Dissertation on

STUDY OF ROSE K LENSES IN KERATOCONUS

Submitted in partial fulfillment of requirements of

M.S. OPHTHALMOLOGY

BRANCH - III

REGIONAL INSTITUTE OF OPHTHALMOLOGY

MADRAS MEDICAL COLLEGE

CHENNAI- 600 003

THE TAMILNADU

DR.M.G.R. MEDICAL UNIVERSITY

CHENNAI

APRIL 2014

CERTIFICATE

This is to certify that this dissertation entitled **"STUDY OF ROSE K LENSES IN KERATOCONUS "** is a bonafide record of the research work done by **Dr. KOMAL MEHTA ,** post graduate in Regional Institute of Ophthalmology and Government Ophthalmic Hospital, Madras Medical College and Government General Hospital, Chennai-03, in partial fulfillment of the regulations laid down by The Tamil Nadu Dr.M.G.R. Medical University for the award of M.S. Ophthalmology Branch III, under my guidance and supervision during the academic years 2011-2014.

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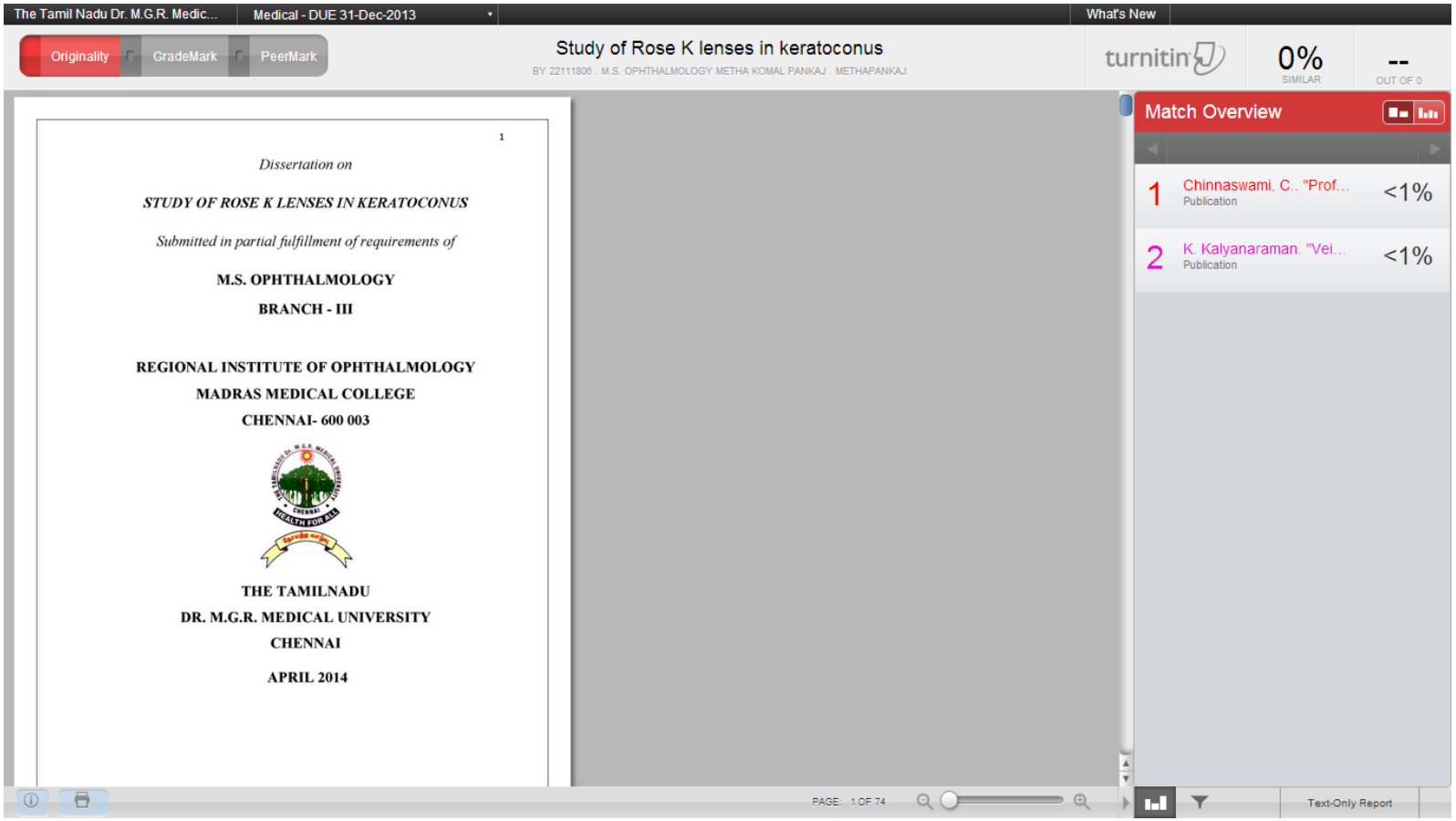
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PART I

INTRODUCTION

The cornea serves as the transparent ‘window’ of the eye that allows the entry of light.

The collagen fibrils that are present in the cornea are interwoven and are responsible for its mechanical strength. It also protects the inner components of the eye from physical injury and maintains ocular contour.

Cornea contributes more than two thirds of the total refractive power of the eye. The regular arrangement of collagen fibres in the corneal stroma accounts for the transparency of this tissue.[1,2]

Corneal shape in addition to its transparency is critical for light refraction, the shape of the cornea is prolate i.e.it is flatter in the periphery and steeper centrally, which creates an aspheric optical system.Changes in the corneal shape results in various types of optical aberrations leading to a compromise in the best corrected visual acuity.

HISTORY

Historically **Keratoconu**s was referred to by several different terms, *like conical cornea conica, sugar loaf cornea, prolapses corneae, procidentia corneae, staphyloma transparent de la cornée, staphyloma pellucidum, staphyloma corneae totale conicum pellucidum, staphyloma diaphanum and keratoconus*.[3]

Earliest references to keratoconus have been observed as early as **1748** by **BurchardMauchart** and in **1766 by Taylor**.

In **1854, John Nottingham** gave an exhaustive treatise called as**'Practical Observations on the Conical Cornea' which**was recognized as the first work to fully consolidate and distil the disparate strands into a modern, comprehensive understanding of keratoconus.[3]

Early treatment of keratoconus consisted of cauterizing the conical area with silver nitrate and the instillation of miotics accompanied by a pressure dressing.The first known application of a contact lens for the correction of keratoconus was in **1888 by Eugene Kalt**.[3]

ANATOMY OF CORNEA

Cornea is a transparent, avascularstructure which comprises of 1/6th of the eyeball and the cornea-tear film interface with air contributes towards maximum refractive power of the eye.

Development:

The development of cornea begins at around 5th intrauterine week. Epithelial cells of the cornea are derived from the epidermal ectoderm, whereas keratocytes and endothelial cells are of neural crest (neuroectodermal) origin.

The epithelium on the immature lens differentiates into the corneal epithelium.The neural crest cell-derived mesenchyme then migrates in the space between the primitive corneal epithelium and lens vesicle in three waves during the seventh week.

The first wave results in formation of the corneal endothelium and trabecular endothelium; the second wave gives rise to keratocytes; and the third wave to the iris. During the eighth week, the keratocytes form five to eight layers of collagen lamellae and the corneal endothelium starts to form Descemets membrane. Thus any defects in the migration of

neural crest-derived mesenchymal cells results in various anomalies of the cornea and anterior segment of the eye.[1,2]

Dimensions of Human Cornea:

Anterior surface – Elliptical -Vertical – 10.6mm,Horizontal – 11.7mm

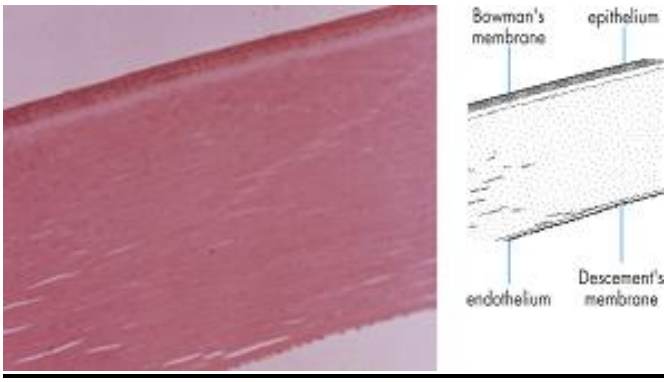
Posterior – Circular – 11.7mm in diameter

Thickness of cornea -0.52 mm centrally and 0.67mm peripherally

In optical zone, the radius of curvature is 7.8mm anteriorly and 6.5mm posteriorly.[4]

Layers of the Cornea:

1. Epithelium
2. Bowman's membrane
3. Stroma
4. Dua's layer
5. Descemets layer
6. Endothelium



EPITHELIAL CELL LAYER:

The corneal epithelium is stratified, squamous and non-keratinized layer.

The most superficial cells of the corneal epithelium form an average of two to three layers of flat, polygonal cells which are joined by tight barrier junction. Beneath the superficial cell layer are the suprabasal or wing cells. This layer is about 2–3 cells deep and consists of cells that are less flat, but possess similar tight junctions. Beneath the wing cells are the basal cells, which comprise the deepest cellular layer of the corneal epithelium. The basal cell layer is composed of a single-cell layer of columnar epithelium approximately 20 μm tall. Besides the stem cells and transient amplifying-cells, basal cells are the only corneal epithelial cells capable of mitosis. They are the source of both wing and superficial cells, and possess lateral intercellular junctions characterized by gap junctions and zonulae adherens. The basal cells are attached to the underlying basement membrane by an extensive basal hemidesmosomal

system. The basement membrane is composed of an extracellular matrix material secreted by the basal cells. The basement membrane, approximately 0.05 μm in thickness, adheres to the underlying Bowman's membrane.

Epithelial stem cells - undifferentiated pluripotent cells that serve as an important source of new corneal epithelium - have been localized to the limbal basal epithelium. As the cells migrate to the central cornea, they differentiate into transient amplifying cells and basal cells.

BOWMAN'S MEMBRANE:

It is an acellular zone which is 8-14 microns thick and is composed of a network of fine randomly oriented collagen fibrils.it does not regenerate following injury. It lies between the basement membrane and the stroma.

STROMA:

It consists of 80-90% of the thickness of the cornea and is around 500 microns thick.The stroma differs from other collagenous structures in its transparency and biomechanical properties. The functional properties of stroma result from the precise organization of stromal fibers and extracellular matrix. The fibers are aligned in a parallel fashion within each lamella, and arranged at angles relative to fibers in adjacent

lamellae. This network contributes to the mechanical strength of the cornea. Also the maintenance of the regular arrangement of the stromal fibers is important for its optical clarity .The peripheral stroma is thicker than the central stroma. The collagen fibrils as they approach the limbus, changedirection to run circumferentially.[6,7,8]

DUA'S LAYER :

It is a recently discovered layer in the cornea which is thought to be made up of condensed and densely packed stromal fibers. This layer is important during Lamellar Keratoplasty. [5]

DESCEMETS MEMBRANE:

It is the basal lamina of the corneal endothelium. It has regenerative potential and is the toughest layer of the cornea. It is composed of type IV collagen and glycoprotein including fibronectin.

It is the breaks in this Descemets membrane the results in acute hydrops in a case of keratoconus.

ENDOTHELIUM:

It is the inner most layer of the cornea and it lies in contact with the aqueous. It consists of a monolayer of hexagonal cells which have very limited potential for regeneration. It is very important for maintaining corneal deturgescence of the cornea. The average adult cell density is around 2500-3000 cells/sq. mm. A density of less than 500 cells /sq. mm results in corneal edema.

NERVE SUPPLY OF THE CORNEA:

The ophthalmic division of the TRIGEMINAL nerve supplies the cornea through the anterior ciliary nerves. The anterior ciliary nerves which enter the sclera from the perichoroidal space connect with the conjunctival nerves to from the pericorneal plexus. The nerves as they pass into the cornea lose their myelin sheath and divide into anterior and posterior group.

The posterior part passes to the posterior aspect of the cornea. The anterior part form a plexus subjacent to Bowman’s membrane, then connect to form the sub epithelial plexus and finally end as intraepithelial plexus.

ECTATIC DISORDERS OF THE CORNEA

The no inflammatory ectatic diseases of the cornea include:

1. Keratoconus
2. Pellucid marginal degeneration
3. Keratoglobus
4. Posterior keratoconus

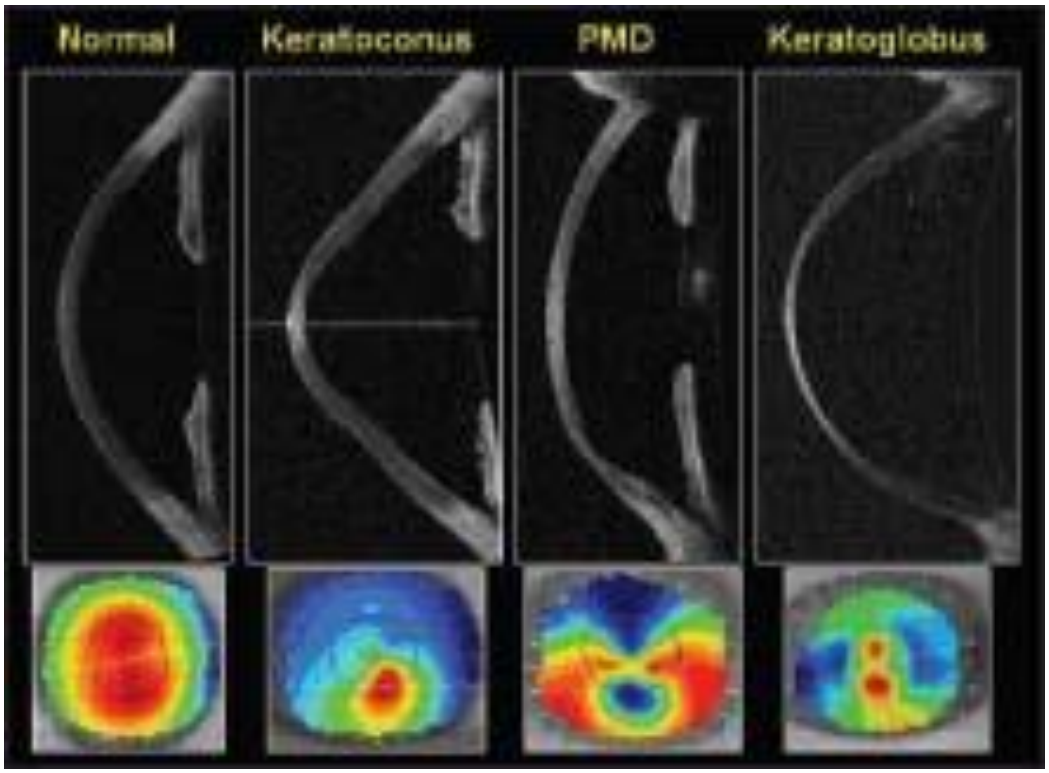
Corneal thinning is considered a hallmark of these ectatic diseases. The area of maximal thinning, relative to the location of maximal corneal protrusion, helps in differentiating these conditions. [9]

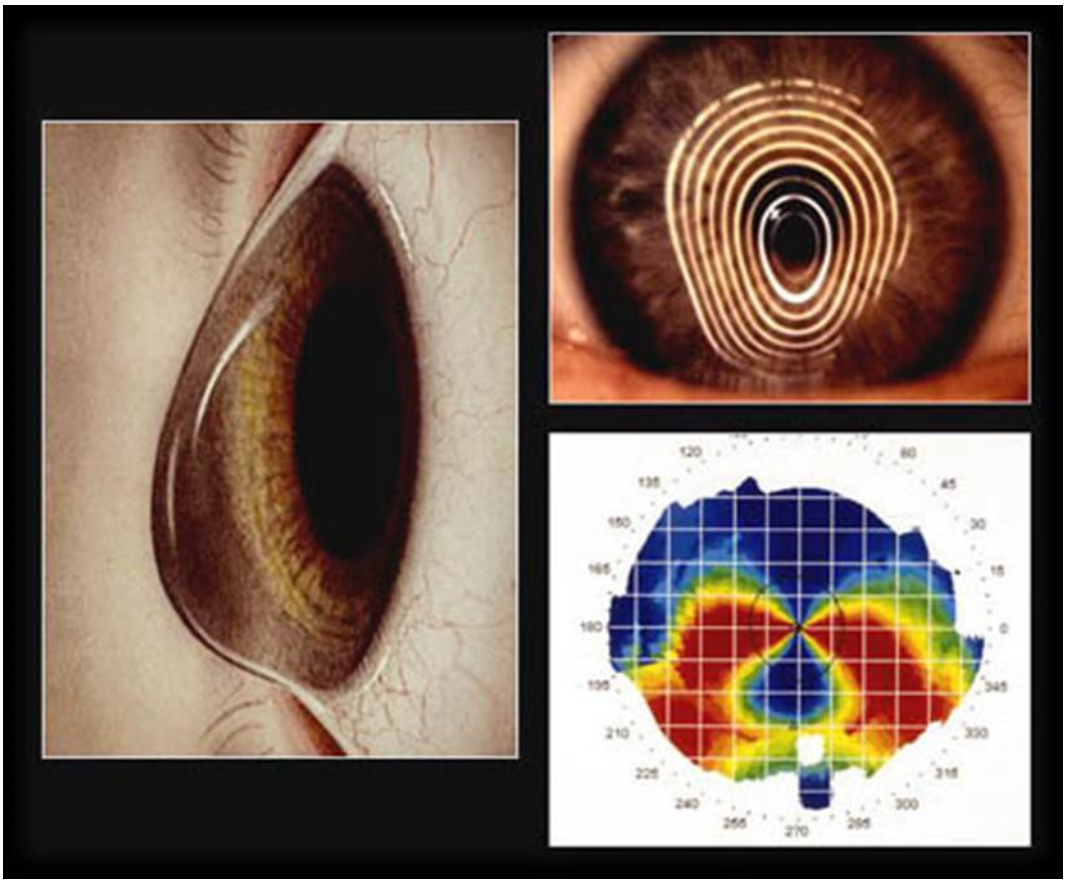
The following table helps differentiate the three conditions.[10]

	Keratoconus	**Pellucid marginal degeneration**	**Keratoglobus**
Frequency	Most common	Less common	Rare
Laterality	Usually bilateral	Bilateral	Bilateral
Age at onset	Puberty	Age 20 to 40 years	Usually at birth
Thinning	Inferior Para central	Inferior band 1 to 2 mm wide	Greatest in periphery
Protrusion	Thinnest at apex	Superior to band of thinning	Generalized
Iron line	Fleischer ring	Sometimes	None
Scarring	Common	Only after hydrops	Mild
Striae	Common	Sometimes	Sometimes

Posterior Keratoconus: It's a mild form of the disease characterized by localized increase in the posterior curvature resulting in thinning of the cornea. The anterior surface is minimally involved.

Terriens Marginal degeneration: Though it is not a type of non-inflammatory ectatic disorder of the cornea, it is included in the differential diagnosis of keratoconus. It affects both superior as well as inferior cornea and is associated with vascularization as well as lipid deposition.





PELLUCID MARGINAL DEGENERATION

KERATOCONUS

Keratoconus is defined as a progressive, non- inflammatory, ectatic disorder of the cornea characterized by progressive thinning and induced myopia and irregular astigmatism.

Since keratoconus affects the younger age group it is very important to recognize and provide adequate treatment for this condition at the earliest.

Keratoconus is usually suspected when the following are observed:

1. Young patient with increasing myopic astigmatism.
2. Decreased quality of vision
3. Difficulty in obtaining best corrected visual acuity of 6/6
4. High cylindrical correction
5. Irregular astigmatism.

Prevalence:

The prevalence of keratoconus is approximately 54.5 per 100,000 population. The average annual incidence rate is 2 per 100,000 population.

Genetics: Most families with keratoconus show an autosomal dominant pattern with variable penetrance. There are 10 different chromosomes (21,20q12,20p11,18p,17,16q,15q,13,5q14.3,2p24,3p14) and three different HLA types associated with keratoconus, which includes HLA-A26, B40, and DR9.

PATHOGENESIS:

It has been suggested that enzyme abnormalities in the corneal epithelium, such as

1. increased expression of lysosomal enzymes
2. decreased levels of inhibitors of proteolytic enzymes,

play a role in corneal stromal degradation. This has been substantiated by the presence of the following in the keratoconustissue:

1. Increased mRNA levels of antioxidant enzyme (catalase)
2. Increased levels of degradative enzyme (cathepsin)
3. Decreased levels of tissue inhibitor matrix metalloproteinase as compared to normal corneas.
4. Gelatinolytic activity in the stroma which occurs due to decreased function of enzyme inhibitors.
5. Abnormalities in corneal collagen and its cross-linking may be the cause of keratoconus.

Thus the characteristic stromal thinning seen in keratoconus is associated with increased degenerative enzyme activities and decline in enzyme inhibitors.[9,10,11]

ASSOCIATIONS OF KERATOCONUS:

OCULAR:

1. Leber's congenital amaurosis
2. Retinitis pigmentosa
3. Retinopathy of prematurity.
4. Fuchs’endothelial dystrophy
5. Posterior polymorphous dystrophy

SYSTEMIC:

1. Atopy
2. Down's Syndrome
3. Ehlers-Danlos
4. Marfan'sSyndrome
5. Cruzon's Syndrome
6. Apert's Syndrome
7. Osteogenesis Imperfecta

CLINICAL FEATURES

SYMPTOMS:

Patients usually present with the following complaints:

1. Progressive visual blurring and/or distortion
2. Photophobia
3. Glare
4. Monocular diplopia
5. Ocular irritation

The diagnosis of keratoconus depends on slit lamp findings, topographic and keratometric evidence. A diagnosis of *frank keratoconus* is made when characteristic slit lamp findings are documented. A diagnosis of *Keratoconus Forme fruste*is made in presence of abnormal topography and a normal slit lamp examination.

Gross Examination:

1. **Visual Acuity:**In early disease, visual acuity may be normal even in symptomatic patients. Later in the disease the vision will not improve to 6/6 on Snellens visual acuity. Contrast sensitivity measurement may, however, uncover visual dysfunction before

Snellens visual acuity loss can be measured[10]. High, irregular myopic astigmatism not correcting to 6/6 should raise a suspicion of keratoconus.

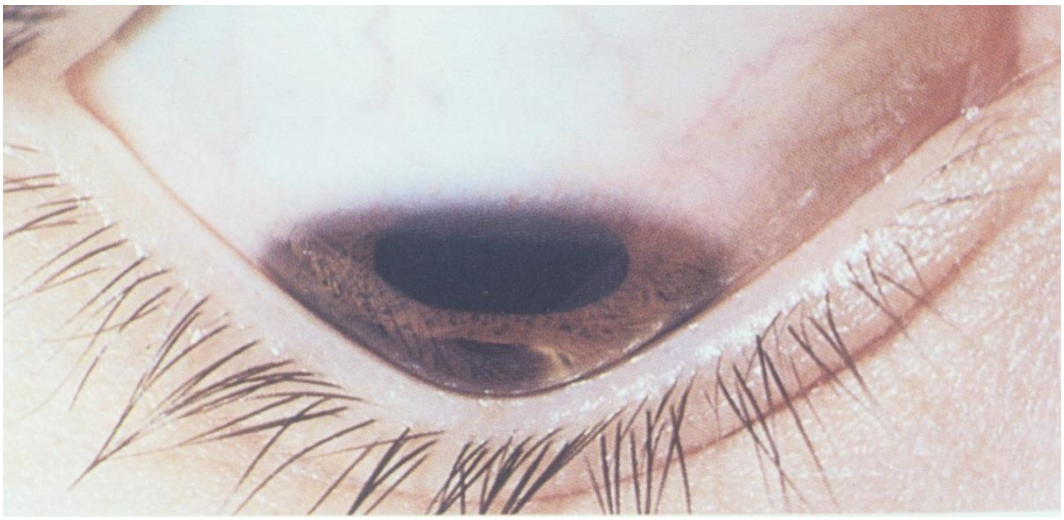
2. **Munson's Sign**: 'V' shaped protrusion of the lower lid on down gaze due to ectatic cornea.

3. **Rizzuti's Sign:**When a light beam is focused temporally across the cornea, it appears in an arrowhead pattern at the nasal limbus.

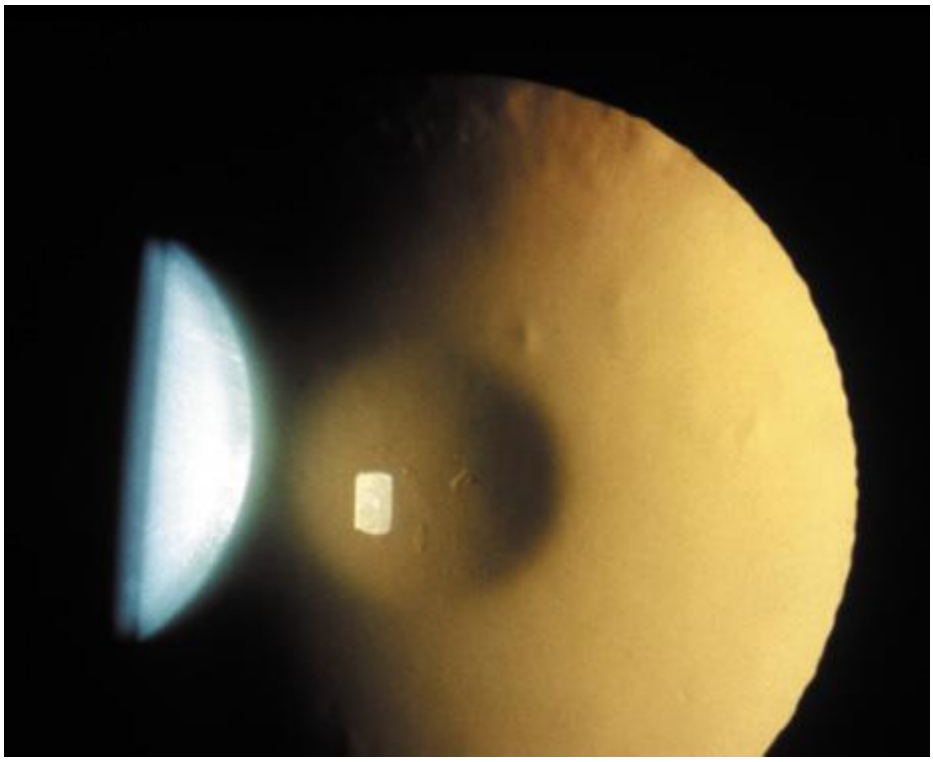
4. **Retinoscopy sign:** A scissoring reflex is seen on retinoscopy. As the optical path through the eye is longer along the cone than the surrounding cornea, the retinoscopic reflex will appear distorted and flash unequally as light streak is passed through the patient's pupil.

5. **Charleaux Oil Droplet Sign:** Dark round shadow in the corneal mid periphery is seen due to total internal reflection of light surrounding the red reflex.

Munson’s sign



Oil droplet reflex

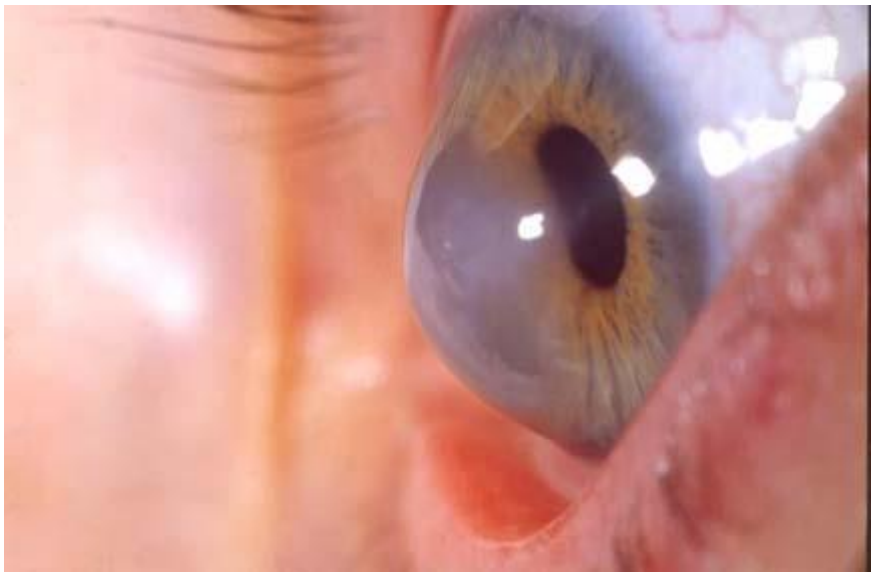


Slit lamp findings:

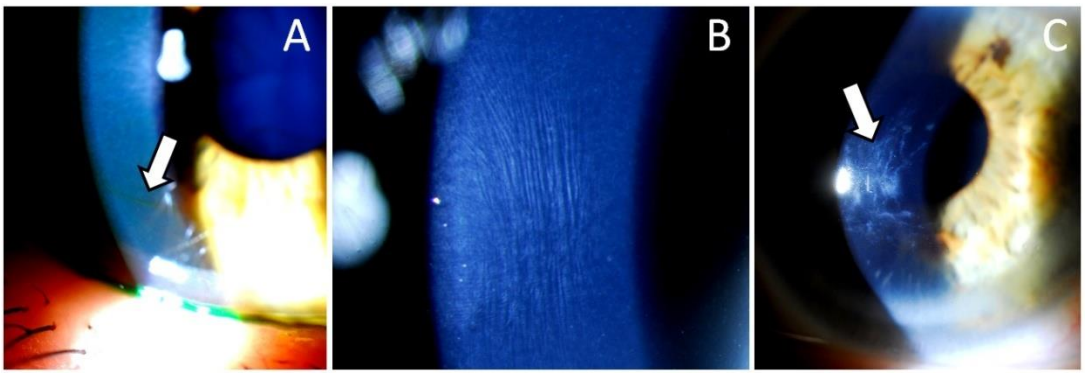
1. An eccentrically located ectatic protrusion of the cornea isnoted.
2. Steepening of the cornea, especially inferiorly
3. Thinning of the corneal apex
4. Clearing zones in the region of Bowman's layer
5. Scarring at the level of Bowman's layer.
6. **Vogt's Striae:** Vertical folds at the level of posterior stroma and Descemets layer, that clears when pressure is applied to the globe.
7. **Fleischer ring:** A ring of iron deposition accumulates in the epithelium at the base of the cone. Seen best with cobalt blue filter.

Corneal Hydrops: Acute rupture of Descemets membrane may occur resulting in acute over hydration of the cornea and accumulation of lakes of fluid within the corneal stroma. The overlying corneal epithelium may become edematous. The ruptured Descemets membrane curls in on itself, and over time endothelial cells spread over the posterior stromal defect to lay down new Descemets membrane and recompensate the cornea. This is associated with sudden deterioration of vision and pain.Over a period of time it results in scarring, flattening with or without neovascularization of the cornea.

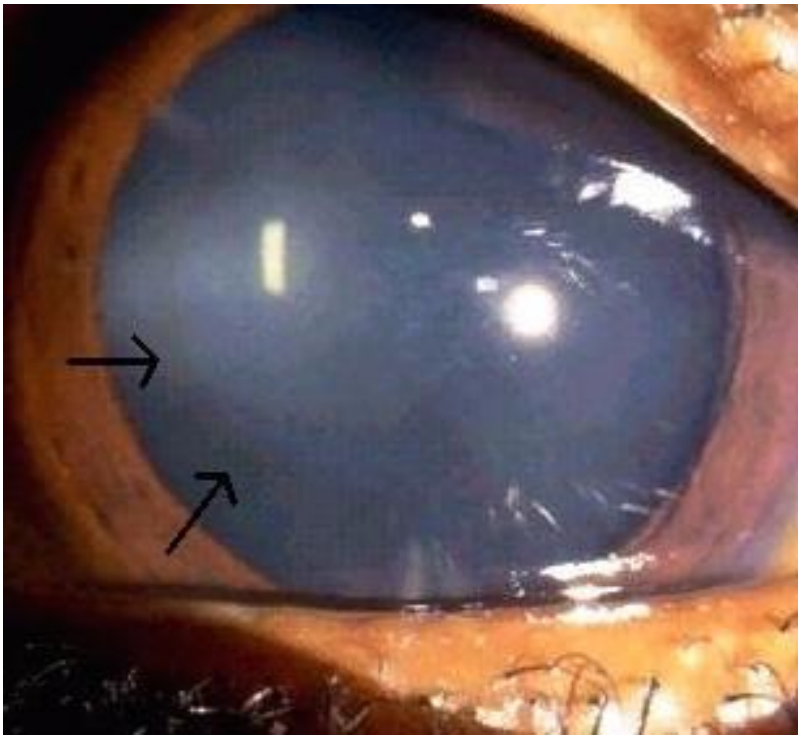
Corneal hydrops



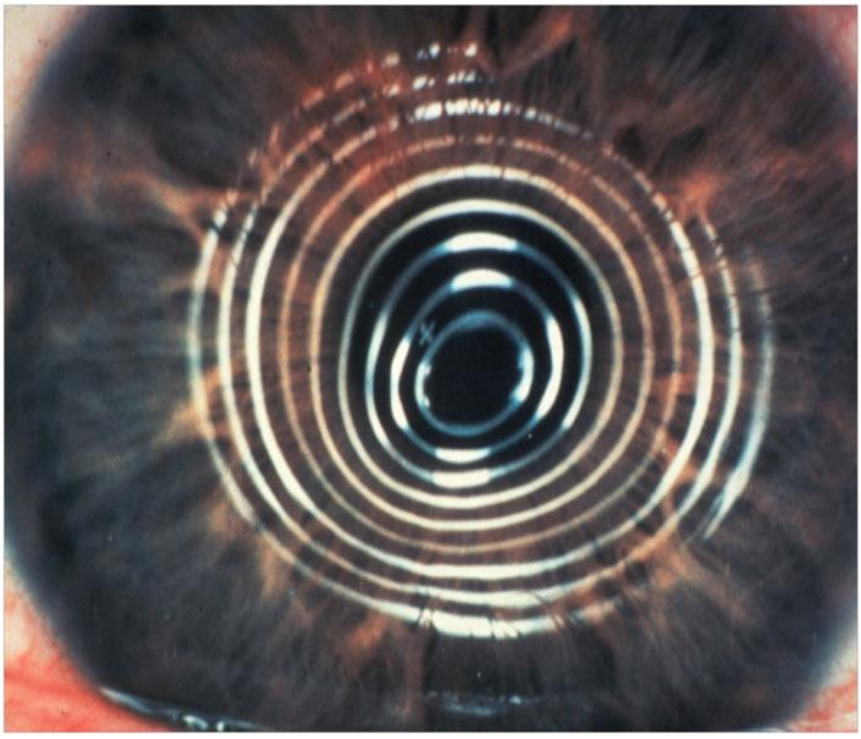
Vogt's Striae



Fleischer's ring



Irregular mires in Keratoconus



KERATOMETRY

Keratometry is the procedure to measure the radius of curvature of the anterior surface of the cornea using the first Purkinje image. It measures only the central 3mm of the cornea.The keratometric index makes several approximations including the assumption of spherical radii of curvature for the anterior and posterior corneal surfaces. Hence any corneal pathology that results in a significant alteration in corneal thickness or changes in the curvature of the anterior and/or posterior cornea will introduce errors.

Hence keratometry has been abandoned in favour of corneal topography for diagnosis and monitoring of keratoconus.

CORNEAL TOPOGRAPHY

Mainly three types are present:

1. Placido based : Video keratoscopy
2. Slit-scanning based : Orbscan
3. Scheimpflug based : Pentacam

Videokeratoscopy

The modern corneal topography was introduced to measure the corneal surface beyond the capabilities of a keratometer. It emerged via a series of instrument developments that began with the keratoscope, followed by the photokeratoscope, and finally the videokeratoscope. The videokeratoscope combines video capture of corneal images with computer processing to provide maps of the corneal surface power distribution. This is now called the corneal topographer. The target configuration that is still used is the circular mire pattern that characterized the Placido disk introduced by Antonio Placido in 1880. The Placido disk consists of a target with 9 concentric rings that alternate black and white mires.

These rings are reflected off the anterior corneal surface via Purkinje image number one and captured by the videokeratoscope. These images are then analyzed by the computer system.

Videokeratoscopy evaluates **8000 to 10,000**specific points across the entire corneal surface. It provides both quantitative and qualitative evaluation of the corneal curvature.

The two most common maps are:

1. **Axial Map:**Also called as power or sagittal map. It shows variation in corneal curvature and uses colours to represent dioptric powers of the cornea. Warm colours like red and orange denote steeper areas and cool colours like blue and green denote flatter areas.

2. **Curvatural Map:**Also known as Tangential map, instantaneous map or true map. It recognizes sharp power changes better than the axial map.

SCALES:

1. **ABSOLUTE SCALE:**The colour coding system is fixed. It used a scale of 1.5D intervals. The advantage of this scale is that different maps can be compared to each other if they are shown in an absolute scale. However the disadvantage is that it can miss subtle keratoconus changes.

2. **NORMALISED SCALE:**A set number of colours are adjusted to fill the range of dioptric power within the given map. The

advantage of this is that it can recognize subtle changes. The disadvantage is that different maps cannot be compared.

KERATOCONUS PREDICTION INDICES

1. Sim K1
2. Sim K2
3. SAI
4. Analyzed Area (AA)
5. Opposite Sector Index (OSI)
6. Centre Surround Index (CSI)
7. Irregular Astigmatism Index (IAI)
8. Differential Sector Index (DSI)

KISA INDEX:

KISA% = K x I-S x AST x SRAX x 100/300

Where K – central corneal steepening

I-S - inferior-superior dioptric

AST INDICES – Sim k1-simk2 (astigmatic indices)

SRAX index – skewed radial axis

KISA INDEX: 60-100% keratoconus suspect

>100% Keratoconus

Rabinowitz Criteria:

Central corneal power value greater than 47.2 D

Inferior–superior dioptric asymmetry (I-S value) over 1.2

Sim-K astigmatism greater than 1.5 D

Skewed radial axes (SRAX) greater than 21 degrees.

Krumeich classification for Keratoconus:

Severity	Sim K	Thickness in microns	Spherical equivalent	Cornea
Grade 4	>55	<200	Not measurable	Scar present
Grade 3	54-55	200-400	>-8D	No scar
Grade 2	48-53	400-500	5-8D	No scar
Grade 1	<48	>500	<-5D	No scar

ORBSCAN

It is a scanning-slit topography device which provides the clinician with an anterior elevation map (anterior float) based on a best-fit sphere, a mathematically derived posterior elevation map (posterior float), a power map, and a topographical pachymetry map. The posterior float is the least reliable of all the four as it is not measured but mathematically derived. Still it is better than Videokeratoscopy as it gives some idea about the posterior surface of the cornea and thus helps in recognition of keratoconus forme fruste.

Red flag signs for keratoconus or keratoconus suspect in ORBSCAN:

1. Posterior float - Diopteric value > 55D
   - Elevation > 50 microns
2. Pachymetry <500microns at the thinnest point
3. Best fit sphere steeper than 55 D
4. Inferior pachymetry <20microns thicker than central pachymetry
5. Corneal power <40D or >48D

PENTACAM

It is a Scheimpflug based system which generates a complex image of the anterior segment. Pentacam obtains 50 Scheimpflug images in 2 seconds.500 points are taken in 1 image. Thus a total of 25000 points are taken and the final image is obtained It gives the anterior and posterior surface of the cornea. It gives the sagittal curvature, front elevation, back elevation and corneal thickness map. It also measures the anterior chamber angle, depth,volume,anterior and posterior surface of the lens and lens densitometry.

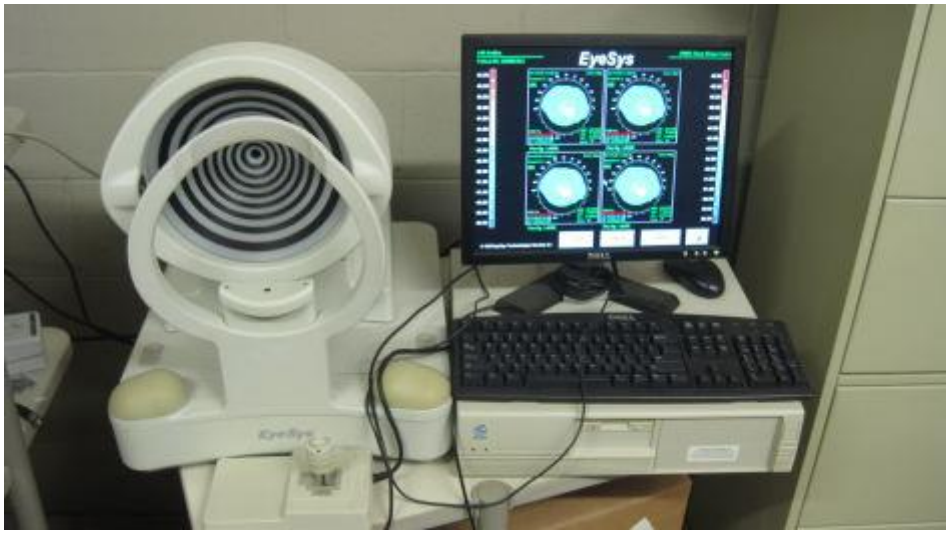
A cornea with the following is suspicious for an ectatic corneal contour:

1. Isolated island of anterior elevation greater than 11 microns
2. Posterior elevation greater than 20 microns

ADVANTAGES

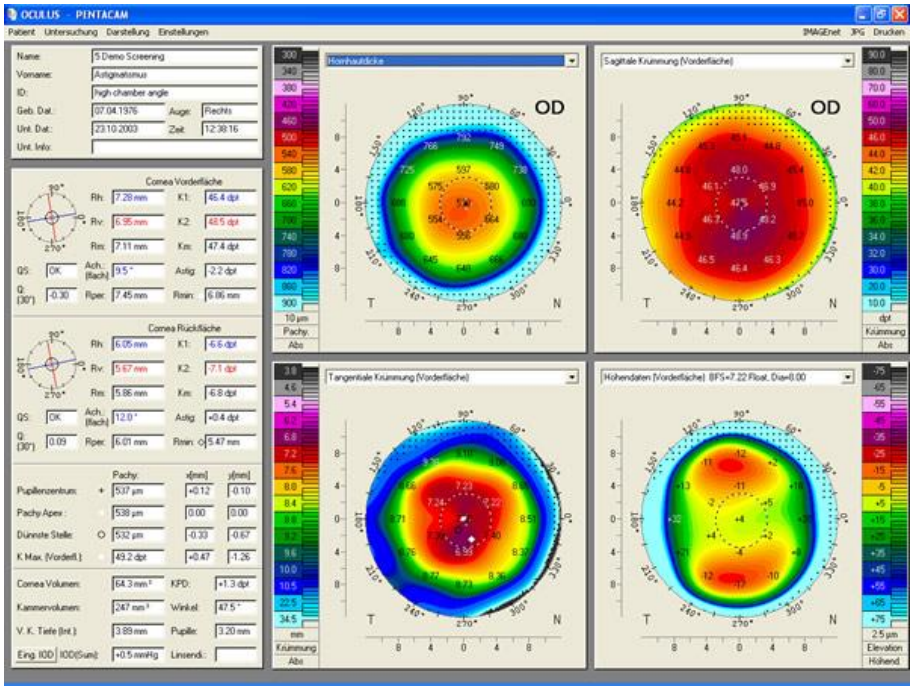
1. Higher resolution of the cornea.
2. Wavefront analysis can be done.

ORBSCAN

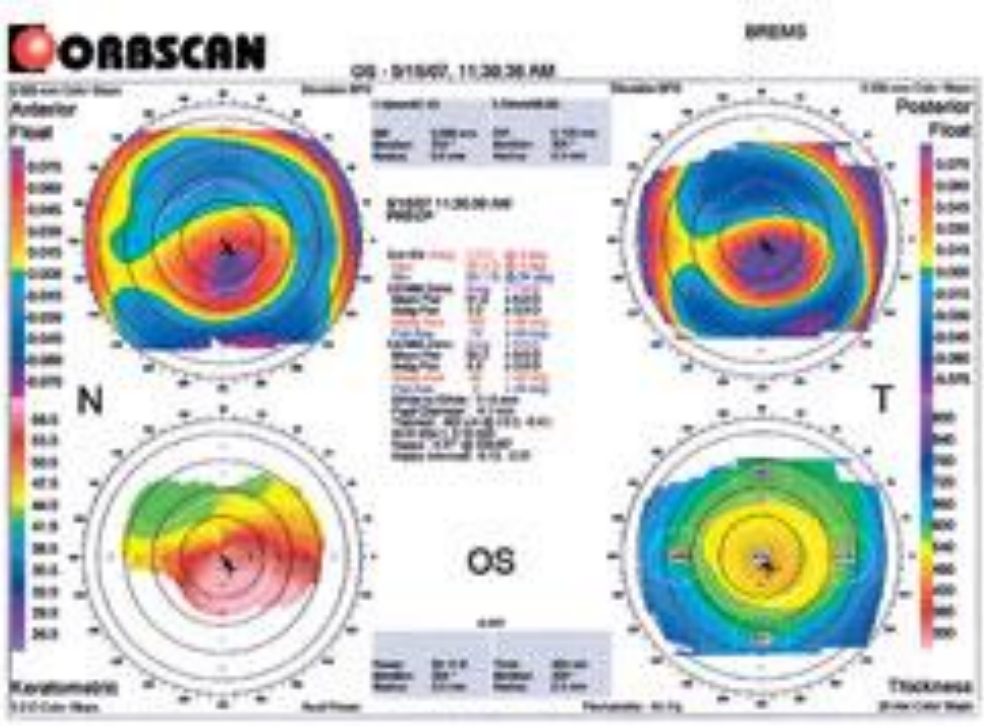


VIDEOKERATOSCOPY

PENTACAM REPORT



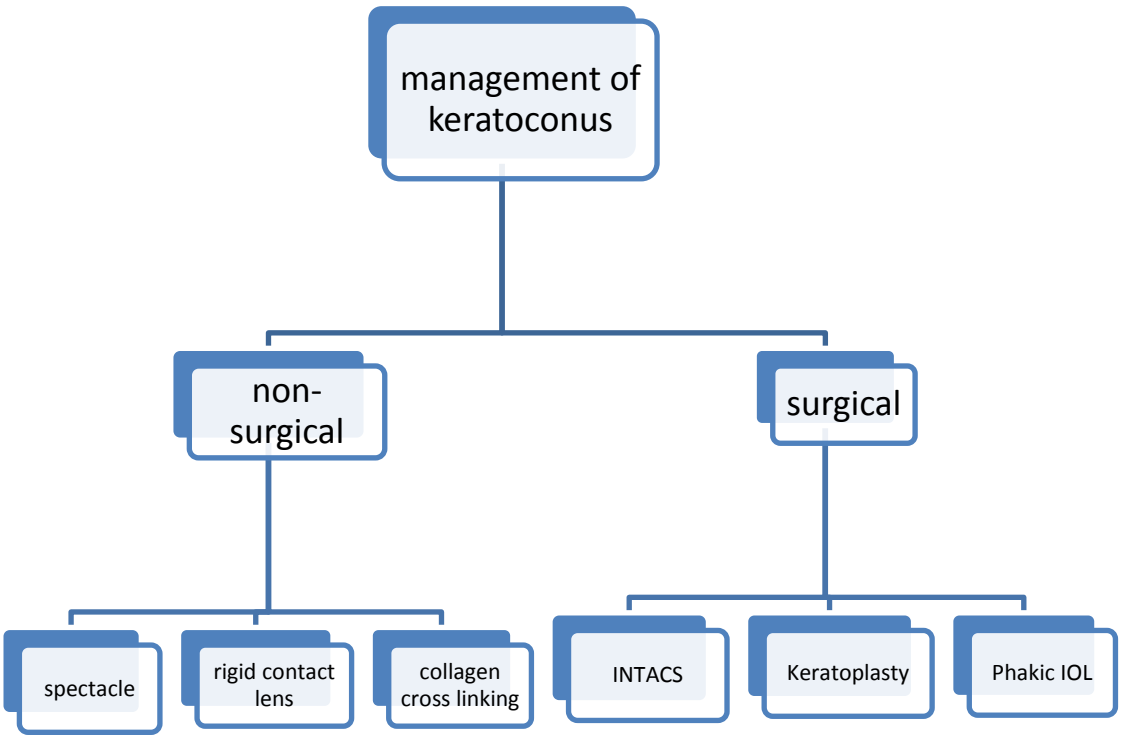
ORBSCAN REPORT



MANAGEMENT OF KERATOCONUS

As Keratoconus is a disease of the younger population a proper and adequate management is of utmost importance.

A variety of surgical as well as non-surgical options for management of keratoconus are available depending on the severity of the disease, patient affordability and patient preference.



1. **Spectacle correction**: The first management option most of the times is contact lens correction. Only once glasses fail to provide adequate visual function, other methods are tried.

2. **Contact lens:** It improves visual function by creating a new anterior refractive surface. Contact lenses do not prevent progression of corneal ectasia. Contact lenses must be tailored to the individual's visual needs and comfort tolerance. Many keratoconus patients can be successfully fitted with contact lenses, achieving good visual function with a stable, well-tolerated lens.

The following types of contact lenses are available[: [13,14,15]]

a. **Rigid gas-permeable (RGP)** :

Relatively flat-fitting hard contact lenseswith the so-called three-point touch technique are the mainstay of contact lens treatment for keratoconus. An apical clearance fitting technique is also commonly used.

Other options include soft toric lenses, standard bicurved hard lenses, custom-back toric lenses, piggyback systems, hybrid lenses made of combined hard lens with a soft skirt, scleral lenses, and mini-scleral lenses.

b. **Hybrid lenses:**

These lenses have rigid centre which optimizes vision while a soft rim which improves comfort.

SoftPerm lens: It has an optic zone diameter of 7.0 mm.

The newer SynergEyes KC has a rigid optic of 7.8 mm made of highly oxygen permeable material bonded to a soft outer skirt composed of PolyHEMA. SynergEyes offers a significantly higher Dk which may improve patient comfort.

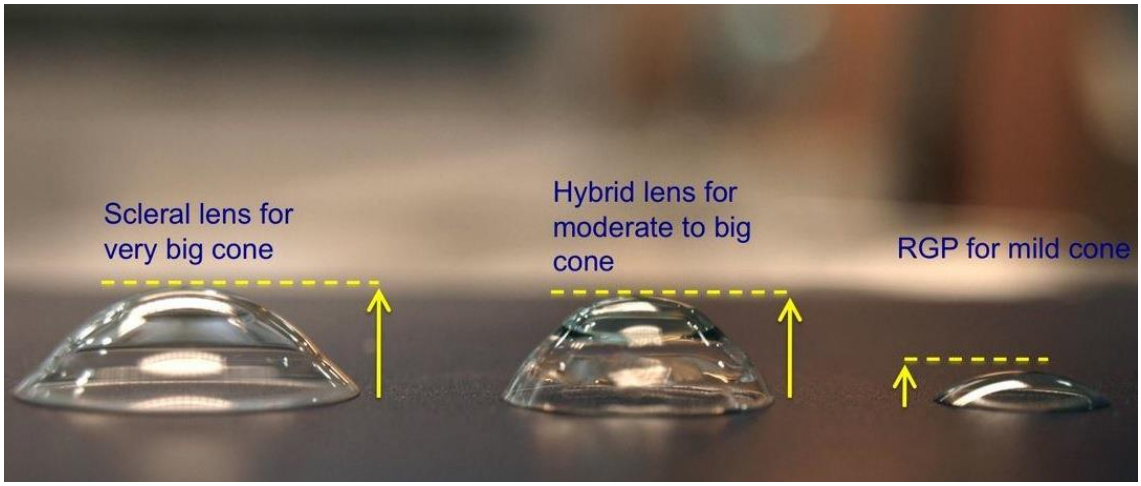
c. **Mini-scleral lenses**:

They have a diameter of 14–17 mm compared to scleral lenses with a diameter of 20–24 mm. Mini-scleral lenses are designed to offer the benefits of scleral lenses such as vaulting the cornea to limit cornea touch, providing a tear fluid reservoir, correcting astigmatism, and improving vision, in addition to offering practitioners and patients greater ease in fitting and handling.

d. **Piggy Back lenses :**

A soft contact lens is placed over the eye over which a rigid lens is placed.

HYBRID LENS

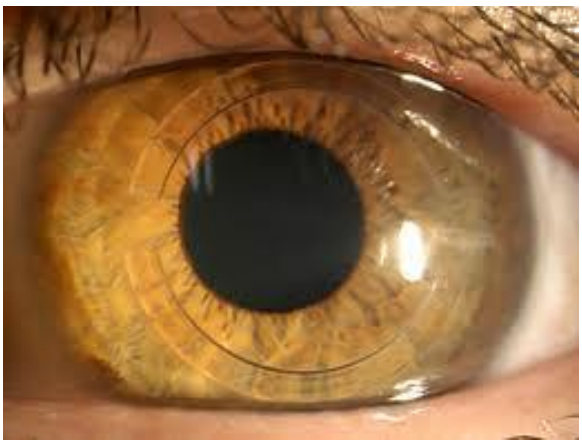


SCLERAL LENS

e. **Rose K lenses :**

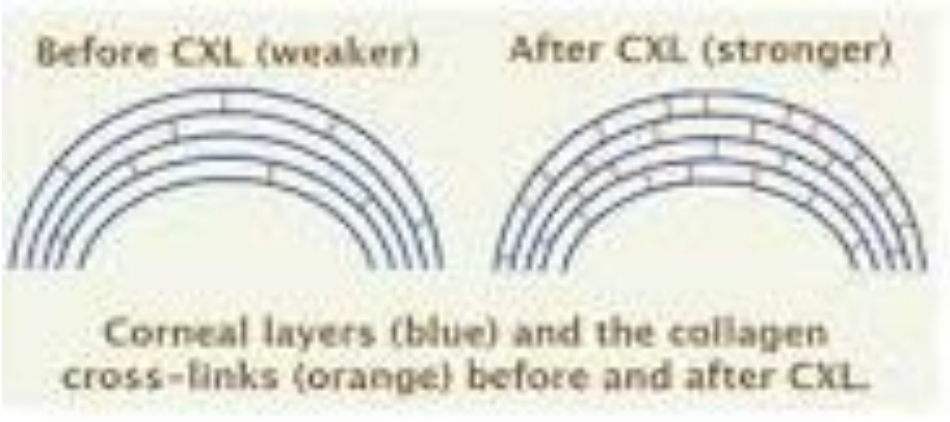
They are specially designed lenses for keratoconus the details of which are discussed later.

INTACS



3. **Intrastromal ring segment insertion (INTACS)**: Ferrara rings and Intacs are commonly used ring segments and are made of rigid polymethyl methacrylate.They are C shaped implants inserted into the corneal stroma at 2/3rd depth.The ideal candidates should have low spherical equivalents and average keratometry readings of less than 53 D. It improves visual acuity by flattening the central cornea, reducing astigmatism and centering the cone. It is important to set proper patient expectations prior to surgery and inform the patient those spectacles and/or contact lenses will still be needed after surgery. [16]

4. **Corneal collagen crosslinking with Riboflavin (C3R):** Using Riboflavin as a photosensitizer, cornea is subjected to UV-A radiation. This results in increase in the cross-linking among corneal collagen fibrils, thereby strengthening the cornea.



Corneal layers (blue) and the collagen cross-links (orange) before and after CXL

5. **Lamellar Keratoplasty:**Keratoconus is the most common indication for Lamellar Keratoplasty. It is also known as Deep Anterior Lamellar Keratoplasty (DALK).This procedure involves dissection of stroma up to the level of Descemets membrane and transplantation of donor tissue that has had its Descemets membrane removed.Since the recipient endothelium is intact the chances for rejection are less also the donor selection criteria is not very stringent.

6. **Penetrating Keratoplasty:** Done in cases where there are descement membrane tears, post hydrops scarring, deep scarring .Here a full thickness corneal graft is placed. The chances of rejection are more in such cases.

KERATOPLASTY

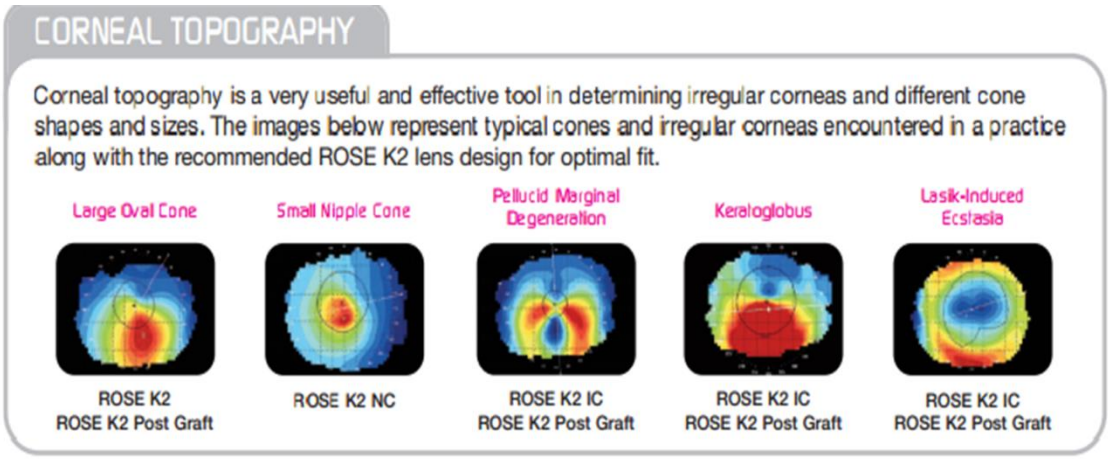
ROSE K LENSES

Rose K is a proprietary lens developed by Paul Rose from New Zealand. It obtained FDA approval in 1995.

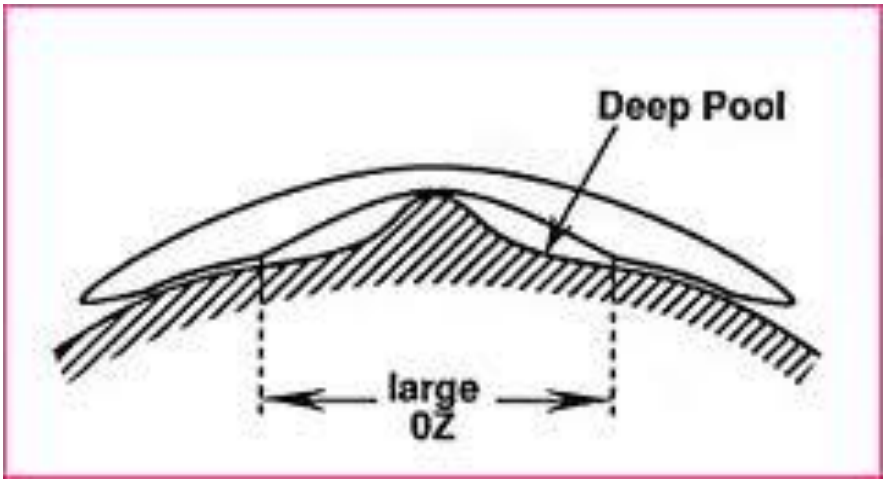
Types of Rose K lenses:

1. Rose K2 lens - for central cone
2. Rose K IC (irregular cornea) -for large cones, pellucid marginal Degeneration.
3. Rose K NC (nipple cone) - for nipple cone
4. Rose K Post Graft - post keratoplasty , Pellucid Marginal degeneration.
5. Rose K XL mini scleral lens – Advanced Keratoconus, pellucid marginal degeneration, severe dry eye, chemical**injury.**

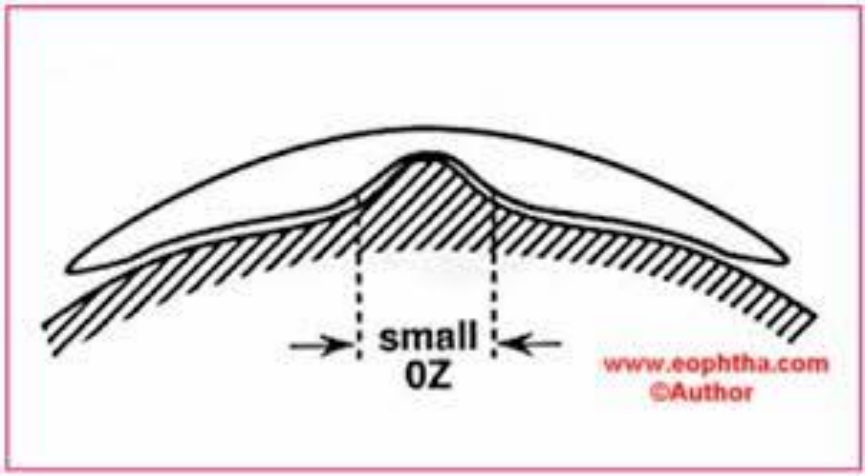
	Rose K2	Rose K NC	Rose K IC	Rose K Post Graft	Rose K XL
Primary application	Oval Keratoconus, Nipple Keratoconus	Moderate and steep Nipple Cones	Pellucid Marginal Degeneration, Keratoglobus, LASIK induced Ectasia and Post Graft.	For patients who have undergone penetrating Keratoplasty.	Keratoconus, Pellucid Marginal Degeneration (PMD), Post Graft, Corneal Rings, Post-LASIK ectasia, advanced dry eye
Secondary application	Early Pellucid Marginal	All Nipple Cones.	Oval Keratoconus	Oval Keratoconus, Nipple keratoconus and Lasik	Polluted work conditions, stability for sport or working environment, Piggyback
Parameters	BASE CURVE 4.30 mm to 8.60 mm DIAMETER 7.9 mm to 10.4 mm POWER Any EDGE LIFT Standard, standard flat, Standard steep. More lifts are available - see section on Edge Lift	BASE CURVE 4.3 mm to 7.70 mm DIAMETER 7.6 mm to 9.0 mm POWER Any EDGE LIFT Standard, standard flat, Standard steep. More lifts available - see section on Edge Lift	BASE CURVE 5.70 mm to 9.30 mm DIAMETER 9.4 mm to 12.0 mm POWER Any EDGE LIFT Standard, standard flat, standard steep, double flat, Double steep.	BASE CURVE 5.70 mm to 9.30 mm DIAMETER 9.4 mm to 12.0 mm POWER Any EDGE LIFT Standard, standard flat, standard steep, double flat, Double steep.	BC range: 5.80 to 8.40 mm. Diameter range: 13.60 to 15.60 mm Standard diameter 14.60 mm.



REGULAR CONTACT LENS



ROSE K LENS



Principle of Rose K:

Standard lens designs with fixed optical zones (OZ) do not ideally fit the cone shape of keratoconus patients. Figure 1 shows a standard lens that will yield unwanted pooling at the base of the cone and peripheral bearing that can seal off and cause corneal problems.

Benefits of a smaller optical zone to fit the cone contour. The design results in little tear pooling at the base of the cone and show an even distribution of tears under the lens.

Advanced Fitting options:

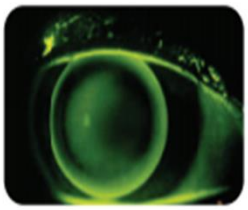
1. Toric peripheral curves.
2. Asymmetric Corneal Technology or ACT.
3. Front, back and bi-toric design.

Fitting Procedure:

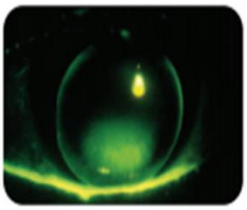
1. Using topography average K reading is calculated from K1 and K2.
2. From this average radius of curvature is derived
3. For radius of curvature 7.1mm and flatter, select first trial lens 0.2mm steeper than the meanK reading.
4. For K readings from 6.0 to 7.0mm, select the first trial lensequal to the mean K reading.

5. For K readings 5.9mm and steeper, select the first trial lens 0.4mm flatter than the mean Kreading.
6. Now the fit of the lens is assessed. Dynamic fit where the stability of lens in various positions is tested and static fit where fluorescein staining is done.
7. If it is steep than the next flatter lens is tried and if it's flat then the next steeper lens is tried.
8. After trial the best fitting lens is selected.
9. If required the peripheral edge lift can be added to the lens.
10. An over refraction is performed over this lens.
11. While ordering the lens the selected base curve,the refractive power required and if any advanced modifications required are mentioned.
12. The patient is called for follow up next week, then one month later and then 6 months later.

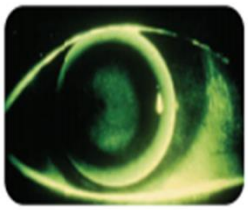
ROSE K2



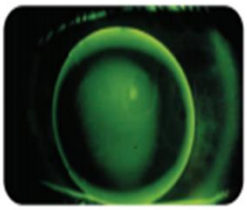
Optimum fit immediately after blink.



Optimum fit a few seconds after blink. Don't judge fit in this downward location.



Good fi: centrally - loose peripherally.



Steep centrally - good fit peripherally.

The ideal fit should show an apical contact area of 2-3mm and a midperipheral contact annulus.

Advantages of using Rose K:

1. It provides better visual acuity as compared to spectacles.
2. Helps to delay surgical intervention.
3. Better comfort levels as compared to a conventional rigid gas permeable lens.
4. Cosmetically better
5. Especially helpful in patients with unilateral advanced disease, preventing optical aberrations induced by high powered spectacles.

Complications of Rose K lens:

The complications of Rose K are similar to those of a conventional Rigid Gas Permeable lens:

1. Patient discomfort and intolerance
2. Foreign body sensation and irritation
3. Infection
4. Protein deposits over the lens
5. Corneal edema
6. Corneal warpage
7. Vascularization of the cornea
8. Dryness
9. Too steep fit resulting in corneal edema and intolerance

Too flat fit resulting in lens slippage and poor stability.

PART II

10.

AIMS AND OBJECTIVES

AIMS AND OBJECTIVES

Primary Objectives:

To check for improved visual acuity with Rose K lenses as compared to spectacle correction.

Secondary Objective:

To look for better fit in patients with keratoconus as compared to conventional Contact lenses and Rigid gas permeable lenses as well as better patient comfort and tolerability.

Study design - Prospective study

Duration–1 year

Centre– Cornea services, RIO GOH, Chennai.

Sample size- 15 cases.

INCLUSION CRITERIA-

1. Topographic evidence of keratoconus
2. Clinical evidence of keratoconus
3. Post C3R patients.
4. Patients with spectacle BCVA of 6/12 or less

EXCLUSION CRITERIA-

1. Patients with very steep Cornea
2. Scarred corneas

MATERIALS AND METHODS

MATERIALS AND METHODS

1. After appropriate case selection, unaided visual acuity and best corrected visual acuity of the patients was tested on Snellens chart.
2. Topography for each of the patients was done using a videokerotography.
3. Average Sim k value was calculated and as per the Rose K fitting guide, lens with appropriate base curve was selected. Lenses that were selected were from the normal rose K2 lens trial set.
4. After giving an adaptation period of 30min, the dynamic and static fit was assessed.
5. In **dynamic fit** assessment, the lens fit was considered to be acceptable when the lens was centered adequately on the cornea with good post blink movement, with good stability on different gaze movements.
6. In **static fit**, the goal was to achieve a “light feather touch” in the centre with midperipheral bearing and peripheral clearance, which was assessed by fluorescein staining.

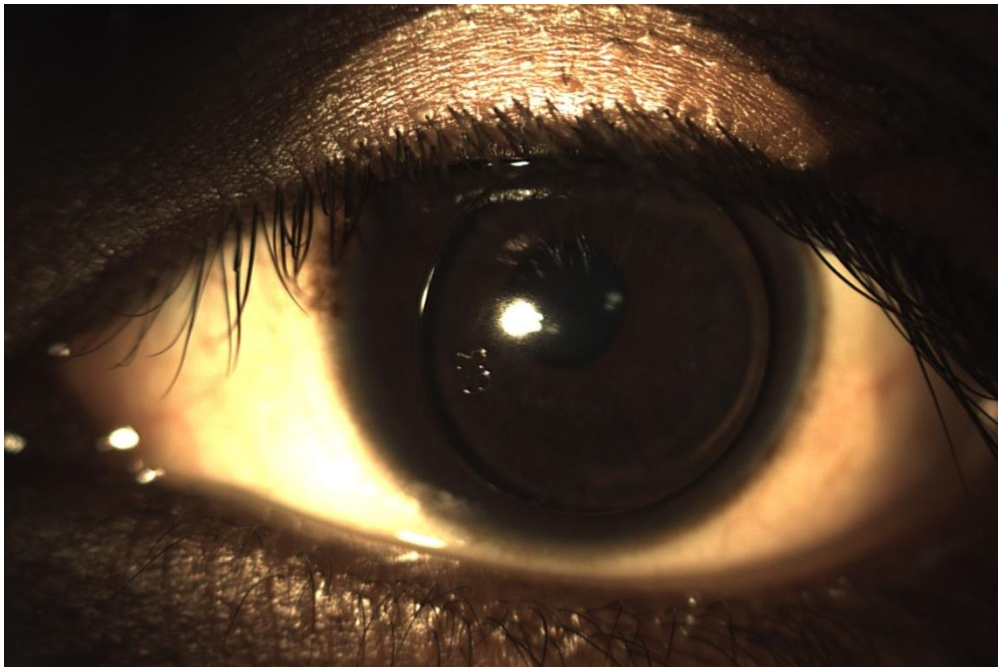
7. After finding the optimal lens fit, the final Visual acuity of the patient was checked. After one successful trial the patients were called for a retrial before dispensing the lens.

8. The patients were followed up after a period of 1 week, 2 weeks, 1 month and 6 months.

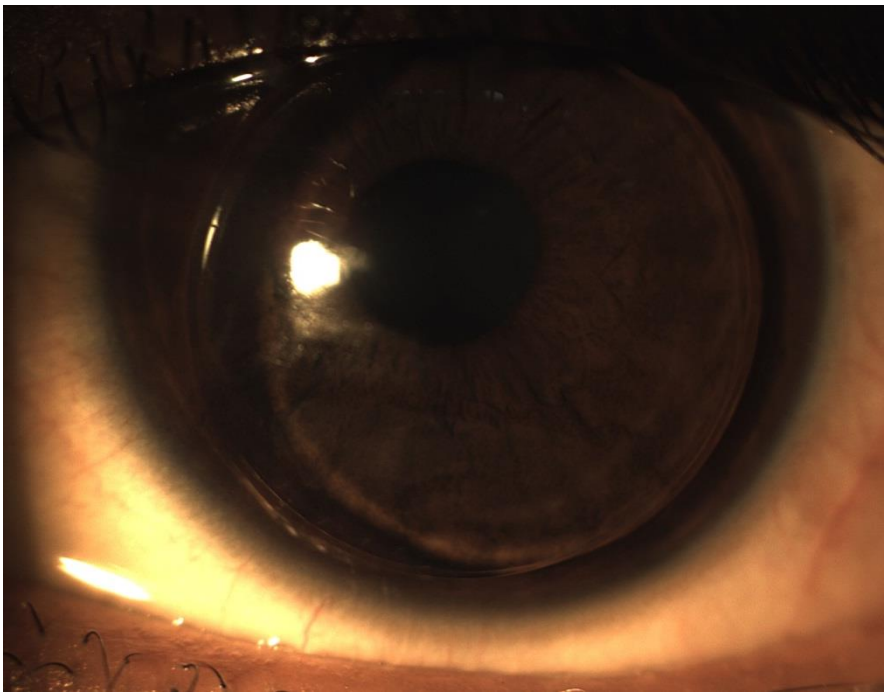
9. During follow up, patient was assessed for visual acuity, comfort,tolerance.

10. Patient was examined under slit-lamp to check for any congestion, papillary reaction, infection, protein deposits over the lens.

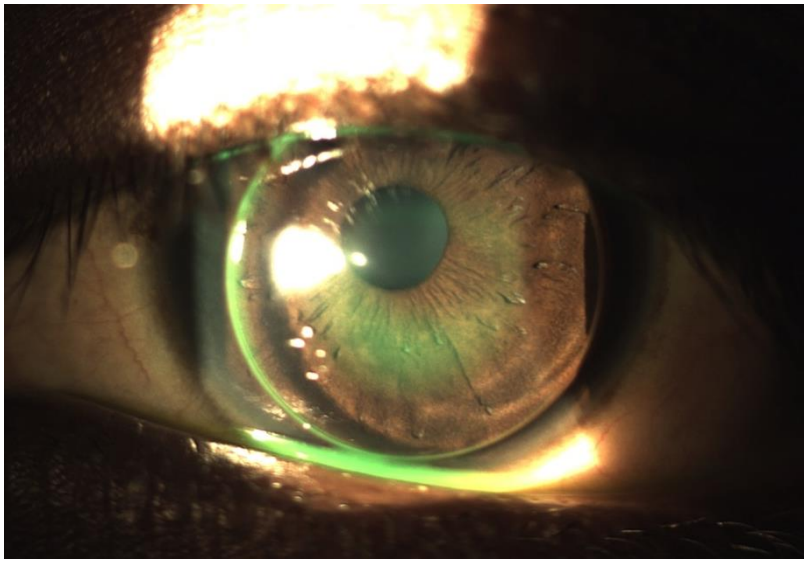
PATIENT 1



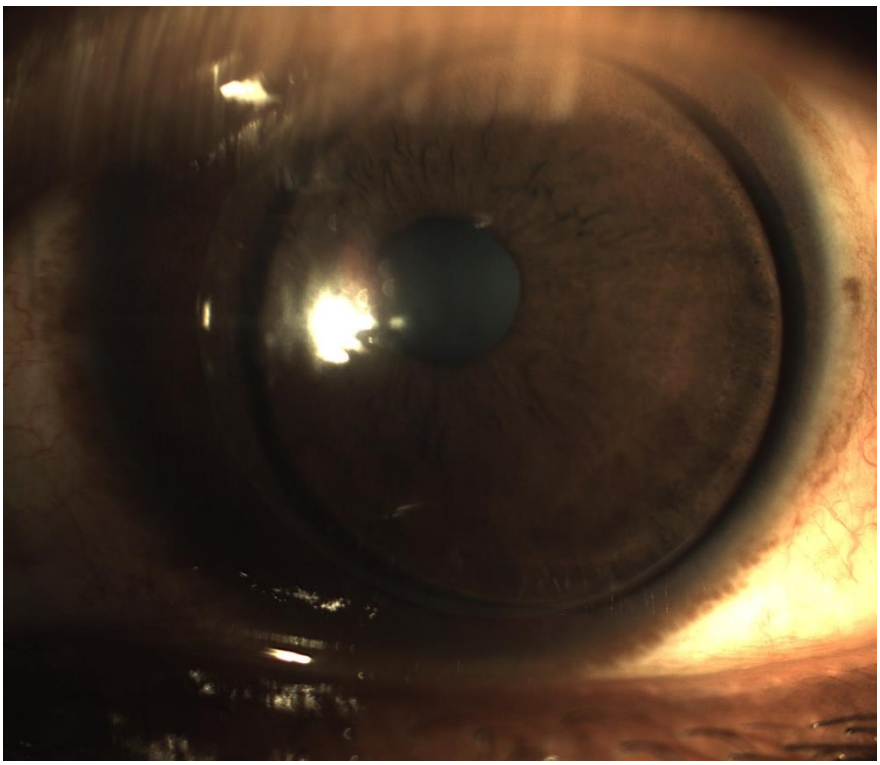
PATIENT 2



PATIENT 1 FLORESCEINE STAIN



PATIENT 3



RESULTS

RESULTS

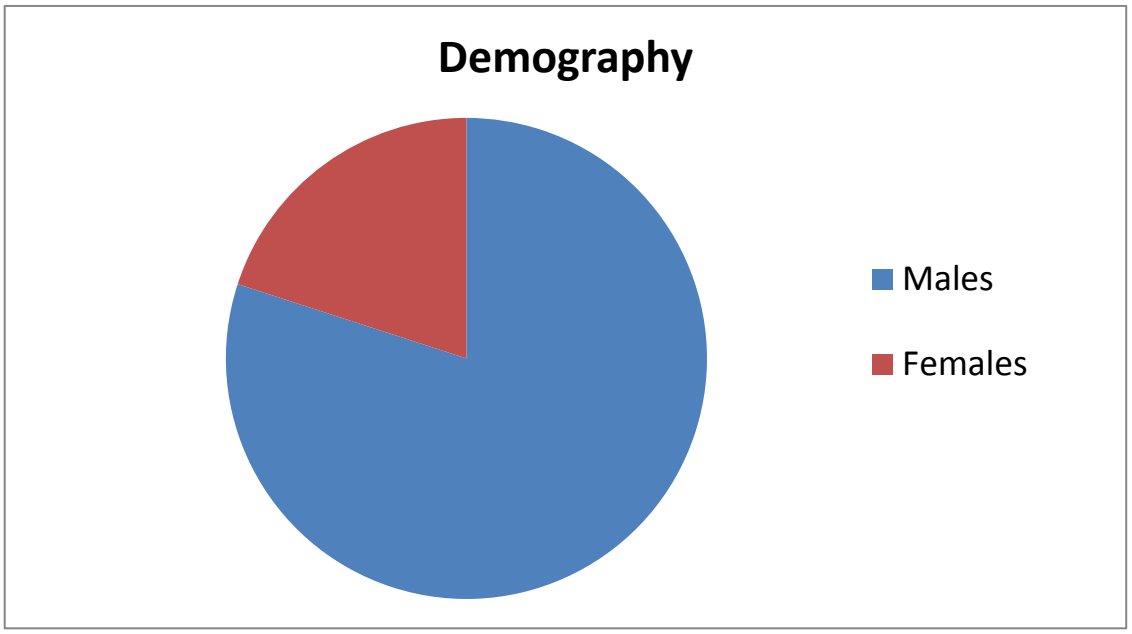
Demography:

Total: 15 patients

Males: 12

Females: 3

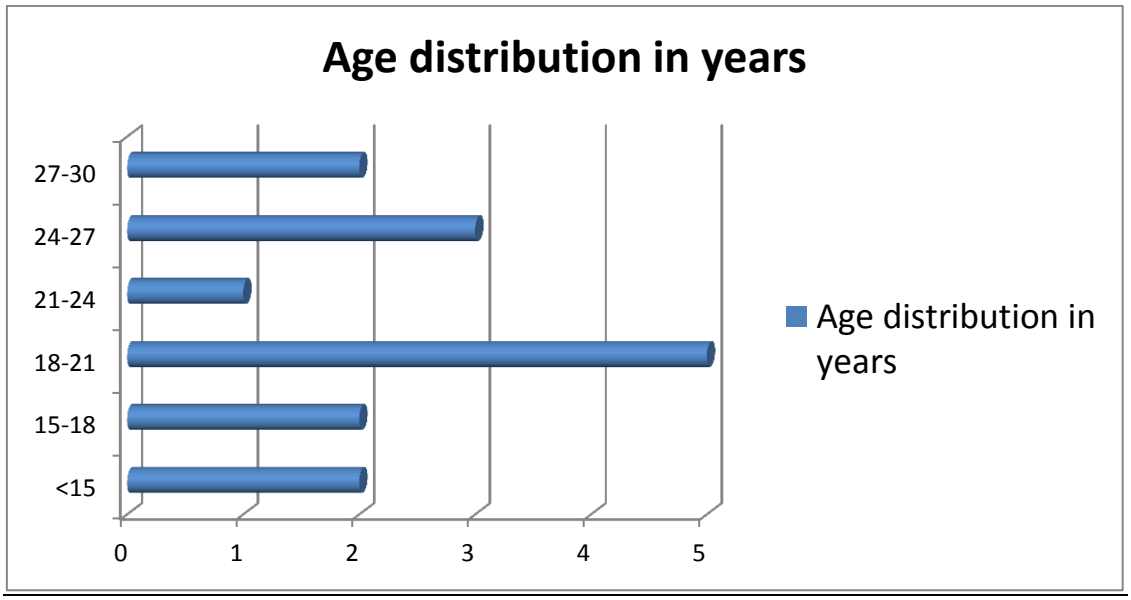
Chart: 1



AGE DISTRIBUTION: Table 1

Age group	No. of Patients
<15	2
15-<18	2
18-<21	5
21-<24	1
24-<27	3
27-30	2

Chart: 2



In our study, out of the total number of patients being tried for Rose K lens maximum belonged to the age group of **18-21 years**. The youngest patient being **14 years** of age and the oldest being **28 years of age**. The mean age being**20.8 years.**

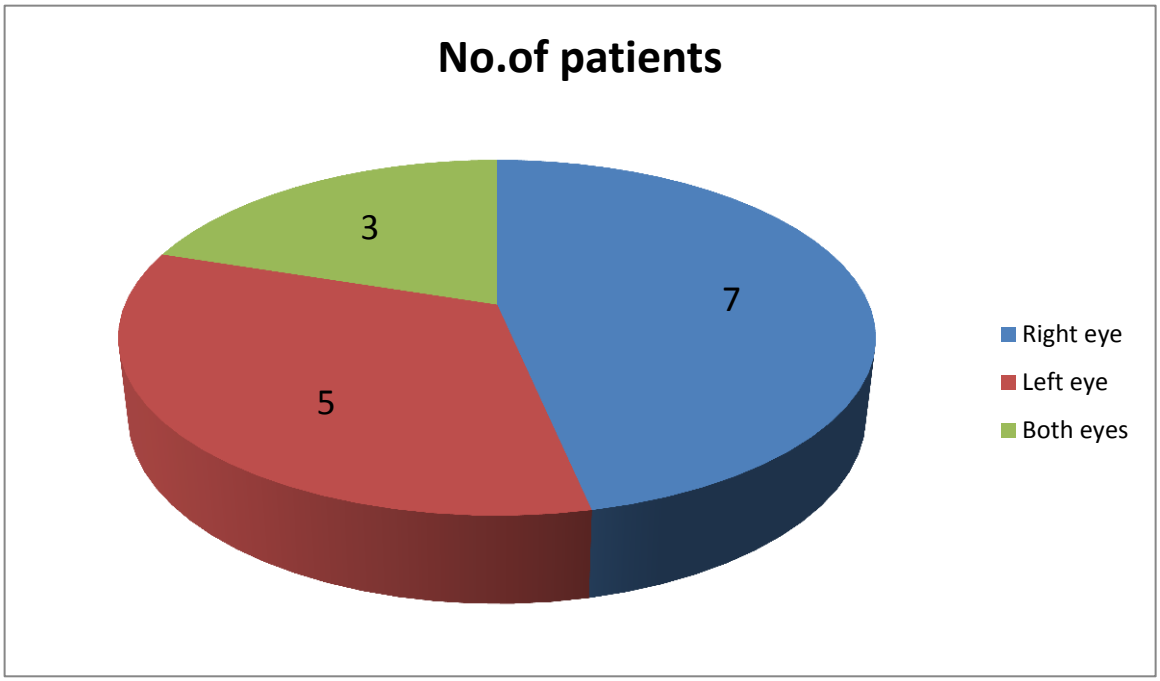
LATERALITY

Right eye : 7 patients

Left eye : 5 patients

Both eyes : 3 patients

Chart: 3

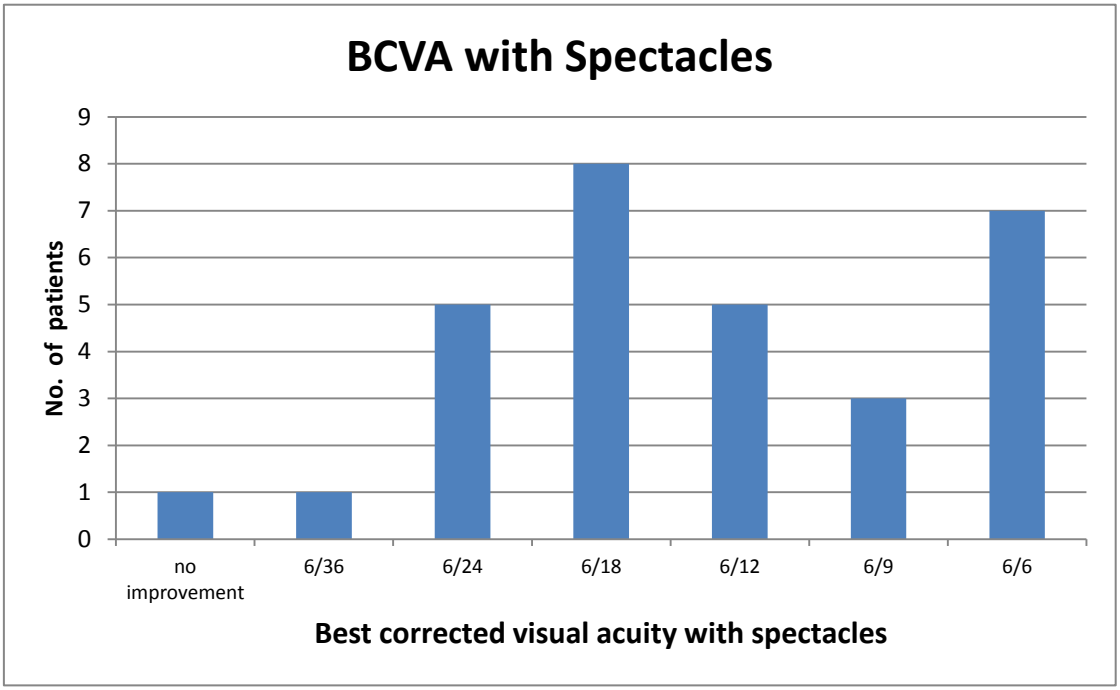


Maximum number of patients were fitted in the **Right eye** with Rose K lens, i.e.**7** patients followed by **5 patients** in the **Left eye** and **3** patients for **both** the eyes.

RANGE OF BEST CORRECTED VISUAL ACUITY OBTAINED THOROUGH SPECTACLE CORRECTION

BCVA with spectacles	No. of patients
No improvement	1
6/36	1
6/24	5
6/18	8
6/12	5
6/9	3
6/6	7

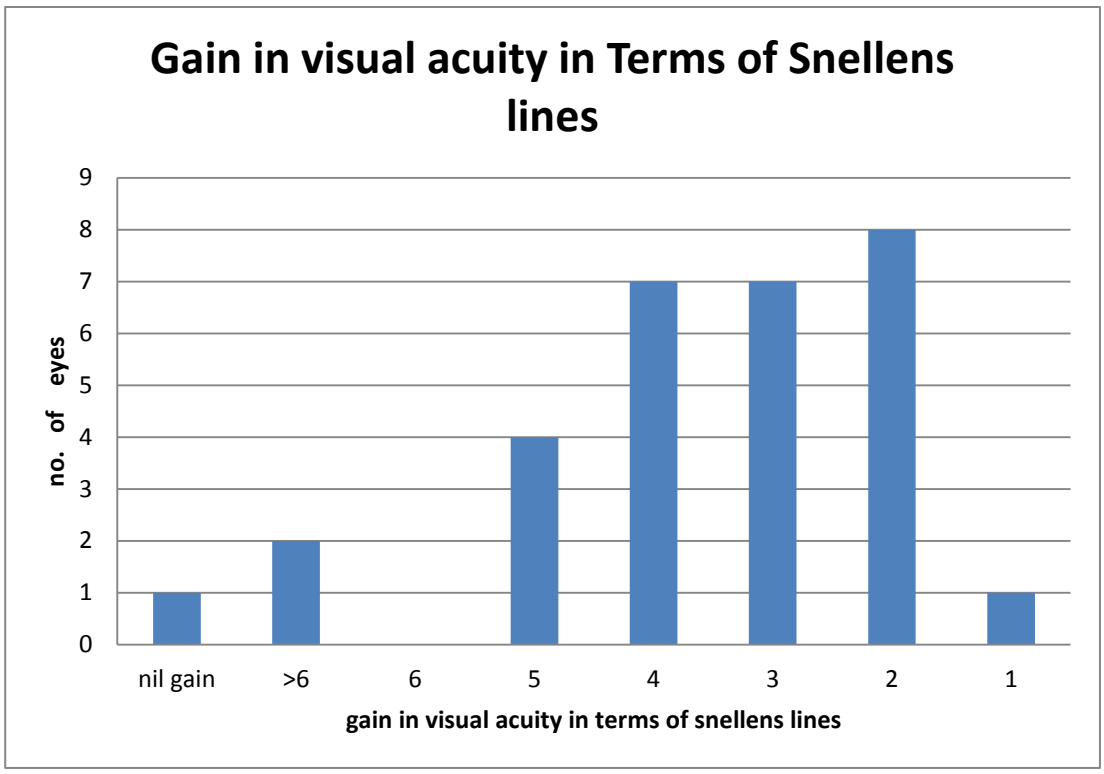
30 eyes of the 15 keratoconus patients were analyzed for the maximum corrected visual acuity that can be obtained with spectacles. The maximum number of patients showed improvement up to 6/18 i.e. 8 eyes followed by 7 eyes that were corrected up to 6/6 by spectacle correction itself.5 patients showed improvement up to 6/24 and 5 patients up to 6/12 and 3 patients up to 6/9.1 patient showed no improvement and 1 improved up to 6/36.


BCVA with Spectacles
No. of patients
9
8
7
6
5
4
3
2
1
0
no improvement
6/36
6/24
6/18
6/12
6/9
6/6
Best corrected visual acuity with spectacles

GAIN IN VISUAL ACUITY WITH SPECTACLES IN TERMS OF SNELLENS LINES

GAIN IN VISUAL ACUITY IN TERMS OF SNELLENS LINES	NO.OF EYES
Nil gain	1
>6 lines	2
6 lines	0
5 lines	4
4 lines	7
3 lines	7
2 lines	8
1 line	1

Maximum number of eyes showed an improvement of 2 Snellens lines with spectacle correction i.e. 8 eyes. 7 eyes showed an improvement of 3 and 4 Snellens lines .An improvement of 5 lines is shown by 4 eyes where 6 lines or more is shown only by 3 patients. Average improvement being 3.2 Snellens lines.

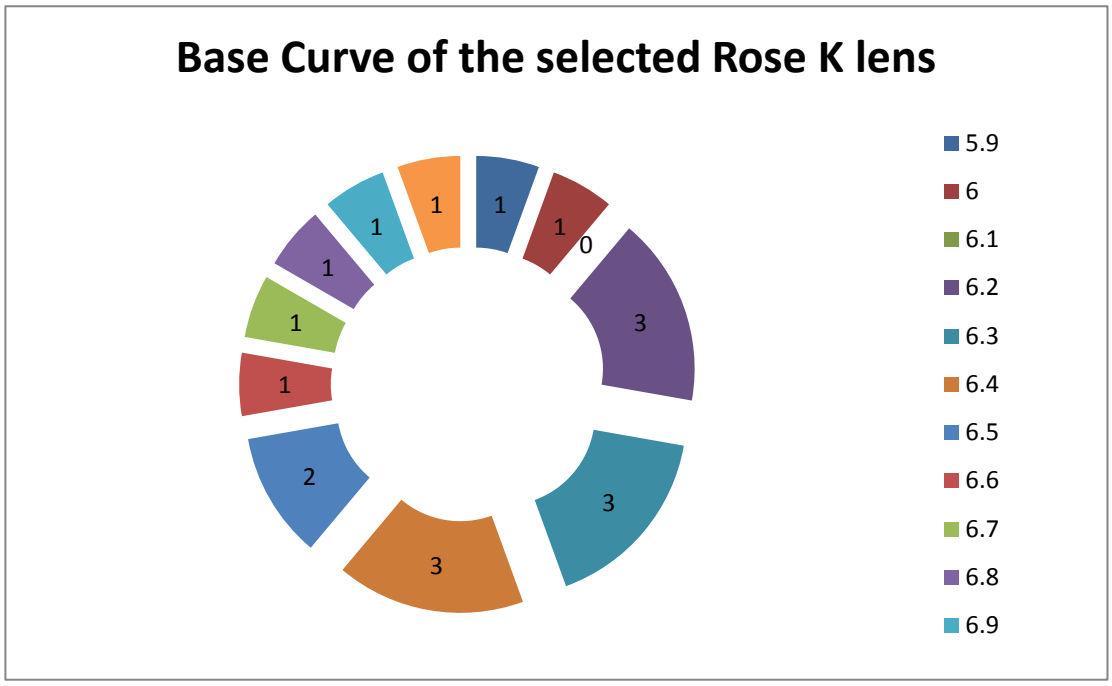

Gain in visual acuity in Terms of Snellens lines
no. of eyes
9
8
7
6
5
4
3
2
1
0
nil gain
>6
6
5
4
3
2
1
gain in visual acuity in terms of snellens lines

RANGE OF SELECTED BASE CURVES SELECTED FOR ROSE K LENS

As per the inclusion criteria of the study patients improving to 6/9 or 6/6 vision by Snellens chart were excluded from trial of Rose K. Hence only 18 eyes of 15 patients were tried for Rose K lenses.

Base Curve	No. of eyes
5.9	1
6	1
6.1	0
6.2	3
6.3	3
6.4	3
6.5	2
6.6	1
6.7	1
6.8	1
6.9	1
7 and above	1

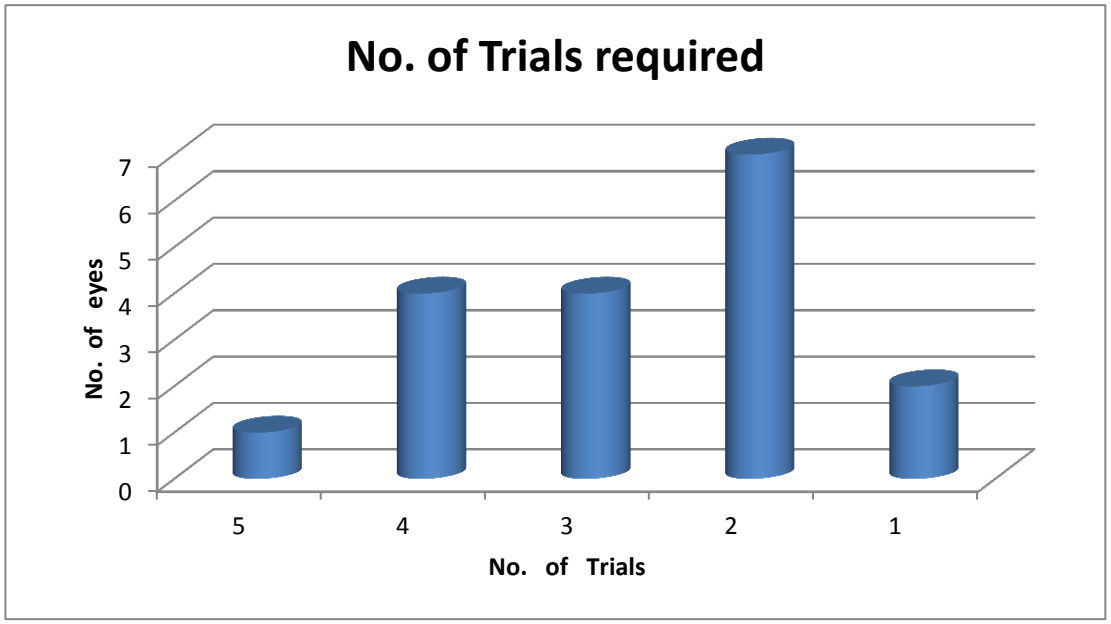
The most common base curve ranged from 6.2 to 6.4, total 9 patients (i.e. 50%).followed by 6.5.


Base Curve of the selected Rose K lens
1
1
0
3
3
3
2
1
1
1
1
1
5.9
6
6.1
6.2
6.3
6.4
6.5
6.6
6.7
6.8
6.9

NUMBER OF TRIALS REQUIRED TO REACH THE CORRECT BASE CURVE OF ROSE K LENS

No .of trials	No. of eyes that required that trials
5	1
4	4
3	4
2	7
1	2

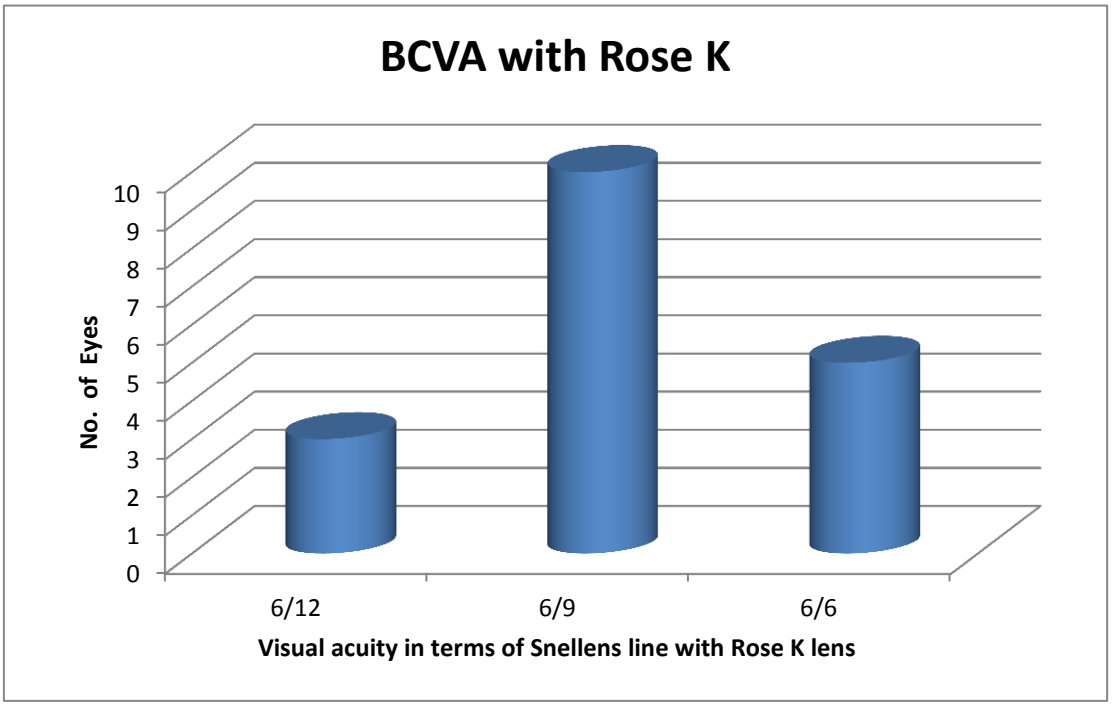
Most of the eyes that are 7 required only 2 trials to reach to the correct base curve, followed by 4 eyes requiring 3 and 4 trials each.5 trials were required by only 1 eye and two eyes required only one trial. The mean number of trials required is 2.7.



BEST CORRECTED VISUAL ACUITY OBTAINED WITH ROSE K LENS

BCVA with Rose K	No. of patients
6/12	3
6/9	10
6/6	5

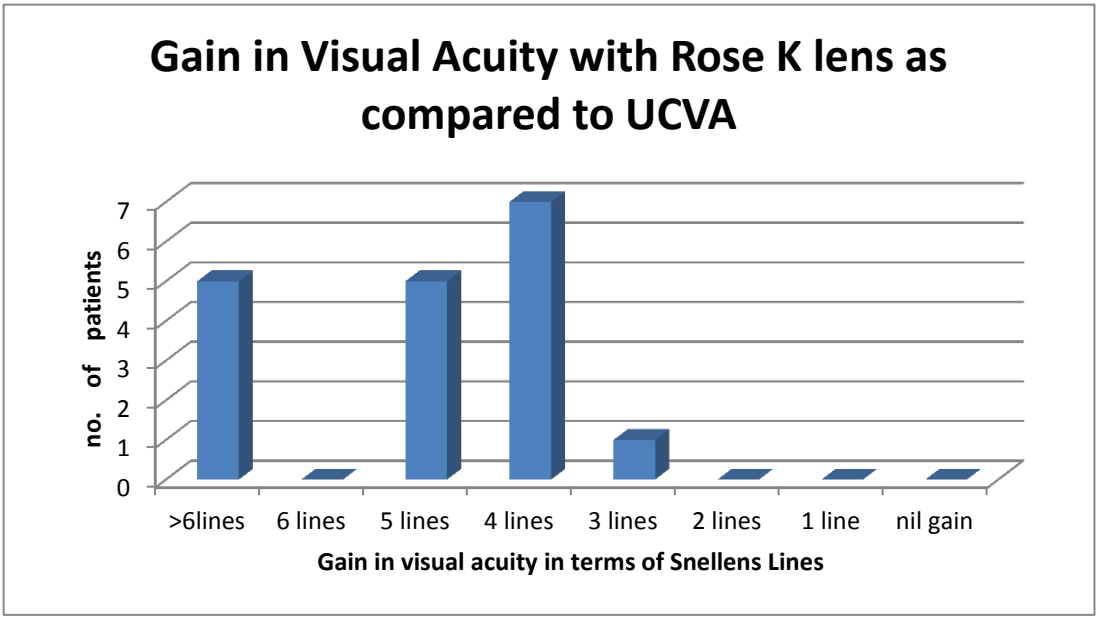
Best corrected visual acuity obtained with Rose K lens ranged from 6/12 to 6/6.Maximum eyes i.e. 10 were corrected to 6/9 with Rose K lens, 5 eyes improved to 6/6 whereas 3 eyes improved to 6/12.



GAIN IN VISUAL ACUITY WITH ROSE K LENS AS COMPARED TO UNCORRECTED VISUAL ACUITY IN TERMS OF SNELLENS LINES

GAIN IN VISUAL ACUITY IN TERMS OF SNELLENS LINES	NO.OF EYES
>6 lines	5
6 lines	0
5 lines	5
4 lines	7
3 lines	1
2 lines	0
1 line	0

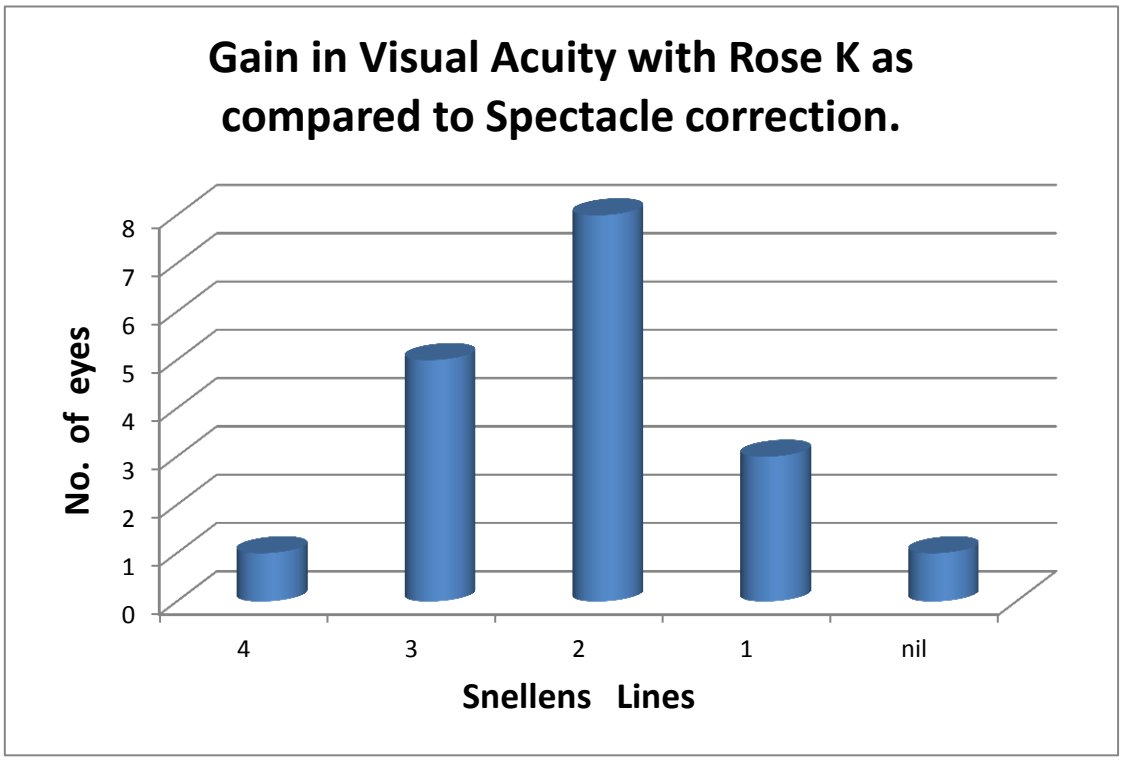
7 eyes showed an improvement of 4 Snellens lines,5 eyes showed improvement more than 6 Snellens lines.5 eyes showed an improvement of 5 lines. We saw a minimum improvement of at least 3 lines with Rose K lens as compared to uncorrected visual acuity. The average improvement being 4.7 Snellens lines.



IMPROVEMENT IN VISUAL ACUITY WITH ROSE K LENS AS COMPARED TO SPECTACLE CORRECTION IN TERMS OF SNELLENS LINES

Gain in visual acuity in terms of Snellens Lines	No. of eyes
4 lines	1
3 lines	5
2 lines	8
1 line	3
Nil gain	1

The maximum gain that we saw of Rose K over spectacles was 4 Snellens lines.Maximum number of patients i.e. 8 patients showed a gain of 2 Snellens lines and 1 patient did not show any improvement over that achieved with spectacles.



STATISTICS

Statistical analysis was done using SPSS software.

Paired‘t’ test

	Mean	SE	T
Rose K	2.0667	0.182	4.766*
Spectacle	o.5333	0.236	

*Significant at 5% level of probability.

Interpretation : Rose K lens definitely improves visual acuity in general provided the patient’seyes are congenial for such intervention.

CHI-SQUARE TEST

SPEC * ROSE Cross tabulation Count					
		ROSE			Total
		1.00	2.00	3.00	
SPEC	-1.00	1	1	0	2
	.00	0	2	3	5
	1.00	1	4	1	6
	2.00	1	1	0	2
Total		3	8	4	15

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.583(a)	6	.361
Likelihood Ratio	7.602	6	.269
Linear-by-Linear Association	.405	1	.525
N of Valid Cases	15		
a 12 cells (100.0%) have expected count less than 5. The minimum expected count is .40.			

Symmetric Measures					
		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Interval by Interval	Pearson's R	-.170	.278	-.622	.545(c)
Ordinal by Ordinal	Spearman Correlation	-.219	.285	-.809	.433(c)
N of Valid Cases		15			
a Not assuming the null hypothesis.					
b Using the asymptotic standard error assuming the null hypothesis.					
c Based on normal approximation.					

INTERPRETATION: The chi –square test result is limited by the small sample size of this study. The chi-square result for this study shows that Rose K is not useful in all cases of Keratoconus; however in cases in which it can be used it shows a definite improvement.

COMPLICATIONS SEEN ON FOLLOW UP

On follow up only one patient showed protein deposits over the lens. Following a change of lens solution the patient was then very comfortable. No other patient showed any other complication.

DISCUSSION

DISCUSSION

Keratoconus usually affects the younger age group. A visual impairment in this age group could hamper the quality of life of the affected individuals. Hence providing them with a good option for correcting the condition is highly beneficial. In our study the mean age of the patients was 20.8 years, indicating a young population.

In our study as per the standard treatment procedure that is followed, the patients were first corrected with spectacles and only if they did not show adequate improvement they were considered for Rose K lens. Most of the patients in whom we tried Rose K lens did show improvement in theirbest corrected visual acuity over that provided by spectacles.

The spectacles provided a mean improvement of 3.2 Snellens lines over uncorrected visual acuity whereas with Rose K lenses there was an improvement of 4.7 Snellens lines over the uncorrected visual acuity.

Also when we compared spectacles and Rose K lens. Rose K provided an improvement of 2.1 Snellens lines over that provided by the spectacles.

Also in patients of Keratoconus who have irregular astigmatism and high cylinder values. Spectacles even if they give reasonable visual acuity are sometimes intolerable due to optical aberrations induced by them. In

unilateral cases use of spectacles is not very comfortable due to anisometropia induced by them.Also thick spectacles could be unsightly and cosmetically unacceptable in this younger population. Hence Rose K lens provide a very good alternative to spectacles.

Due to the conical shape of the cornea in keratoconus, fitting of conventional Rigid Gas permeable lenses is troublesome resulting in a fitting that may be either too steep or too flat. The custom fit of Rose K helps to overcome this to quite an extent.

Thus in patients who are not adequately corrected by spectacles or who experience discomfort with conventional Rigid Gas Permeable lens that otherwise would have had to resort to surgical procedures like INTACS or Keratoplasty, Rose K provides a good alternative.

All our patients were comfortable on follow up. Only one patient reported deposition of protein over lens. By changing the lens solution the problem was overcome. Otherwise no other serious complications were encountered.

Thus as per our study Rose K lenses are a very good treatment option for patients of Keratoconus.

CONCLUSION

CONCLUSION

In our study we conclude that:

1. Rose K is a viable treatment option in Keratoconus.
2. Rose K lens provides improved visual acuity in patients who are not adequately corrected by spectacles and conventional contact lenses.

It delays the need for surgical intervention thereby decreasing patient morbidity.

PART III

PROFORMA

Name: Op No:

Age/Sex: CC no:

Complaints of the patient:

Duration of complaints:

H/o present illness:

H/o any allergies:

Past History:

H/o similar complaints in the family:

H/o wearing spectacles:

H/o contact lens use:

EXAMINATION:

General examination:

Systemic examination:

Ocular Examination:

1. Head Posture
2. Orthophoria :

RE LE

3. Munson’s Sign:
4. Rizzuti’s Sign :
5. Slit-Lamp Examination :

    a. Conjunctiva:
    b. Cornea:
    c. Anterior chamber
    d. Iris
    e. Pupil
    f. Lens
    g. Fundus

6. UCVA
7. BCVA with spectacles
8. AR/Subjective
9. Topography value
   Sim K1:
   Sim K2:
   Average:
   Difference:

10. Calculated Base curve of Rose K;
11. Final Base curve of the selected Rose K lens :
12. No. of trials :
13. Visual Acuity with Rose K :

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Key to Master Chart

1. CC no : Cornea clinic number
2. UCVA :Uncorrected visual acuity
3. BCVA : Best corrected visual acuity
4. K1 : Steeper axis on Topography
5. K2 : Flatter axis on Topography
6. BC : Base curve
7. V/A : Visual Acuity
8. n/a : Not applicable, used when the inclusion criteria is not met with
9. OKP : Optical Keratoplasty
10. Selected Base curve : Base curve that was selected for dispensing the lens

Abstract :

Title: STUDY OF ROSE K LENSES IN KERATOCONUS

Aim : To check for improved visual acuity with Rose K lenses as compared to spectacle correction.

Materials and methods: 18 eyes of 15 patients who did not improve adequately with spectacles were studied in our institute. Keratoconus patients who did not show adequate improvement wit spectacles were tried for Rose K lens. Improvement in visual acuity , better tolerability and better comfort of the patient were studied.

Results : We found significant improvement in visual acuity and patient comfort with rose K lenses.Patients showed an improvement of 2-3 Snellens line above that with spectacles.

Conclusion : We found that Rose K is a very good option for keratoconus patients and can also be an alternative for delaying surgical intervention.

Keywords : Keratoconus, Rose K ,contact lens , visual acuity in keratoconus , treatment for keratoconus.

SR . NO	NAME	AGE	M/F	CC. NO	DIAGNOSIS	UCVA	BCVA WITH SPECTACLES	TOPOGRAPHY	1st trial BC	Selected BC	No. of trials	V/A with Rose K	GAIN IN V/A WITH Rose K
1	Ramesh Kumar K.	27	M	1654	BE keratoconus	RE 6/60 ph 6/24	**RE** 6/60 -4.50Dsph/-0.75DCyl 180 6/24	RE K1 +53.78D (6.28) ,K2 +52.66D(6.41)	6.3	6.4	2	6/12	3 snellen line
						LE 6/24 ph 6/6p	**LE** 6/36 -0.75Dsph/-1.50Dcyl 130 6/9	LE K 1 +44.64 (7.56), K2 +43.33D(7.79)	7.6	7.6	1	6/6	1 snellen line
2	Arunachalam	14	M	5654	BE keratoconus	RE 4/60 ph 6/18	RE 4/60 -4.75Dsp/-2.00DCyl 150 6/6	RE K1 +56.62D(5.94) , K2 54.43D(6.2)	n/a	n/a	n/a	n/a	
						LE 4/60 ph 6/36	LE4/60 -3.00Dsp/-5.00DCyl 130 6/24	LE K1 +60.18D(5.61) , K2 57.49(5.87)	6	6.2	3	6/6	4 snellen line
3	Sudha	28	F	9269	Be keratoconus	RE 6/36 ph 6/12	RE 6/36 -5.ooDcyl 50 6/18	RE K1+ 57.12D(5.9) , K2 +52.0D(6.49)	6.2	6.3	2	6/9	2 snellen lines
					post C3R status	LE 6/36 ph 6/24	LE 6/36 -1.00Dsph/-4.00DCyl 150 6/18	LE K1 +49.63D(6.8) , K2 +47.27D(7.19)	6.9	6.7	3	6/9p	2 snellen lines
4	Laxmikanthan	26	M	6589	BE Keratoconus	RE 6/60 ph 6/36	RE 6/60 -3.25DS/-2.00 Cyl 40 6/9	RE K1 +45.31D(7.45) K2+42.46D(7.8)	n/a	n/a	n/a	n/a	
						LE 3/60 ph 6/36	LEL 3/60 -6 Dsph/-2.75 6/24 NIP	LE +K1 56.16D (6.01) K2 +51.12D(6.6)	6.3	6.2	2	6/9	3 snellen line
5	Vinoth	16	M	10249	BE keratoconus	RE 6/18 ph 6/6	RE 6/18 -0.25DSph/-2.25Dcyl 10 6/6p	K1 +48.97D(6.89) , K2 + 45.9D (7.35)	n/a	n/a	n/a	n/a	
					LE post C3R	LE 6/36 ph 6/18	LE 6/36 -3.00dcyl 120 6/18	K1 +57.78D(5.84) , K2 +50.19D(6.72)	6.2	5.9	4	6/9	2 snellen line
6	Santosh	25	M	10122	BE Keratoconus	RE 6/24 ph 6/12	RE 6/24 -1.25D/-1.25Dcyl 140 6/6	K1+58.31D(5.8) , K2+55.74D(6.12)	n/a	n/a	n/a	n/a	
						LE 3/60 ph 6/60	LE 3/60 -4.00Dsph/-4.50DCyl 180 6/12p	K1+54.38D(5.12) , K2+49.99D (6.75)	5.9	6	2	6/12	nil gain , better comfort
7	S Rama Seslan	19	M	6173	BE keratoconus	RE 6/36 ph 6/18	RE 6/36 -5.50Dsp/-4.00DCyl 25 6/12p	K1 +60.14D(5.61) , K2+53.89D(6.26)	6.1	6.2	2	6/6	2 snellen line
					RE post C3R	LE 6/24 ph 6/12	LE 6/24 -1.00Dsph/-2.00DCyl 140 6/6p	K1+52.14D(6.23) , K2+49.86D(6.62)	n/a	n/a	n/a	n/a	
8	Nagaraja	20	M	3078	BE keratoconus	RE 6/36 ph 6/12	RE 6/36 -5.00DSp/-4.5DCyl 17 6/18	K1 +60.15D(5.61) , K2+54.75D(6.16)	5.9	6.3	5	6/12	1 snellen line
					LE post OKP	LE 3/60 nip	LE 3/60 NIG NIP	irregular mires , values not obtained	n/a	n/a	n/a	n/a	
9	Ramu	20	M	5489	BE keratoconus	RE 6/36 ph 6/18	RE 6/36 -3.00DCyl 43 6/18	K1+52.1D(6.17) , K2+51.8D(6.34)	6.2	6.4	3	6/9	2 snellen lines
					LE post OKP	LE 6/60nip	LE 6/60 -3.00DSp/-2.50DCyl 45 6/36	not possible,due to irregular mires	n/a	n/a	n/a	n/a	
10	Vasudevan	23	M	3594	BE keratoconus	RE 6/60 ph 6/24	RE 6/60 -4.00Dsph/-2.50DCyl 6/24	K1 +53.2D(6.34) ,K2 +51.17D(6.56)	6.4	6.3	2	6/9	3 snellen line
					LE OKP	LE 6/60 ph 6/36	LE 6/36 -3.00 DSP 6/18	not possible,due to irregular mires	n/a	n/a	n/a	n/a	
11	Devan	19	M	3543	RE Keratoconus	RE 5/60 ph 6/24	RE 5/60 -4.00DSp/-0.75DCyl 180 6/18p	K1+50.82D(6.64), K2+48.4D(6.97)	6.8	6.5	4	6/6	3 snellen line
					RE post C3R	LE 6/12ph6/6	LE 6/12 -1.00Dcyl 90 6/6	K1+45.21D(7.46), K2+44.71D(7.55)	n/a	n/a	n/a	n/a	
					LE keratoconus suspect								
12	Ahalya	14	F	15274	BE keratoconus	RE 6/36 ph 6/18	RE 6/36 -2.50Dsph/-2.00Dcyl 6/6	K1+48.32D(6.98), K2+45.49D(7.42)	n/a	n/a	n/a	n/a	
					LE PostC3R status	LE 4/60 ph 6/24	LE 4/60 -5.ooDsph/-3.0DCyl 60 6/18	K1+50.32D(6.71), K2+46.23D(7.3)	7	6.8	3	6/9	2 snellen line
13	Vinoth	20	M	15434	BE Keratoconus	RE 6/36 ph 6/24	RE 6/36 -2.00Dsph/-3.00 Dcyl 120 6/12	K1 +49.92D(6.76), K2 +46.31D(7.29)	7	6.9	4	6/9	2 snellen line
						LE 6/18 ph 6/12	LE 6/18 -1.50Dsph/-1.00DCyl 140 6/6	K1 +48.30D(6.99) , K2 +44.28D(7.62)	n/a	n/a	n/a	n/a	
14	Anitha	26	F	15384	RE Keratoconus	RE 6/60 ph 6/24	RE 6/60 -3.00Dsph/-1.50Dcyl 45 6/24	RE K1+53D (6.37) , K2+48.64D(6.93)	6.6	6.6	1	6/9	3 snellen line
					LE keratoconus suspect	LE 6/36 ph 6/18	LE 6/36 -2.0Dsph/0.75DCyl 90 6/12	LE K1+54.58D(6.18), K2+49.06D(6.88)	6.5	6.4	2	6/6	2 snellen line
15	Nirmal Kumar	15	M	15374	BE keratoconus	RE 6/60 ph 6/18	RE 6/60 -3.50Dsph/-2.00DCyl 124 6/12	RE K1+52.93D(6.18) , K2+45.88D(7.36)	6.8	6.5	4	6/9	1 snellen line
					BE post c3R	LE 6/24 ph 6/12	LE 6/24 -1.00Dsp / -0.75 Dcyl 180 6/9	K1+46.85D(7.2) , K2+43.05D(7.84)	n/a	n/a	n/a	n/a	