.

2. Corneal suturing.

3. Tissue addition.

4. Tissue removal.

(**Rowsey and Hays, 1993**).

I. Lamellar:

Keratomileusis (Carving the corneal disc).

Keratomileusis in situ (Carving the corneal bed).

Lamellar keratotomy.

Epikeratoplasty.

Intracorneal lens (keratophakia).

Lamellar keratoplasty.

II. Refractive keratotomy

Radial.

Transverse.

Modification of penetrating keratoplasty.

Circumferential.

III. Laser:

Excimer laser (ArF gas, 193 nm.).

Intrastromal, solid state laser.

IV. Keratectomy manual:

Concentric wedge.

Concentric lamellar.

V. Thermokeratoplasty.

VI. Penetrating keratoplasty and cataract surgery (refractive aspects).

VII. Phakic Intraocular lens.

VIII. Posterior scleral support.

(Waring, 1985)

Whereas keratomileusis, epikeratoplasty, photorefractive keratectomy correct myopia by altering anterior corneal curvature in the visual axis, radial keratotomy depends on the effect of adjacent incisions made peripherally to alter central corneal curvature. (Fyodorov, 1979, 1980).

Keratoplasty means molding of the cornea that's why refractive corneal surgeries are referred to as refractive keratoplasty. These surgical procedures are the most commonly practiced and are the most effective in correcting refractive errors owing to the refractive properties of the cornea, they include radial keratotomy, epikeratophakia, keratomileusis, and photorefractive keratectomy using the excimer laser, and those are particularly the surgeries we are going to discuss in our study.

Anatomy Of The Cornea

Anatomy of The Cornea

The cornea is an avascular, transparent structure forming the anterior 1/6 th of the outer coat of the eye.

It is oval being 11 mm. in the vertical meridian, and 12 mm. horizontal, from behind it is circular being 11.5 mm. in diameter. The radius of curvature of the anterior surface is 8 mm. and that of the posterior surface is 6 mm. Thickness is 0.6 mm. in the center and 1 mm. at the limbus (**Wolff, 1976**).

The cornea consists of five layers from without inwards: The epithelium, Bowman's membrane, stroma, Descemet's membrane and the endothelium (**Klyce and Beuerman, 1988**).

1. The Epithelium:

It is nonkeratinized stratified squamous epithelium, consisting of four to six layers of cells, it is 50 - 100 u thick (**Ehlers, 1970**).

It is divided mophologically into three layers:

- Superficial squamous cell layer.
- Middle or wing cell layer.
- Deep basal cell layer.

a) Superficial cells:

The cells are polygonal in shape, with a distinct surface membrane, having microscopic projections (microvilli and microplicae)(**Klyce and Beuerman, 1988**).

Ultrastructurally: they have a lucent cytoplasm containing free ribosomes, and fragments of endoplasmic reticulum. The golgi complex, which is necessary for the export of synthesised protein, is poorly developed. The mitochondriae are small, some tonofilaments are associated with the desmosome. Microfilaments (actin layer) are parallel beneath the cell membrane (**Teng, 1961**).

b) Wing cells:

Reveal foreshortening that occurs during transition from basal cells to superficial cells. The nuclei are rounded or elongated, parallel to the surface. The cells interdigitate, and joined by desmosomal junctions. Matts of tonofibrills fill the cytoplasm, few microtubules and mitochondriae are present. (tonofilaments are intermediate filaments between the diameter of microfilaments and that of microtubules)(**Klyce and Beuerman, 1988**).

c) Basal cells:

The columnar basal cells, represent the germinative layer of the epithelium, and posseses more cytoplasmic organelles than the more anterior layers. The mitochondriae, are small and in moderate number around the nuclei. The Golgi complex is less prominant, and found anterior to the nucleus. Scattered ribosomes and rough endoplasmic reticulum together with mass of tonofilaments and some microtubules are present. The lateral

borbers of the basal cells interdigitate together by zonulae adherens. The posterior surface of the cells is flat, and rests on the basal lamina to which they are attached by hemidesmosomes **(Klyce and Beuerman, 1988)**.

2. Basal lamina and Bowman's membrane:

The basal lamina, forms a boundary that separates the epithelium from the stroma. By Electron microscopy it is formed of anterior clear zone (the lamina lucida) and a more obvious dense zone (the lamina densa). The basal lamina is an extracellular secretory product of the basal cells. The absence of the basal lamina can result in the ingrowth of epithelial cells into Bowman's layer, or the anterior stroma **(Segawa, 1964)(Gillette, 1982)**.

Bowman's layer is formed of randomly arranged collagen fibrills, that merge into the more organized anterior stroma **(Klyce and Beuerman, 1988)**.

3. Stroma:

The stroma is formed of stacked lamellae of collagen fibrills. It constitutes 90% of the corneal thickness. Numerous keratocytes are scattered throughout between the lamellae **(Klyce and Beuerman, 1988)**.

By electron microscopy, the fibrills appear to have a uniform diameter, they are surrounded by extracellular matrix **(Hogan et al., 1971)**.