REFRACTIVE KERATOPLASTY
[Thickness Volume Technique]

Essay

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By

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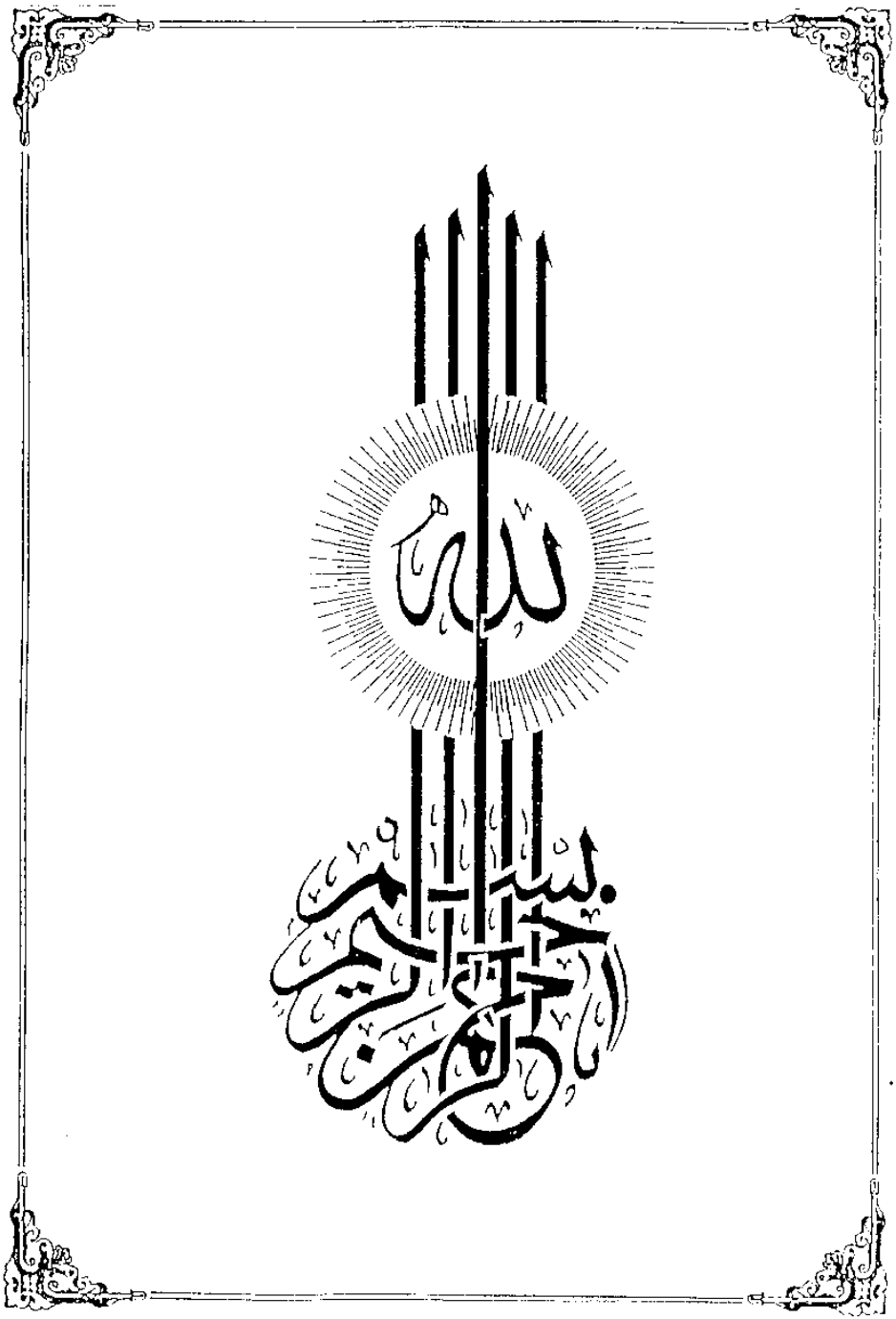

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INTRODUCTION

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Refractive keratoplasty is defined as the employment of techniques for the deliberate surgical modification of the corneal radius or curvature, to effect a permenant benificial change in the refractive state of the eye.

This has intrigued corneal surgeons for many years. Dr. José I. Barraquer is considered the father of the refractive keratoplasty. In 1949, the idea occurred to him after observing the results of penetrating keratoplasty in keratoconus and aphakia. In keratoconus, Barraquer tried to use a smaller graft than trephine opening in the host, to reduce the curvature of the cornea and the results were found to be successful.

Then he tried oversized grafts in aphakic penetrating keratoplasties and was able to increase the curvature of the cornea. This led to his concept on the surgical approach of the problem, of extreme myopia and extreme hypermetropia of aphakia by surgical procedure.

Different experimental techniques have been tried by number of authors, including José I. Barraquer, Louis J. Girard, Richard C.Troutman, Sato, Fyodorof and many others.

The surgical methods used currently to induce optical changes in the cornea, fall under two categories, involving two distinctly different principles:

A) Thickness volume technique.

B) Surface area procedure.

A) **Thickness Volume Techniques :**

Which are extraocular surgical techniques, to modify the curvature of the anterior surface of the cornea, by modifying its thickness in the zone of optic axis. The addition or removal of 0.01 mm induce one diopter power alteration, hence the need for precise exactly caliberated instruments. This technique includes:

(1) **Keratomileusis:**

Developed by Dr. José I.Barraquer in 1958. It is an autoplastic operation in which a previously calculatd lamellar corneal resection is made, and the tissue is

frozen, carved by a lathe into a lens, and then resutured to the patient's cornea. It is used for correction of either myopia or hypermetropia.

(2) **Keratophakia:**

It developed by Barraquer in 1968. It is a homoplastic keratoplasty in which a lamellar keratectomy of approximately 50% of corneal thickness is made, and a pocket is created into which is placled a section of donor cornea, that has been frozen and carved into a plus lens. This operation is used only for correction of hyperopia.

(3) **Epikeratophakia:**

Developed by Herbert E. Kaufman and Theodor P. Werbline in 1981, for the correction of aphakic vision, in which a piece of donor cornea is lathed to the shape of a contact lens, and sutured on to the surface of the recipient cornea after removal of the epithelium. This affect the corneal curvature either to increase or decrease it.

(4) **On Lay Lamellar Keratoplasty:**

Is a modification of epikeratophakia to produce

flattening of the keratoconus cornea, especially the large cones and decrease the amount of astigmatism.

(5) **Hydrogel Keratophakia:**

This is still under experimental work, in which hydrogel lens material is inserted within the central corneal lamellae.

B) **Surface Area Technique:**

In which either we lengthen or shorten the corneal radii and thereby affect the optical modification by flattening or steepening the corresponding corneal meridians. It has been determined that the removal of 0.1mm corneal tissue will effect a power change of approximately one diopter. Under this category are the following operations:

(1) **Corneal Wedge Resection**: of Barraquer and Troutman (1980). For correction of high corneal astigmatism, an arc shaped wedge of corneal tissue is removed and is centered on the axis of flatter meridians. When the edges of the excised area are approximated, the longer corneal radius will be shortened and thus become more steeper. Simultaneously, this will produce flattening

of the other steeper meridian perpendicular to the resection (Troutman, R.C. 1980).

(2) **The relaxing incisions (Barraquer, Sato, Troutman, Fyodorof 1980):**

Is the simplest form of surgical treatment of corneal astigmatism. An arc shaped vertical cut through 80% of the thickness of the cornea in the axis of steeper meridian, will result in flattening of the cornea in this meridian. This relaxing incision will be rapidly filled in with scar tissue from the surrounding stroma and flatten the meridian at which it is performed (Girard, L.J. 1980).

(3) **The radial keratotomy (Sato 1953 and Fyodorof 1979):**

Here eight radial incisions are made through 80% of corneal thickness and extend from a point just peripheral to the visual axis through the limbus. These radial incisions steepen peripheral cornea and flatten central cornea (Girard, L.J. 1980).

In this essay, after an introduction about the anatomy, optics of the cornea and past surgical techniques, we will try to discuss the operations of the first category of thickness volume technique. We will discuss principle, instrumentations, indications, contraindications, surgical technique and complications of each operation.

CORNEAL ANATOMY

and

GRAFT HEALING

CORNEAL ANATOMY AND GRAFT HEALING

The cornea is the clear transparent anterior one six of the fibrous tunic of the eye. It is set into the opaque sclera like a watchglass. The corneoscleral junction is known as the limbus, which is of about 1 mm width and have different histological structure than that of the rest of the cornea.

Viewed from in front, it is elliptical with diameter 11.7 mm horizontally and 10.6 mm vertically. From behind, it is circular with diameter 11.7mm. (Hogan, M.J. 1971).

The anterior surface is not uniformly curved. In the central third, which is the optical zone, an area of 4 mm diameter, it is approximately spherical with radius of curvature is about 7.8 mm. Beyond this optical zone, the peripheral zone becomes flattened. The posterior surface is more strongly curved, of radius 6.8mm. (Donders 1864). This high curvature of the posterior surface make the cornea thinner at the center than near the margin.

The corneal thickness varies, anatomical measurement (on the dead eye) are in general greater than optical one (on the living eye). Anatomically, it is 0.7 mm in the center and 1.1 mm at the periphery (Duck Elder, S. 1961). Optically, the thickness is 0.52 mm increasing to 0.67 mm at the periphery, using Hagg-Striet Pachometer (Azen, S.P. 1979).

The plane through the outer visible border of the cornea is called the base of the cornea, and the distance between this and the center of the cornea is called its height.

All these figures are measured in cornea of adult man, it is slightly differ according to age and sex.

Minute anatomy:

Behined the precorneal film, the cornea is composed of five layers, these are:

1- The epithelium or layer of stratified squamous epithelium. It represents 10-12% of the total thickness of the cornea. It rest on a basement membrane which seperates it from the next layer.

2- Bowman's membrane.

3- Substantia propria or the stroma. It represents nine tenth of the entire thickness of the cornea.

4- Descemet's membrane.

5- Endothelium.

The cornea is supplied by the ophthalmic division of the Trigeminal nerve, via the ciliary nerves.

The cornea is avascular, it take its nourishment from the aqueous by lymphatic permeation through the spaces between the lamellae. No actual lymphatic vessels lined by endothelium are found. (Wolff, E. 1976).

Healing of corneal grafts:

Epithelium:

Repair of the epithelium results by two factors, epithelial slide, which is a horizontal migration of epithelial cells surrounding the wound to cover the defect, and multiplication of the divided epithelial cells by mitosis.

In case of keratoplasty, epithelium from both the donor and recipient contributes to healing of the