Anatomy Of The Cornea

The cornea is the first and most powerful lens of the optical system of the eye (due to the difference between the refractive indices of air and cornea). The radius of curvature of anterior surface of the average cornea in the central region is 7.5 mm (cotlier,1981), and that of the posterior surface is 6.5 mm. Its vertical diameter is 11 mm and its horizontal diameter is 12 mm (wolff,1968). The refractive power of the cornea is 43.0D or about 70% of the total refractive power of the eye (Cotlier,1981). The thickness of cornea is 0.52 mm centrally and 0.67 mm peripherally (Wolff,1968).

The cornea consists of 5 layers.

** Corneal epithelial cells are ordinarily 5 or 6 in depth. several layers of flattened cells form the surface, beneath these are 3 layers of winged cells and finally, a fifth layer of rather tall cells that form the so called the basal layer of the epithelium. These layers are tightly integrated and resist

sliding from side to side because of their complex relationship (Girard,1981). Between the columnar epithelial cells and Bowman's membrane is a basement membrane from 60 to 65 nm thick (Cotlier, 1975). The basement membrane joins the epithelium to the Bowman's membrane (Girard, 1981). This layer is approximately 50 um thick (Wolff,1968).

** **Bowman's membrane** is actually not a membrane but rather a modified portion of corneal stroma. It is composed of a randum arrangement of modified fibrillae between which and surrounding which is a ground substance containing water. The membrane contains a fine network of fibrillae 100-150 A in diameter. Its anterior surface is covered by the basement membrane of the epithelium and its posterior surface merges with the lamellae of the stroma (Girard,1981). Bowman's membrane is a sheet of transparent tissue about 12 um thick (Cotlier,1981).

** **The Corneal stroma** is composed of collagen fibrils that arrange themselves in bundles criss cross in various directions from limbus to limbus while moving

from one layer to another as in the weave of a basked. At the limbus some collagen bundles are arranged circularly (Girard,1981).

The layered structure of the stroma makes the corneal splitting as in superficial keratectomy technically easy.

The cell bodies or keratocytes are flattened so that they do lie parallel to the surface and their cell processes interlace with one another. The stroma comprises about 90% of the whole cornea (Cotlier,1975).

It is about 0.5 mm in thickness (Wolff,1968)

** Descemet's membrane is a structureless membrane bounding the inner surface of the stroma , it is about 10 um thick.

It is considered to be the product of secretion of the endothelial cells (Cotlier, 1981).

Descemet's membrane is a true basement membrane that is capable of regeneration by the endothelial cells (Girard, 1981)

** **Endothelium** is a single layer of hexagonal cells attached to descemet's membrane by hemidesmosomes. The cells are united by numerous interdigitations, desmosomal adhesions and zonula occludens at their interfaces. The number of cells varies with age. The normal adult cornea has about 3000/mm^2 .

They are the most medically active corneal cells, since they have the ability to synthize collagen and to maintain corneal deturgecence through their enzyme activity (Girard,1981)

Corneal Transparency

The normal cornea is transparent. The anatomic picularities of the corneal structures such as a unformity and regularity in the arrangement of the epithelial cells, the closely packed corneal lamellae of uniform size running almost parallel to each other and the absence of blood vessels, all contribute to the efficiency of the eye as an optical instrument. The transparency of the cornea depends on its physical make up (Cotlier,1981).

Epithelial regeneration after injury :

When the epithelium suffers a discontinuity , such as after an abrasion , two factors result in restoration of the epithelium : Epithelial slide which is a horizontal migration of the epithelial cells surrounding the denuded area to cover the defect , and multiplication of the epithelial cells by mitosis.

The entire cornea can be re-epithelialized in 4-7 days.

However if the surface is irregular such as after injury or keratoplasty , or if there is a defect in the precorneal film, re-epithelialization may consist of one or two layers of flattened epithelium , that frequently break down , forming superficial ulcers , and may require weeks to reconstitute a normal epithelium.

Re constitution of the epithelium can be aided by protection by such methods as keeping the lids patched , or using a very thin soft contact lens. Re-epithelialization may be delayed by such factors as lower

temperatures , or by certain toxic substances or alteration of PH of the tears (Girard, 1981).

A Classification Of Refractive Corneal Surgery

The classification of refractive corneal surgery was done by Waring (1985) based on surgical technique :

1- **Lamellar refractive keratoplasty** involves the placement of a lenticule on or within the cornea to alter its refractive power, usually by changing its anterior curvature There are four lamellar refractive keratoplasty techniques :

i) **keratomileusis**, in which a disc of the anterior part of the patient's cornea is removed with a microkeratome ground into a new shape on a cryolathe , and sutured back into place

ii) **Epikeratoplasty** , in which a human donor lenticule - either lyophilized or fresh - is ground into a new shape on a cryolathe and is sutured to a groove in the de - epithelialized surface of the cornea

iii) **Keratophakia**, in which a human donor or synthetic plastic lenticule is placed within the corneal stroma.

iv) **Lamellar keratoplasty**, in which a lenticule that has no refractive power is used to diminish the myopia and irregular astigmatism of keratoconus or of some peripheral corneal thinning disorders. (also, some other superficial corneal pathology) .

2- **Keratotomy** involves making a partial - thickness incision into the cornea to flatten it and reduce its refractive power in that meridian.

3- **Keratectomy** involves the removal of a cresentic piece of stroma and suturing the wound which steepens the cornea and increases its power in that axis.

4- **Penetrating keratoplasty**, the major reason for doing penetrating keratoplasty is to replace the central portion of a scarred or distorted cornea by a clear, regular button of donor tissue.

Epikeratophakia is a newly developed, investigational form of refractive corneal surgery for the correction of aphakic vision. The procedure involves the removal of the corneal epithelium from the recipient eye and the suturing of a prelathed lamellar donor corneal graft onto the surface of the recipient cornea. (Werblin et al, 1981b).

Indications of epikeratophakia

1. **Aphakia** : epikeratophakia is a newly developed investigational form of refractive corneal surgery for the correction of aphakic patient (Werblin et al,1981).

2. **Keratoconus** : patients with mild to moderate keratoconus and no central scarring are ideal candidates for epikeratophakia (Mc Donald et al, 1986).