"COMPARATIVE STUDY OF CLEAR CORNEAL VERSUS SCLERAL TUNNEL INCISION IN PHACOEMULSIFICATION"

By

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IN
OPHTHALMOLOGY

Under the Guidance of
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Date: **Signature of the Candidate**

LIST OF ABBREVIATIONS USED

AL	:	Axial length
ATR/A	:	Against the rule astigmatism
BCVA	:	Best corrected visual acuity
CC	:	Clear corneal incision
CF	:	Counting finger
D	:	Diopter
DS	:	Diopter spherical
DC	:	Diopter cylindrical
DM	:	Descemets membrane
DBCS	:	District blindness control society
ECCE	:	Extracapsular cataract extraction
HM +	:	Hand movements present
ICCE	:	Intracapsular cataract extraction
IOL	:	Intraocular lens
IOP	:	Intraocular pressure
K	:	Keratometry
Mm	:	Milimeters
NS	:	Nuclear sclerosis
PC	:	Posterior capsule
PCO	:	Posterior capsule opacification

PL	:	Perception of light
PMMA	:	Polymethyl methacrylate
PR	:	Projection of rays
PSC	:	Posterior subcapsular cataract
SC	:	Scleral tunnel incision
SE	:	Spherical equivalent
SIA	:	Surgically induced astigmatism
SICS	:	Small incision cataract surgery
SRK	:	Sanders, Retzlaff and Kraff
ST	:	Scleral tunnel incision
UCVA	:	Uncorrected visual acuity
WTR/W	:	With the rule astigmatism
WHO	:	World health organisation
Yrs	:	Years

ABSTRACT

TITLE OF THE TOPIC:

COMPARATIVE STUDY OF CLEAR CORNEAL VERSUS SCLERAL TUNNEL INCISION IN PHACOEMULSIFICATION.

NEED FOR THE STUDY:

In phacoemulsification the nucleus is ultrasonically fragmented and aspirated by a small incision. It is opted as the surgery of choice due to better patient compliance, earlier stabilization of refraction, improved visual acuity and minimal postoperative astigmatism and minimal complications.Recently preferences has been shifted from scleral incision to clear corneal incision in phacoemulsification.Hence we are conducting this study to assess the merits and demerits of the two techniques.

Objectives of the Study:

1)To assess postoperative visual acuity in patients with clear corneal and scleral tunnel incision in phacoemulsification.

2)To compare the postoperative astigmatism (type and amount) in phacoemulsification with the two incisions.

3) To analyse intra and postoperative complications if any in both.

MATERIAL AND METHODS:

Source of Data:

Eighty senile cataract patients, source being routine ophthalmology out patients presenting to the R.L.Jalappa Hospital and Research Centre, Kolar between the period from December 2011 upto July 2013.Informed and written consent was taken from all the patients. After all necessary ocular and systemic examinations patients were divided into two groups of 40 each to undergo clear corneal incision and scleral tunnel

incision followed by phacoemulsification with foldable IOL implantation respectively. Post operative visual acuity and postoperative astigmatism was compared between two groups and complications if any was noted. Statistical analysis was done by Chisquare tests and Mann Whitney u test.

- **RESULTS:** 33(82.5%) out of 40 patients with clear corneal incision had post operative visual acuity ranging 6/6 -6/9 at the end of 1st week only compared to 29(72.5%) out of 40 patients with scleral tunnel.
- 33(82.5%) out of 40 patients with clear corneal incision had minimal postoperative astigmatism(0.25-0.50D) compared to 34(85%) out of 40 patients in scleral tunnel incision in three month keratometry follow up.

INTERPRETATION AND CONCLUSIONS:

We found that clear corneal incision induces faster vision recovery. No significant difference was found in post operative astigmatism in between the two groups in keratometry three month post operative in study conducted.

KEYWORDS

Phaco, Clear corneal incison, Scleral tunnel incison, WTA, ATA, BCVA, Scalar analysis.

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INTRODUCTION

Cataract comes from the latin word which means waterfall.It is the loss of transparency in the crystalline lens.Senile cataract has consistently topped the WHO charts as a leading cause of blindness. Annual incidence of 3.8 million cataracts and over 9 million cataract blind people have been reported in India[1] and expecting to blind 40 million by 2025.[2]

With no medical treatment yet available, surgery forms the sole but easy way out providing utmost satisfaction to both patient as well as to a surgeon.Even with the government spending lakhs of rupees on mobile camps through DBCS and VISION 20/20 and evolution of techniques like SICS providing for good results with less complications,It still remains a major cause of correctable morbidity in our dependant geriatric population.

Cataract surgery or the removal of the opacified crystalline lens was a pioneering technique in the field of surgery itself. It has undergone a commendable revolution from 17th century practise of couching at the time of Sushrutha to Intracapsular cataract extraction, extracapsular cataract extraction, small incision cataract surgery and phacoemulsification.

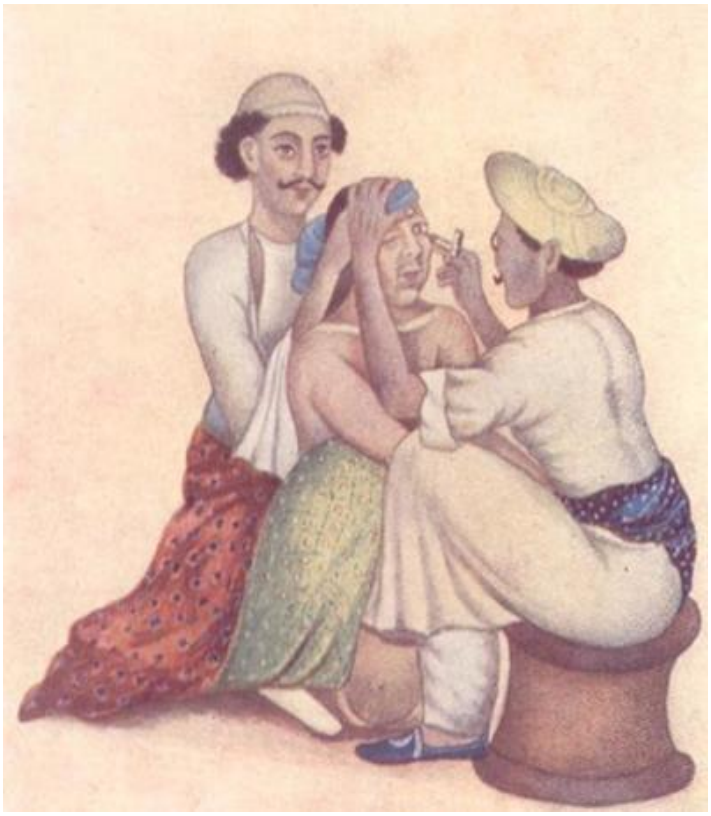


FIGURE 1:PRACTISE OF COUCHING

Phacoemulsification is the recent technique of cataract surgery. The advent of this surgery by an ultrasonically activated probe inserted into the cataractous crystalline lens was pioneered by Kelman in 1967.[3] It is a procedure where the nucleus is ultrasonically fragmented and aspirated by a small incision. It has been opted as the surgery of choice due to better patient compliance, earlier stabilization of refraction, improved visual acuity, minimal post operative astigmatism and minimal complications. It enabled ophthalmologists to extract cataracts through the smallest possible incision using an ultrasound probe or laser probe, to break the lens without damaging the lens capsule. Today it has become the preferred technique for cataract removal. No sutures are required as incision is self sealing.[4]

The refractive aspect of cataract surgery has received considerable attention. The amount of surgical induced astigmatism can be controlled better and the faster wound

stability reduces the time required for visual rehabilitation. Phacoemulsification surgery is characterized by a valvular incision which does not required to be sutured.This leads to minimal corneal distortion and early visual rehabilitation and if planned preoperatively, it can help in reducing a pre-existing toricity in the cornea. A well constructed wound can be closed by virtually any method with good results.A poorly constructed wound can be the source of astigmatism, irritation, hemorrhage, corneal trauma or wound leak and endophthalmitis. There are two commonly used techniques-phacoemulsification by clear corneal incision and phacoemulsification by scleral tunnel incision. Recently preference has been shifted from scleral tunnel incision to clear corneal incision. Clear corneal incisions are well tolerated, induces less postoperative astigmatism and faster visual recovery.[5]

ADVANTAGES OF CLEAR CORNEAL INCISION:

Temporal clear corneal incisions have become popular because of several reasons:

- The horizontal meridian of the cornea is wider than the vertical merdian.Therefore, the distance from the visual axis to the periphery is longer, resulting in less flattening as the incision is transmitted to the visual axis.Hence there is lower incidence of surgically induced astigmatism at the temporal site.
- Less surgery time.
- Elimination of the need for cautery and the potential for subconjunctival haemorrhage and hyphaema.
- Promotes rapid visual recovery and visual restoration.
- Well tolerated by the patients.

- It can be performed under topical anaesthesia.
- It is mainly suitable for foldable IOLs.
- Visibility during the phacoemulsification procedure is better due to shorter tunnel.
- No obstruction from the brow as in deep set eyes and therefore no need of bridle suture.
- Good red reflex because of perpendicular iris location to the light of microscope.
- Irrigating fluids spontaneously drain from the eye without pooling.
- Leaves superior conjunctiva undisturbed for future trabeculectomy.
- Does not disturb the filtering bleb in an eye with a functional bleb.

DISADVANTAGES OF CLEAR CORNEAL INCISION:

- Not suitable for the trainee surgeon.
- Endothelial damage.
- Conversion into SICS is not possible.
- Increased risk of endophthalmitis as it is not covered by conjunctiva.

ADVANTAGES OF SCLERAL TUNNEL INCISION:

Scleral tunnel incisions have some advantages like

- Less post operative astigmatism.

- Better wound closure.
- Safest incisions to perform especially for the trainee surgeon.
- Decreased endothelial damage.
- Easy to convert to SICS.
- Since it is covered by conjunctive there are decreased chances of endophthalmitis.

DISADVANTAGES OF SCLERAL TUNNEL INCISION:

- More surgery time.
- Requires cautery and the potential for subconjunctival haemorrhage and hyphaema.
- It cannot be performed under topical anaesthesia.
- Visibility during the phacoemulsification procedure is not better due to longer tunnel.
- Leaves superior conjunctiva disturbed for future trabeculectomy.
- Disturbs the filtering bleb in an eye with a functional bleb.

Cornea contributes almost 2/3rd of the refractive power of the eye. The full thickness incision made in the cornea can differentially affect the curvature of the cornea to varying amount, in different meridians. The site, size and types of the incision are the major determinants for this change. The more corneal, and larger the incision, more is the induced astigmatism. The wound apposition of the inner lip of the incision determines the degree of alteration in the curvature of the cornea. Postoperative

astigmatism depends primarily on the size, architecture and location of the incision. Self sealing tunnel incisions do not induce corneal changes caused by sutures. Thus the incisions are more than a port of access to the anterior chamber. It is the most important step during surgery affecting ocular integrity and corneal stability. Sutureless clear corneal incision technique provides major advantages like less ocular tissue manipulation and surgical time. Also a corneal incision means we do not need to cauterize the sclera at the limbus. Cauterization can contribute to astigmatism by causing contraction of the adjacent scleral and corneal lamellae.

The last two decades have seen a rapid advancement in cataract wound architecture.With advancements in technology of cataract surgery there has been a gradual trend toward smaller incisions, moving from superior sclera to temporal clear corneal incison, in an attempt to reduce intraoperative complications and postoperative astigmatism. [6]

Hence we are conducting this study to assess the merits and demerits of clear corneal with scleral tunnel incision in phacoemulsification.

AIMS AND OBJECTIVES

1)To assess postoperative visual acuity in patients with clear corneal and scleral tunnel incision in phacoemulsification.

2)To compare the postoperative astigmatism (type and amount) in phacoemulsification with the two incisions.

3) To analyse intra and postoperative complications if any in both.

REVIEW OF LITERATURE

Constantinus Africanus coined the term cataracta, meaning waterfall in latin but then it was just believed to be a coagulation of humours of the eye.[7]Around 1708 the exact cause of this white pupillary reflex got located to the lens and its pathology got defined.The era of cataract surgery can be dated to 1700 when Indians invented the practise of COUCHING(Dislocating the cataract from pupillary plane through a pars plana approach) and continued it for two centuries due to its satisfactory aphakic visual outcome.

Jacques Daviel[8] was the first surgeon to extract a cataractous lens from the eye useing an inferior incision.Pamard then shifted site to superior limbus for ease of surgery.This was the age of ICCE where incisions of 14,12,then 9 mm were used and sutured at the end.**Kratz** is credited for shifting limbal incision into the sclera.**Girard and Hoffman**[9] modified this into a sclerocorneal tunnel with a valve like effect allowing better apposition , healing and wound stability.ECCE had been introduced around 1970's and was here to stay. Introduction of PMMA IOL's by **Harold Ridley** necessitated an incision of 6.5mm for introducing them.Various suture techniques like

Shepherd's [10]single horizontal, **Fine's** [11] infinity, **Masket's** [12]horizontal anchor and **Fishkind's**[13] horizontal overlap were tried to improve stability as well as to reduce postoperative astigmatism. **Ernest**[14] and **Mc Farland** [15]realized the self sealing nature of a sclerocorneal tunnel thus negating need for sutures.Shape of incision then changed from smile to linear, chevron(**Pallin** [16]) and frown(**Singer** [17]) with better healing and less induces astigmatism.

Paul Koch [18]then described the concept of incisional funnel at a time when surgically induced astigmatism formed an important parameter postoperatively in defining the success of surgery.

With advent of technology in last 25 years, the present trend is sub 1 mm clear corneal temporal incision in phacoemulsification pioneered by **Kelman**[3] and implantation of a foldable multifocal IOL. From 17th century practise of couching to present day sub 1 mm phacos and rollable IOL's, cataract surgery has thus undergone a commendable revolution. The incision preferred by the majority of ophthalmologists in the United States today is the clear corneal incision.Most current incisions are designed to be suture free and self sealing.[19]A scleral tunnel incision or a limbal incision in most hands will seal if the geometry is correct.Corneal incisions still require sutures in some cases because of the nature of corneal tissue which resists stretching, and because of the tendency of the incision to tear during implant insertion.[20,21] Corneal incisions are usually located at the temporal aspect of the anterior segment which tends to counteract against the rule astigmatism found in the elderly population most commonly.[22,23]

According to **Kurt Buzard,** ' It is by no means certain that the shift of the external opening of the incision toward the cornea(from the sclera) is beneficial and in fact it is our contention that it is a negative development with disadvantages that are hidden by the smaller size routinely used for clear corneal incisions'.[24]With respect to iatrogenic astigmatism- there is a controversy over whether a superior scleral tunnel incision or a temporal clear corneal incision induces less astigmatism.If there is a difference, it appears to be a small one.But there is agreement over the fact that earlier stabilization occurs with scleral tunnel incisions.[25-27]

ANATOMICAL CONSIDERATIONS [28]

It is essential to know the anatomy of the eye with relation to the tissues manipulating before cataract surgery.

Anatomy of Bulbar conjunctiva and Tenon's capsule

Bulbar conjunctiva is a thin, transparent and loosely attached to the underlying Tenon's capsule by connective tissue strands. A 3mm ridge of bulbar conjunctiva around cornea is called limbal conjunctiva. In the area of limbus; the conjunctiva, Tenon's capsule and the episcleral tissue are fused into a dense tissue which is strongly adherent to underlying corneoscleral junction.

Anatomy of Cornea

It is a transparent, avascular structure occupies the centre of anterior pole of the globe and forms anterior 1/6th of the outer coats of eye ball. It is horizontally oval, with sclera and conjunctiva overlapping it more in the superior and inferior part. In adults, it measures 12mm horizontally and 11mm vertically, the central cornea is nearly spherical and measures 4mm in diameter. The posterior surface of cornea is more curved than anterior surface and circular. The cornea becomes flatter at the periphery more so in the nasal and superior regions. Radius of curvature of central part is 7.8mm anteriorly and 6.5mm vertically posteriorly. The central cornea is thinner and measures about 0.52mm whereas the peripheral cornea is about 0.9mm in thickness.The cornea constitutes the main refractive element of the eye. The refractive index of the cornea is 1.376 which gives the average anterior central region a refractive power of 48.8D .The concave posterior surface faces the aqueous which has lower refractive index 1.336, so that the refractive power 5.8D, giving the entire

cornea a refractive power of +43 D in air which is 3/4th of the total refractive power of eye (+60D).

Sclera

It forms the posterior 5/6th of the globe. It is covered by Tenon's capsule which also covers the recti muscles. Radius of curvature of sclera is about 12 mm. Sclera is thickest at the posterior pole measures about 1mm. It is thinnest at the insertion of recti muscles and measures about 0.3mm at equator it measures about 0.4mm-0.6mm and is about 0.8mm at the limbus.The peripheral cornea are about 0.9mm in thickness.

KASNER'SANATOMY OF SURGICAL LIMBUS

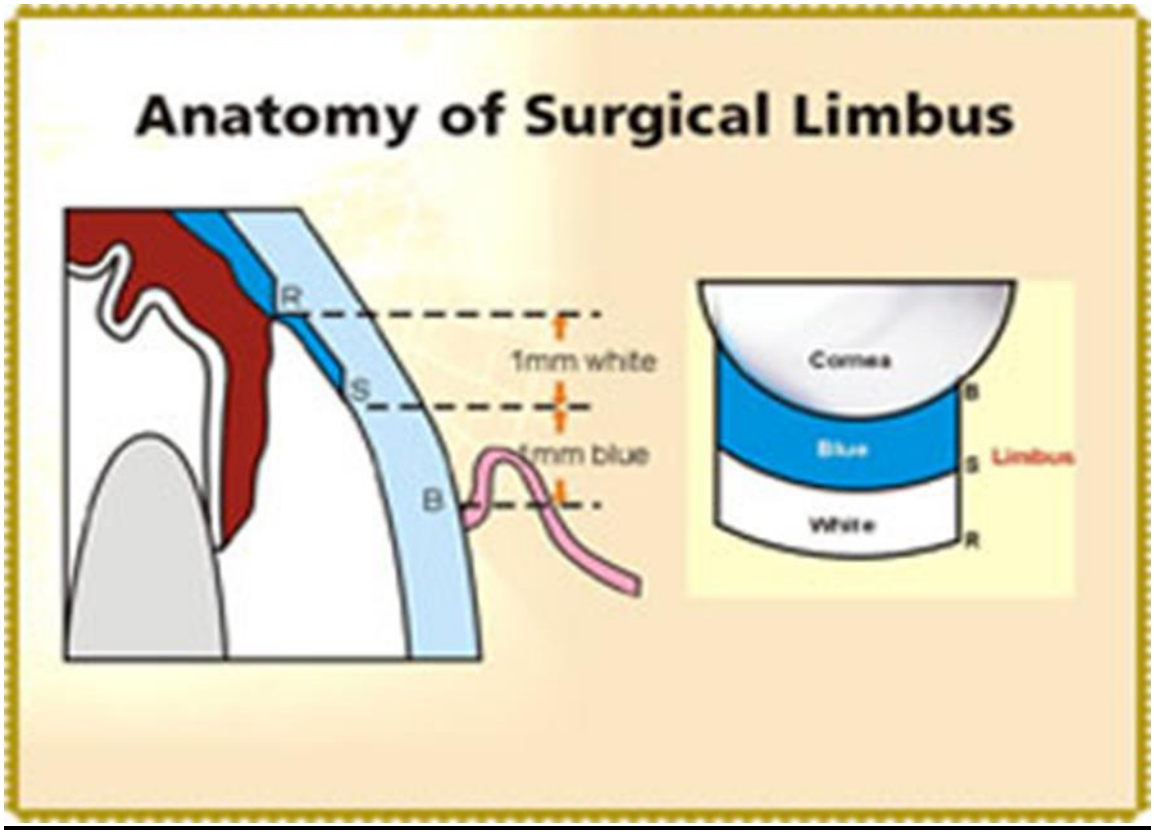


FIGURE 2:ANATOMY OF SURGICAL LIMBUS

Kasner[29] has linked surgical anatomy of the limbus to a tennis court.

1.Anterior baseline formed by the anterior limbal line identified by the insertion of conjunctiva and tenon's capsule into cornea.A bump marks this location and it overlies the termination of Bowman's membrane.

2.The net corresponds to the midlimbal line and marks the end of the blue zone extending posteriorly from anterior limbal line and start of a white zone.The net overlies Schwalbe's line i.e. termination of Descemet's membrane.Blue zone is over clear cornea but white zone overlies the trabecular meshwork.

3.The posterior baseline of the court corresponds to the posterior limbal border overlying the scleral spur or root of iris.

The blue zone is wider in superior (1mm) then inferior(0.8mm) and least in nasal and temporal quadrants(0.4mm).The white zone is constant all over(1mm).

SITES OF CATARACT INCISION ON SURGICAL LIMBUS

1. Scleral incision : it is located posterior to posterior limbal border. Its disadvantage is excessive bleeding and hyphaema.

2. Posterior limbal incision: It is located at white limbal zone. The underlying structure trabecular mesh work may be injured in this incision.

3. Mid limbal incision: Located at mid mid limbal line externally which corresponds to Schwalbe's line internally. Being safest, it is the preferred site of incision for entry into the eye.

4. Anterior Limbal incision : Located at in blue limbal zone and traverses the Descemet's membrane and may cause its stripping.

5. Clear corneal incision : Located in front of the anterior limbal border is associated with high induced astigmatism and also Descemet's stripping.

THE SCLERAL TUNNEL INCISION:

The scleral pocket incision was developed to provide a self sealing and an astigmatically neutral incison.[30,31].The incision size and configuration are determined by the surgeon's preference, and the chosen style of intraocular lens.The options for incision configuration include, linear shape or tangential to the limbus, smile shape or concentric to the limbus, and frown shape or opposite to the limbal curvature.The frown configuration minimises against the rule astigmatism and is reportedly the most astigmatically neutral of these incision.[32,33].A potential advantage of the frown incision is the difficulty in enlarging it,if conversion to ECCE is necessary.

The technique usually follows the creation of a conjunctival flap with the base at the fornix, and blunt dissection of the subtenon' space with scissors.Mild cautery of the bleeding conjunctival and episcleral vessels is performed with high frequency bipolar diathermy.The globe is fixated, and the scleral incision is then made in three steps.The first step is to mark the lateral limits of the scleral incision with callipers, followed by the creation of a vertical groove of a desired length and configuration 40 to 50% scleral depth, useing a microsurgical blade or a diamond blade held perpendicular to the surface of sclera. The second step is the creation of the scleral tunnel, with a rounded crescentric blade, dissecting a lamellar flap anteriorly through the sclera, 1 to 2 mm into clear cornea.The dissection is carried forward to descemet's membrane at the anterior edge of the vascular arcade.The last step is the advancement of the scleral tunnel incision, aiming the tip of the keratome toward the centre of the lens, dimpling the descemet's membrane of the cornea, before entering the anterior chamber creating

a triplanar self-sealing incision.The scleral tunnel must extend into the clear cornea to avoid the prolapse of the iris, damage to the structures of the chamber angle, fluid loss and a flat anterior chamber, and to create a valve effect which will seal the wound at the end of the surgery.Some of the disadvantages of the scleral tunnel incisions are that it can surgically induce astigmatism from the use of cautery to control bleeding conjunctival and episceral vessels, [34,35] presents a difficult access to the anterior chamber with limited movement of the surgical instruments and a difficult access to the lens nucleus, aspiration of the lens cortex, and IOL implantation.

FIGURE 3: SCLERAL TUNNEL INCISION

THE CLEAR CORNEAL INCISION:

The more advanced incision for phacoemulsification surgery is the clear corneal incision.The indications for clear corneal cataract surgery have expanded significantly since the last few years.Initially the indications were limited to those patients on anticoagulants, with blood dyscrasias, patients with cicatrizing diseases such as ocular pemphigoid or Stevens Johnson syndrome.However the greatest advantage of the clear corneal incision has been the ability to do surgery with topical anaesthesia. Another big advantage of clear corneal incisions is the tremendous safety with relative astigmatism neutrality, coupled with exceptional results.

This is a bloodless, self sealing, sutureless and quick incision, best performed temporally where the distance from the visual axis to the periphery is longer and accessibility to the eye is optimal.This temporal approach includes also better preservation of pre existing corneal configuration, and of the limbal zone at the 12'0 clock position in case of a future filtering surgery.It can be used to reduce the patient's natural astigmatism by approximately 0.50D in that merdian.[36,37]

This type of incision can be classified after Fine depending on:

1.LOCATION:

- Corneal tunnel incision:entry posterior to the limbus ,exit at the cornea- scleral junction.
- Corneal tunnel incision:entry just posterior to the limbus ,exit in clear cornea.
- Clear Corneal tunnel incision:entry and exit in clear cornea.

2.ARCHITECTURE:

- Single plane no groove.
- Shallow groove<400 microns.
- Deep groove>400 microns.

3.SIZE AND PLANAR CONFIGURATION:

- Single plane incision 2.5mm by 1.5mm, rectangular tunnel.
- Two plane incision 2.5mm by 1.5mm, rectangular tunnel.
- Three plane incision 2.5mm by 1.5mm, rectangular tunnel plus perpendicular arcuate component.

When making the incision decision must be made as whether to groove or not to groove, the external aspect to the incision.Non grooved single plane incisions utilize a 2.5mm to 3mm steel or diamond knife.[34]First the anterior chamber is filled with a viscoelastic agent through the paracentesis site, giving the eye stability prior to entry into the anterior chamber.The globe is then fixated with a fixation ring or forceps to avoid creating conjunctival tears, haemorrhages or corneal abrasions.The uniplanar incision is made inserting the blade in and out through the cornea at the surgical limbus, 1mm anterior to limbal vessels in the plane of the cornea until the shoulders, which are 2mm posterior to the point of the knife, touch the external edge of the incision.After the tip enters the anterior chamber , the initial plane of the knife is re-established to cut through Descemet's in a straight line configuration. A grooved triplanar self sealing clear corneal incision has three steps.The first step is the creation of an approximately 300micrometer deep, perpendicular incision to the corneal surface, 1 mm anterior to the limbal vessels useing a steel or preferably a calibrated diamond blade.The second step is the creation of a 1.75 to 2mm stromal tunnel

parallel to the iris plane, dissecting the corneal stroma in a lamellar fashion.The third and final step is to downward tilt the keratome blade 30 degrees toward the visual axis, in order to penetrate the anterior chamber.[35]The stability of the wound depends on construction of the internal valve, the total width of the incision, and the length of the tunnel.[36] Generally the clear corneal incision is limited to 4 or 5 mm in length in order to be self sealing.The use of a foldable IOL that could be inserted through a 3 to 4 mm incision allows the surgeon to perform a purely corneal sutureless tunnel of 1.5 to 2mm length, with minimal variation in pre existing astigmatism. Self sealing temporal clear corneal incisions are commonly used in cataract surgery because of the ease of construction and lack of bleeding.[37]When properly created, the clear cornea incision will seal by itself.This can be hastened by stromal hydration.

Stromal hydration is best accompanied by the injection of fluid via syringe attached to a 27 G cannula tightly against the lateral wall of the deeper layers of the incision causing immediate opacification.All properly created incisions usually seal after 1 to 2 mins when the stroma opposes properly.

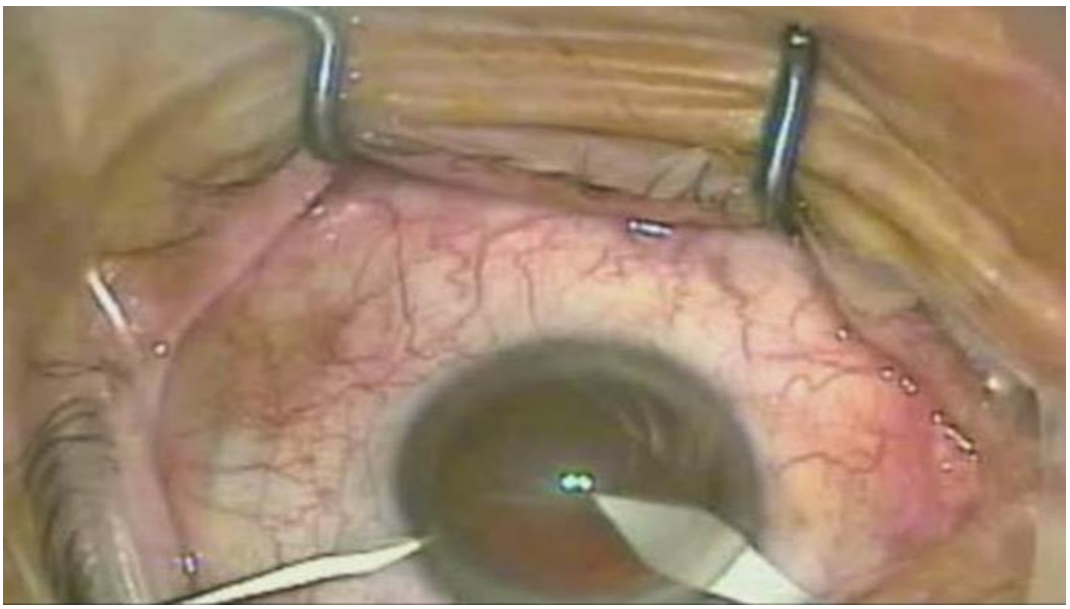


FIGURE 4:CLEAR CORNEAL INCISION

CATARACT INCISION AND WOUND HEALING [38]

Healing varies according to;

a) Location of incision, corneal, limbal or scleral.

b) Whether conjunctival flap has been used; if so, whether it is fornix based or limbal based.

c) Presence of sutures.

Most of the incisions located more towards the sclera anteriorly and cornea posteriorly. Thus healing usually involves scleral, limbal and corneal repair.

Healing of corneal incision

Immediately after completion of incision, the wound edges swell and become somewhat opaque because of imbibition of fluid by the injured corneal lamella (stromal hydration).Anterior and posterior triangle results because of retraction of the superficial and deep parts of the wound. Healing of anterior triangle starts within an hour after injury with the sliding of epithelium and mitotic activity of cells. Epithelial healing is very important because it provides oxygen necessary for collagen synthesis of stroma. Posterior triangle heals more slowly; endothelial cells produce collagen and polysaccharides of Descemet's membrane. The cells rearrange by sliding, thinning and mitosis.

Mitosis is greatest within 24-36hours after injury and disappears after 5 days of injury. The new basement membrane is produced by proliferating endothelial cells which gradually thicken after several months. However, the cut edges of Descemet's membrane never reunites and hence Descemet's membrane is absent over incision

area. Corneal stroma being avascular, healing occurs by fibrosis. Following injury neutrophils are carried to the site and there is swelling of wound edges, the glycosaminoglycans of corneal matrix disintegrate at the edge of the wound, this activates the stromal fibroblasts which migrate across the wound, laying down the collagen and fibronectin. The direction of collagen and fibroblasts is not parallel with the stromal lamellae. It is visible clinically as opaque.

Healing of limbal incision

Classical incision shows similar healing mechanism with some variations. The wound becomes filled by a mass of highly vascularised granulation tissue derived from the episclera. The anterior triangle becomes filled with fibrinous exudates from subconjunctival and episcleral vessels. This coagulation causes adherence of conjunctival flap to the underlying tissue. This is reinforced by ingrowth of fibroblasts connective tissue, which extends into the full thickness of the wound. Stromal fibrocytes do not play a role in healing of limbal incisions. Remodeling of wound is slow and may take as long as 2 years.

Healing of scleral incision

Healing of scleral incision differs greatly, when sclera is incised its fibers do not swell but tend to contract, there are no epithelial and endothelial surfaces to bridge the gap the stromal cells of sclera hardly take part in the healing of a wound so that healing by minimal intention does not occur.

Instead highly vascular tissues on one side or the other, the episclera or uvea actively participates in the repair while the sclera itself plays a more or less passive role. Within 24 hours after incision the region is invaded by leucocytes which originates

from the vessel in the neighbourhood, their role is mainly phagocytic, to remove injured tissue. After 48hours, leucocytes disappear and area is dominated by the activity of histiocytes and vascular elements mainly derived from episcleral and conjunctiva. The sclera itself remains relatively inert with edges of wound remaining clear, while the proliferating fibrous tissue run between them at right angles. Healing of a scleral incision therefore, has been related to the secondary intention. The scleral incisions do not heal as effectively as corneal and limbal incisions. However when a scleral incision is used, it usually does not remain scleral in its entire depth. It usually beveled or made in the planes so that deeper portion assumes the characteristics of limbal or corneal wound healing.

Healing of Sclerocorneal tunnel

Sclero-corneal tunnel healing is complex because the initial groove and peripheral portion of the tunnel are in sclera. The tunnel goes through the limbus into the peripheral cornea and the anterior chamber entry is corneal. According to Jaffe, the healing process is different in each of the 3 zones.

Immediately after an incision, the corneal fibers swell in an attempt to seal the opening, but scleral fibers contract. About 2days after the scleral incision, histiocytes and vascular elements from the episclera and subconjunctiva move into the incision and proliferating fibrous tissue begins to form, running at right angles to the clear cut scleral edges. After several weeks, the fibers begin to align themselves like scleral fibers but the scar is always histologically distinguishable. The sclera itself remains inert. In the limbal portion of the tunnel which is entirely midstromal, stromal fibroblasts are inactive and play very little role in wound healing. Healing of limbal stroma depends upon fibrous ingrowth from the episclera. It may take as long as 2

years or more for stroma to become relatively normal. Once the incision passes into peripheral corneal stroma the healing process is different initially after incision there is 3-5day lag phase during which the corneal fibrocytes transform into fibroblasts. Which then form new connective tissue, At least a month is required for consolidation. At anterior chamber entry, the cut edges of the Descemet's membrane does not reunite 24-48 hours after injury, endothelial cells at the edge of the wound begins to proliferate to cover the retracted edges of Descemet's membrane. Proliferating endothelial cells produce a new basement membrane, which after 2-3 years, thickens to form new Descemet's membrane which is half of the original thickness evidence suggests that scleral pocket incision probably do not heal any faster than the limbal incision.

ASTIGMATISM AND ITS ROLE:[39]

Corneal astigmatism and its effect as a postoperative refractive error has been an undesirable but inevitable byproduct of cataract surgery since the first limbal incision was made.A metamorphosis in the techniques used has greatly attenuated SIA. Astigmatism is a condition of refraction wherein unequal refraction is produced in the two principle meridians and hence a point image cannot be formed on the retina thus blurring the image.(A-privative; stigma-point). It was first considered in 1727 by Sir Isaac Newton who found himself suffering from it. Thomas Young in 1801 then attributed cause to lens after his experiments on oneself immersed in water to negate corneal surface as the cause. The Cambrige astronomer Airy in 1827 was the first to

correct this error with a cylinder. Finally in 1864, Donders provided with the detailed concept of astigmatism as an optical condition and its treatment aspects.

TYPES OF ASTIGMATISM BASED ON THE SITE OF ASTIGMATISM:

1.CORNEA(70%)

(Curvatural type only significant)

-Congenital.

-Acquired.e.g Lid mass, scar post trauma or corneal disease, surgery induced.

2.LENS

-Curvature e.g. keratoconus.

-Refractive index e.g. early cataract.

-Centration e.g. subluxated lens, decentered/tilted lens.

3.RETINA(Only theoretical)

Optically speaking in astigmatism the two principle meridians refract light to form two focal lines, the interval between which determines amount of astigmatic error.

It is classified into following types:

1.REGULAR-Principle meridians(Max and min power) are 90 degrees apart.It can be either of the following-

a)With the rule(Direct): Vertical meridian(90 degrees axis) is steeper.

b)Against the rule(Indirect/Inverse): Horizontal meridian(180 degrees axis) is steeper.

c)Oblique:Principle meridians are 90 degrees apart but lie at any axis other than 90 or 180.

d)Bioblique:Principle meridians are not at right angles to each other but still resolvable into a correctable sphero cylindrical combination.

The correction of these types of astigmatism can be done by giving a cylinder at 90 or 180 axis itself, if it lies within 10 to 15 degrees on either side respectively.[40]

2.IRREGULAR:

-Principle meridians are not 90 degrees apart so not correctable with spectacles.

Normally corneal vertical meridian is 0.25-0.5D steeper than horizontal and hence with the rule type of regular astigmatism.It has been found to reverse in old age giving an against the rule type of regular astigmatism due to pressure effects of lids.

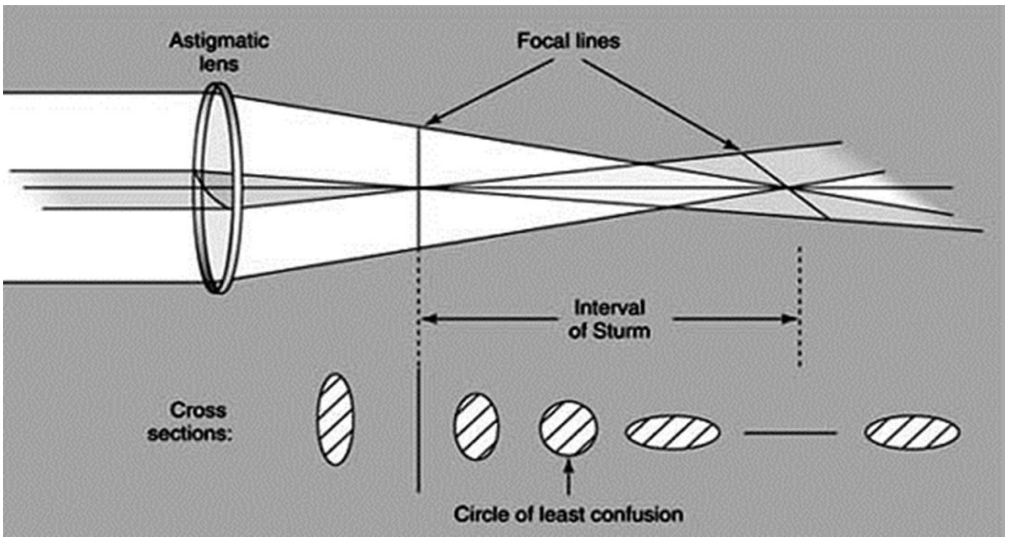


FIGURE 5:STRUM'S CONOID

The retinal image formed in this error is explained on the basis of Sturm's conoid(After mathematician who described it in 1838).

Accordingly it is further classified into

1.Simple-One meridian is emmetropic with focal point on retina and the other can be-myopic or hypermetropic.

2.Compound:Both meridians form an image either in front of (myopic) or behind(hypermetropic) the retina.

3.Mixed:One meridian is myopic and the other is hypermetropic and a circle of least diffusion or confusion falls on the retina allowing for slightly better vision compared to others.

SYMPTOMS:

In none of the above types does a clear image form and hence visual acuity suffers.Attempts to focus on near emmetropic focal line by accommodating is usually seen with a preference for the vertical merdian and thus all objects seem to be vertically distorted.This leads to peculiar vision problems with circles like ovals, point with a tailing off, line with vertical strokes and so on. The constant accommodation effort causes asthenopia and eye strain especially in smaller errors(as induced by surgery) worse with hypermetropes.With larger errors image is so blurred that the effort to accommodate is not attempted.

FIGURE 6: ASTIGMATIC VIEW

A patient thus presents with a gamut of nervous disturbances like headache, dizziness, fatigue and irritability. A correction is mandatory with any of these symptoms. Post operatively measured astigmatism has been found to be better tolerated and proposed to be due to change in refractive index of IOL(1.53) from crystalline lens(1.39-1.41). With the rule type and mixed astigmatism as seen earlier are tolerated better and this acceptance has been found to correlate with SPHERICAL EQUIVALENT especially because its focal point then falls on the circle of least confusion.

SE=Ds+1/2Dc

e.g.simple myope>Mixed astigmatism>compound myope(acceptance).

Henning A, Kumar J, Yorston D, Foster A(2003)[41] in their prospective study on outcomes of sutureless cataract surgery in 500 eyes found the main cause of poor vision(<6/18) postoperatively in around 85.5% cases was induced ATR.

Ahmad I,Wahab A, Sajjad S, Untoo R(2005)[42] studied visual rehabilitation of 115 eyes following cataract surgery.95.6% patients had vision>6/12 with mean SIA of 0.69 D.27 patients with <6/12 vision had ATR of 0.5-1D and 2 others had>1.5D ATR and was cited to be the cause for poor vision.

Factors affecting postoperative astigmatism as follows:[43]

A)Preoperative:

1.Pre existing astigmatism:

-The final astigmatic error depends to a larger extent on the preoperative astigmatism.Some surgeons attempt to leave the cornea with upto 1.5D of WTR astigmatism to enhance contact lens fitting or increase the depth of focus for near vision.Others attempt to correct the preoperative astigmatism during cataract surgery by varying the various surgical factors like incision, suturing or timing of suture removal.

2.Corneal diseases e.g. scars, pterygium:

-Leads to disturbances in the corneal curvature and influencing astigmatism.

3.Scleral disease e.g.thinning, buckle.

B)Intraoperative:

1.Wound parameters

- Length.

-Shorter incision(0.5mm) produce significantly less keratometric astigmatism than longer incision(10-11mm).

- Location.

-Many reports have stated that more anterior incisions induce more astigmatism, with clear corneal incision producing the most.Thereotically the more anteriorly the surgeon incises, the greater the effect a given manipulation will have on the central corneal curvature.

- Shape.

-Recently the concept of astigmatism neutral zone has been introduced wherein the presence of an astigmatism neutral funnel shaped zone has been hypothesized.It is held that a wound placed entirely within the confined of the funnel will have negligible effect on postoperative induced astigmatism.

- Architecture.

2.Suture parameters:

a) Suture length: Suture produce a zone of compression that equals the length of the sutures.Hence long sutures placed close to each other create significant tissue compression leading to WTR astigmatism.Widely placed sutures on the other hand, permit wound slippage and hence causes ATR astigmatism.Sutures that are separated by a distance that equals their length cause minimal astigmatic change.Sutures 1.5mm long are optimal for cataract surgery with the length of the bites being equal on each side of the section.

b)Suture tightness:Loose sutures permit wound edge separation and this leads to ATR astigmatism.Tying sutures with the anterior chamber not fully pressurised produces excess WTR astigmatism.

c)Suture depth:Sutures that are too superficial tend to cut through and permit wound edge slippage leading to ATR astigmatism.Thick sutures if placed deep can erode through due to necrosis of underlying tissue.The two lips of the wound should have the suture at the same depth for optimal apposition.

d)Suture orientation: Sutures should always be oriented radially.Non radial sutures causes lateral displacement of the lips and hence lead on to astigmatism.

3.Cautery.

-The long term affects of cautery may give rise to unacceptable level of postoperative astigmatism by two mechanisms:

a) Heat induced scleral shrinkage.

b)Closure of capillaries and small vessels which affect the wound healing process.

Hence cautery should be used sparingly if at all during cataract surgery.

4.IOL-tilt and size.

C)Postoperative:

1.Wound healing.

2.Suture related problems as mentioned above.

3.IOP.

4.Contact lens wear:

-Leads to alterations in the anterior surface of cornea and thus affecting corneal curvature.

Many studies have found a strong correlation between the refractive cylinder and keratometry readings in patients thus concluding that post operative astigmatism is mainly corneal in origin.

Objective means of determining amount of astigmatism[44] could be either of the following:

A)Measuring corneal curvature:

The anterior corneal surface reflects a part of light incident on it and hence acts like a convex mirror.Its curvature thus can be studied from the catoptrics image thus formed.It is achieved by:

1.Keratometry(ophthalmometer)[45]:

The 'keratometry' or 'ophthalmometry' is an objective method of estimating the corneal astigmatism by measuring the curvature of central cornea. The keratometry readings are not of much value in routine refraction for prescribing glasses; but are of utmost value for prescribing contact lenses and for calculating the power of intraocular lens to be implanted.

Principle. Keratometer is based on the fact that the anterior surface of the cornea acts as a convex mirror; so the size of the image produced varies with its curvature. Therefore, from the size of the image formed by the anterior surface of cornea (first Purkinje image), the radius of curvature of cornea can be calculated. The accurate measurement of the image size is obtained by using the principle of visible doubling.

Types. Two types of keratometers used in practice are Javal-Schiotz model and Bausch & Lomb model.

The Javal-Schiotz model keratometer consists of two illuminated ‘mires’ (A and B) fixed on a rotatable circular arc (C) and a viewing telescope T.The double images (aa1 and bb1) of the mires (A and B) are formed on the cornea. Keratometry readings are obtained by coinciding the images a1 and b as Shown in figure 8. The readings are noted first in the horizontal meridian and then the arc is rotated by 90 degrees and the readings are noted in the vertical meridian.

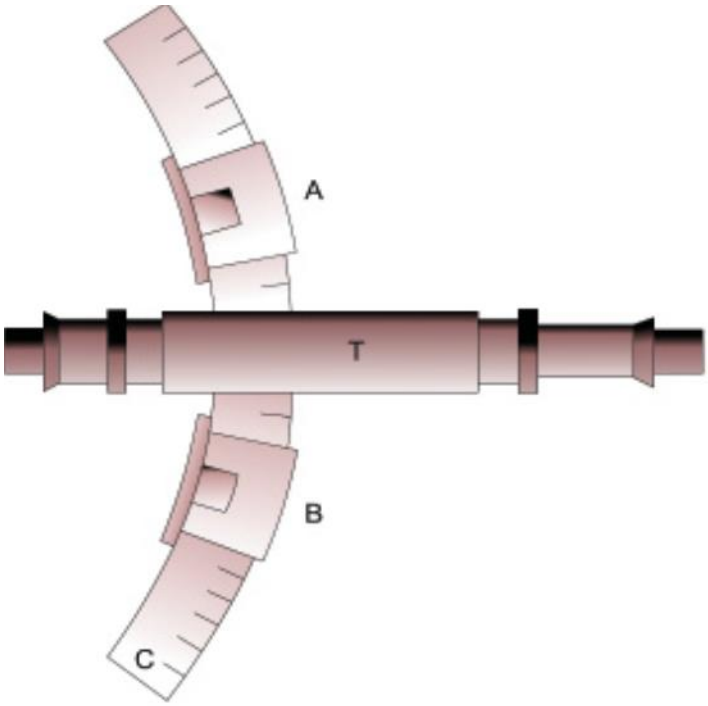


FIGURE 7:BASIC STRUCTURE OF JAVAL AND SCHIOTZ MODEL KERATOMETER.

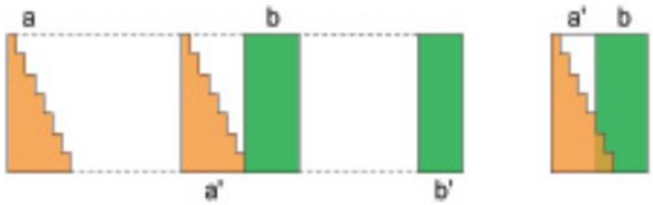


FIGURE 8:MIRES DURING KERATOMETRY WITH JAVAL AND SCHIOTZ MODEL KERATOMETER

Bausch & Lomb keratometer: In it, the ‘mires’ are in the form of circles . With this keratometer the radius of curvature of cornea in horizontal and vertical meridia can be measured simultaneously without rotating the mires.

FIGURE 9 :BAUSCH AND LOMB KERATOMETER

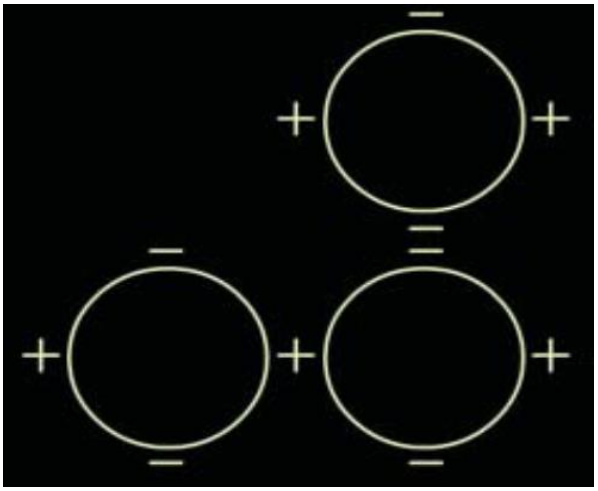


FIGURE 10 : MIRES DURING KERATOMETRY WITH BAUSCH AND LOMB KERATOMETER.

Keratometry measures corneal curvature in two meridians perpendicular to each other in both dioptres and mm.It measures only central 3mm optic zone and hence changes

in peripheral cornea are missed out on such measurements.The two meridians taken would be:

a)Kh:Horizontal axis and 60 degrees on either side of 180.

b)Kv:Vertical axis and 30 degrees on either side of 90.

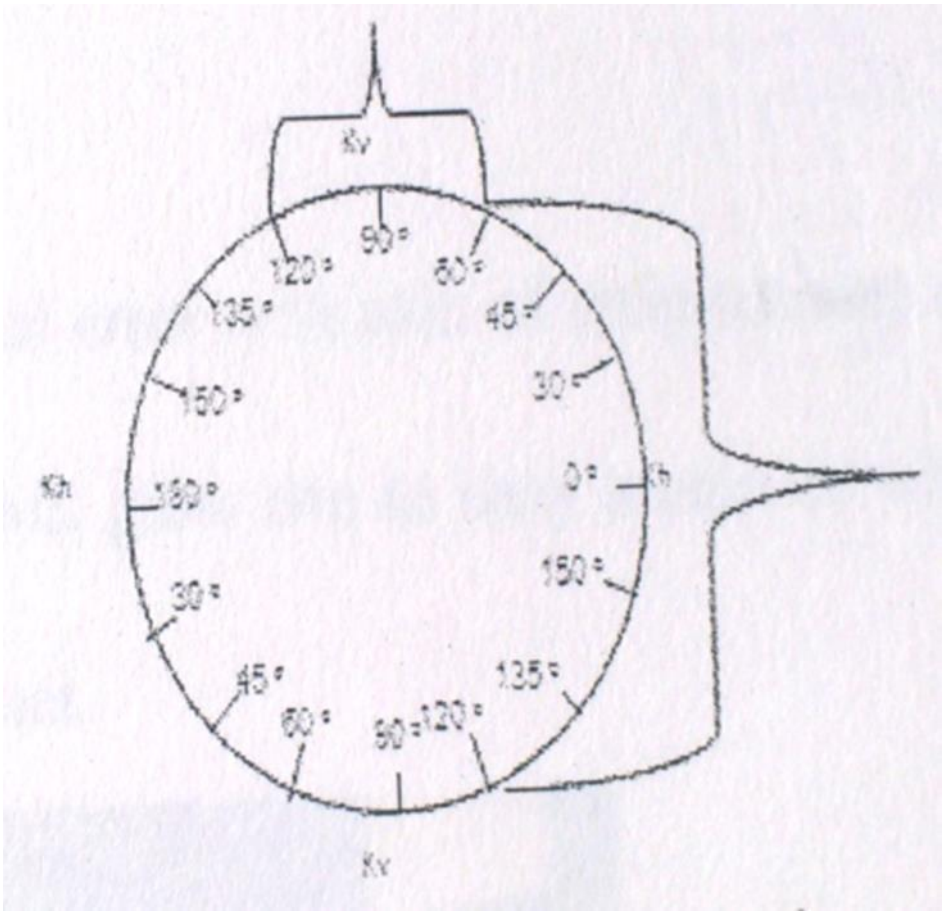


FIGURE 11: AXIS OF ASTIGMATISM

TYPES OF KERATOMETRY:

Surgical Keratometry

Intraoperative keratometry offers the surgeon as excellent opportunity to asses the corneal curvature and helps the surgeon to actually select a desired level of early post operative astigmatism and enables quicker visual rehabilitation.

Qualitative keratometry

Qualitative devices reflect a circle or circles on to the corneal surface allowing estimation of cylindrical axis and power by the pattern produced. Troutman et al designed a qualitative surgical Keratometer by mounting ring of the fibre optic lights on the surgical microscope.

Semi qualitative Keratometer

Hyde astigmatic ruler is an example. It consists of a flat aluminium rod with milled apertures. The first aperture is circular and the rest are elliptical, representing 2, 4, 6 and 8 D of cylinders.

Quantitative keratometry

It can measure the changes in astigmatic magnitude as little as 0.25 D. An illuminated circle of known size is projected on to the optical cornea and the radius of curvature of the cornea is determined by the size of the reflected image.

Automated keratometer:

The reflected image of target is focused on to a photodetector which measures the image size and radius of curvature is computed.The target mires are illuminated with infrared light and an infrared photodetector is used.

Interpreting the findings of keratometry:

Spherical cornea is characterized by:

-No difference in the power between two principle meridian.

-The mires seen as perfect sphere.

Astigmatism is characterized by:

-Difference in the power between the two principle meridian.

-Horizontally oval mires are seen in with the rule astigmatism.

-Vertically oval mires are seen in against the rule astigmatism.

-In oblique astigmatism, the principle meridian are between 3-60 degrees and 120-150 degrees.

Irregular anterior corneal surface is characterized by:

-Irregular mires.

-Doubling of mires.

Clinical uses of keratometers:

-It helps in measurement of corneal astigmatic error.

-It helps to estimate the radius of curvature of the anterior surface of cornea.So it is of great use in contact lens fitting.

-Keratometer is used to monitor the shape of the cornea in keratoconus and keratoglobus.

-We may be able to assess the refractive error in cases with hazy media.

-Keratometer has gained a special place in IOL power calculation.

-It is used to monitor pre and post surgical astigmatism.

-It is used for differential diagnosis of axial versus curvatural anisometropia.

-It is used to detect rigid gas permeable lens flexure.

Practical limitations of keratometry:

Keratometry readings cannot be used directly for refractive correction because:

1) The refraction at the posterior corneal surface is neglected. Tschering found that this may be as much as 0.5 D usually of against the rule type.

2) In phakic eyes, lenticular astigmatism is neglected. This may again amount to the 0.5 D approximately.

3) Keratometry reading does not give the strength of correcting spectacle lenses. The refractive power of the spectacle worn at a vertex distance of 12-13 mm is very different from the keratometry readings.

4) The range of each type of keratometer is different. The range of Bausch and Lomb keratometer is from 9.38mm (+36 D) to 6.49mm (+52 D) which is adequate in most of the cases. By attaching a +1.25D lens over the aperture of the instrument, the upper range can be increased up to +61D for measurement of corneal curvature in conditions like keratoconus. By attaching -1.0D lens, the lower range of the instrument can be extended up to +30 Dioptres.

2.Placido's disc:Simplest and oldest method wherein concentric and equally spaced mires are projected into the cornea from a flat disc and images produced are visualized through a central aperture for any distortion.The astigmatic meridian appears closer and shorter along steeper axis.

FIGURE 12 :PLACIDO's DISC

3.Topography:Computerized analysis of thousands of points on anterior surface with detection of even minor variations and quantitative data for comparison as well.Larger area of the cornea is scanned and analysis of specific patterns possible by computer itself but usually reserved for refractive surgeries alone.[46]

FIGURE 13 :CORNEAL TOPOGRAPHY MACHINE

4.Terry's intraoperative keratometer:Its very useful on the surgical table and is similar to placido's disc with mires which get distorted along astigmatic axis.Accordingly sutures can be placed or released depending on the desired correction.

B)Determining total astigmatic error:

1.Automated refractometer: Gives measures of total error with axis of astigmatism as well.It is especially useful in patients with dull glow due to hazy media or with irregular astigmatism which is difficult to refract.

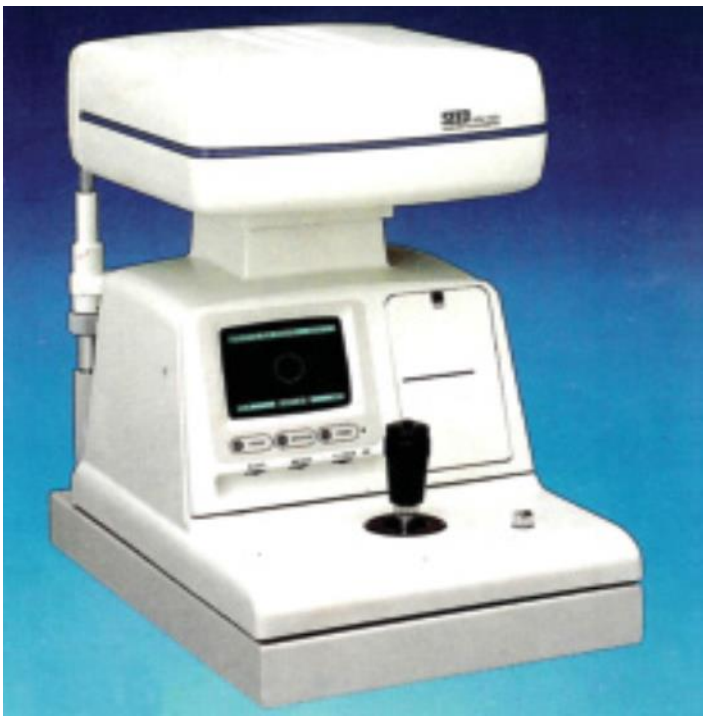


FIGURE 14 :COMPUTERIZED REFRACTOMETER

2.Retinoscopy:Gives total error which includes lenticular astigmatism and spherical correction too.The two principle meridians can be refracted separately and final neutralization calculated together.It can be simultaneously checked for subjective verification for a final prescription.

FIGURE 15:MIRROR RETINOSCOPES

FIGURE 16 :STREAK RETINOSCOPE

3.Astigmatic fan and Jackson's cross cylinder both of them have been used to accurately get axis as well as power of the corrective cylinder.

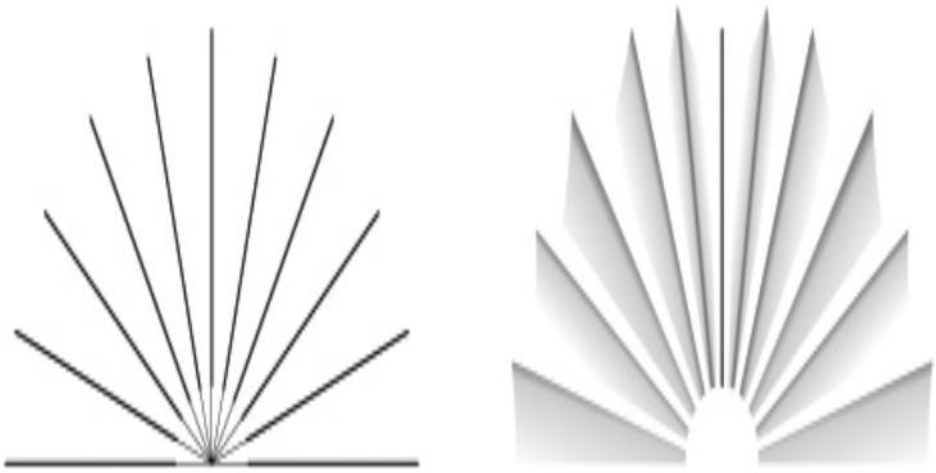


FIGURE 17 :ASTIGMATIC FAN TEST

FIGURE 18 :JACKSON'S CROSS CYLINDER

Methods to measure SIA[47]

1.Scalar analysis-It involves direct subtraction of postoperative cylinder from preoperative cylinder without taking axis into consideration.

2.Vector analysis[48]-This was introduced by Cravy and Holladay and found to be superior to scalar one.It uses the property of a cylinder to have both amplitude(power) and direction(axis) similar to a vector thus allowing for a direct calculation of a resultant vector after subtraction of the pre from the post op cylinder.

3.Trignometric-This also uses vectorial property of a cylinder to plot each value on a graph from which useing trigonometric functions the resultant co-ordinates can be deduced.

4.Naeser's polar value analysis:[49] This is the most accurate method being used presently and involves conversion of the net astigmatic values into orthonormal components in dioptric space called as polar values.Any such pair separated by an arch of 45 degrees thus represents the net curvital and tortional power over that specific meridian.

COMPLICATIONS OF PHACO:

- OPERATIVE COMPLICATIONS
- COMPLICATIONS IN GENERAL:

– DM's tear by phaco tip

– Faulty incision may lead to greater astigmatism.

– Too small a capsulotomy can result in inadvertent inferior tears during trenching .

- Too large capsulotomy- can result in premature and persistent luxation of the lens into the anterior chamber making nucleus related procedures difficult.

• Complications related to hydro procedures- peripheral extensions of tear,chamber collapse.

CORNEAL COMPLICATIONS:

• Heat may be transferred from the probe to the cornea

– Corneal burns-contraction of corneal collagen- distortion of wound- wound leak.

• Holding phaco tip too close to the corneal endothelium – allows the ultrasonic energy to cause endothelial cell loss.

-Allowing lens fragments to circulate in the A.C. without adequate viscoelastic protection can contribute to endothelial cell loss.

COMPLICATIONS FROM RETAINED LENS MATTER:

• Uveitis.

• Corneal edema.

• Glaucoma.

• Cystoid macular edema.

• Retinal detachment.

POST. CAPSULAR TEAR:

Causes:

• Radial capsular tear from rhexis margin may extend onto the post capsule

• Use of high power for soft nucleus.

- During aspiration of 12o clock cortical matter.

POST OP COMPLICATIONS:

1.Wound leak.

2.Postoperative iritis.

3.Post operative glaucoma.

4.Corneal edema.

5.Capsular block syndrome.

LATE COMPLICATIONS:

1.Endophthalmitis.

2.Retinal complications.

3.Glaucoma

4.Posterior Capsular opacification.

5.Cystoid macular oedema.

IMPORTANCE OF POSTOPERATIVE VISUAL ACUITY:

Cataract is a highly treatable condition due to dramatic advances in cataract surgery procedures and intraocular lens design. In developing countries surgery is generally performed when cataract affects patient's daily activities.The aim of cataract surgery is to improve visual function with the assumption that this will also improve overall quality of life. The gains from cataract extraction are usually demonstrated clinically by the change in the Snellen's visual acuity in the eye that had surgery. The impact on

visual function or quality of life has not usually been considered as a separate issue, partly as these have been assumed to follow the improvement of visual acuity.

Visual impairment from cataract is associated with difficulties with activities of daily living and reduces quality of life. Quality of life related to health involves different problems for validation. One is the objective part, which is the functional status of the individual, and the other is the subjective feeling of health and welfare which includes physical, social and psychological functionality.The goal of cataracts surgery is to improve visual acuity and therefore the visual function, considering that it entails improvements in quality of life.

MATERIALS AND METHODS

TITLE OF THE STUDY:

"COMPARATIVE STUDY OF CLEAR CORNEAL VERSUS SCLERAL TUNNEL INCISION IN PHACOEMULSIFICATION"

SOURCE OF DATA:

Eighty patients attending to out patient department of ophthalmology, R.L.JALAPPA HOSPITAL AND RESEARCH CENTRE attached to SRI DEVARAJ URS MEDICAL COLLEGE, TAMAKA, KOLAR with senile cataract fulfilling the inclusion criteria framed were selected for phacoemulsification under peribulbar anaesthesia between December 2011 to July 2013 .

SAMPLE SIZE:

A total number of 80 patients with senile cataract were selected for the study . These patients were divided into two groups :

Group A: Phacoemulsification with clear corneal incision-40 patients

Group B: Phacoemulsification with scleral tunnel incision-40 patients

INCLUSION CRITERIA:

Senile Cataracts(Nuclear sclerosis grades 1,2,3) having astigmatism < 1.25D.

EXCLUSION CRITERIA:

1. Preexisting astigmatism > 1.25D and oblique astigmatism.

2. Previous ocular surgery.

3. Cases of cataracts with glaucoma.

4. Cases of cataract with pseudoexfoliation.

5. Coexisting ocular pathology.

PREOPERATIVE EVALUATION.

- Full history of any previous ocular disease or surgery.
- Visual acuity recording by Snellen's chart and retinoscopy.
- Detailed slit lamp examination.
- Examination by both direct and indirect ophthalmoscopy.
- Ultrasound B scan was done on patients with hazy media to evaluate posterior segment.
- Applanation tonometry.
- Lacrimal sac syringing.
- Keratometry .
- A scan with intraocular lens power calculation by SRK-2 formula .
- General physical and systemic examination including cardiovascular system and respiratory system examination.
- Blood pressure recording and blood sugar estimation was done.
- Sensitivity to local anaesthetics tested.
- Informed and written consent for surgery.

SURGICAL TECHNIQUE

All patients were given systemic antibiotics (tablet ciprofloxacin 500mg b.d.) on the preoperative day. On the day of surgery pupils were dilated adequately using instillation of 0.8% tropicamide and 5% /10% phenylephrine eye drops every 10 minutes, one hour before surgery. To sustain the pupil dilatation the anti-prostaglandin eye drops such as flubiprofen was instilled three times one day before surgery and half hourly for two hours immediately before surgery.

SURGICAL TECHNIQUE IN GROUP A:

The eye to be operated is painted, draped and prepared for surgery under aseptic precautions.

1. Local anesthesia, peribulbar block is given using 2% xylocaine with adrenaline mixed with 1500 units of hyaluronidase and 0.5%Bupivacaine.

2. Universal wire speculum applied.

3. a) In group A- 2.8mm triplanar clear corneal incision was made in superior temporal quadrant 1mm anterior to anatomical limbus followed by phacoemulsification.

4. Side-port entry was made with the help of 1.5mm valvular corneal incision at 9 0 clock position.

5. Anterior capsulotomy by continuous curvilinear capsulorrhexis of adequate size was done.

6. Hydrodissection was done to separate cortico-nuclear mass from the posterior capsule.

7.Hydrodelineation was done.

8. Phacoemulsification was performed by divide and conquer technique.

9. Irrigation and aspiration of the remaining cortical matter was done

10.Foldable intraocular lens placed in the capsular bag.

10.The viscoelastic cleared from the anterior chamber.

11. Subconjunctival gentamycin(20mg) and dexamethasone(1mg) was given at end of the procedure.

SURGICAL TECHNIQUE IN GROUP B:

1.Local anaesthesia, peribulbar block is given using 2% xylocaine with adrenaline mixed with 1500 units of hyaluronidase and 0.5%Bupivacaine.

2.Universal wire speculum applied.

3.Superior rectus(Bridle) suture is passed to fix the eye in downward gaze.

4.A small fornix based conjunctival flap is made and sclera is exposed superotemporally.

5.Hemostasis is achieved by applying gentle and just adequate wet field cautery.

b) In group B- 2.8 mm scleral triplanar incision was made in superior temporal quadrant 1to1.5mm posterior to limbus followed by phacoemulsification.

6. Side-port entry was made with the help of 1.5mm valvular corneal incision at 9 0 clock position.

7. Anterior capsulotomy by continuous curvilinear capsulorrhexis of adequate size was done.

8. Hydrodissection was done to separate cortico-nuclear mass from the posterior capsule.

9.Hydrodelineation was done.

10. Phacoemulsification was performed by divide and conquer technique.

11. Irrigation and aspiration of the remaining cortical matter was done

12.Foldable intraocular lens placed in the capsular bag.

13.The viscoelastic cleared from the anterior chamber.

14. Subconjunctival gentamycin(20mg) and dexamathasone(1mg) was given at end of the procedure.

Postoperatively all patients received a course of topical antibiotic and steroid eye drops second hourly for a week, followed by a tapering dose for 6 weeks along with Flurbiprofen eye drops 0.03% 3 times a day for 4 weeks. Systemic antibiotic Tab Ciprofloxacin 500mg was given for 1 day before and continued for 5 days postoperatively. Tab Diclofenac stat was given in case the patient complained of pain.

Post operatively visual acuity unaided and with pinhole vision, keratometry and complications if any was recorded in each patient postoperatively on first day, first week, first month and third month. Postoperative astigmatism was evaluated by Baush and Lomb keratometry readings. Amount of astigmatism was calculated using only scalar analysis i.e. by subtracting the two K readings on that day.

Any intraoperative and postoperative complications if present is noted.

Important complications noted such as

- Faulty incision problems.
- Corneal burns.
- Descemet membrane tear.
- Posterior capsular tear.
- Wound leak.
- Post operative iritis.
- Postoperative glaucoma.
- Posterior capsular opacification.
- Capsular blockage syndrome.
- Cystoid macular edema.
- Retinal detachment.
- Endophthalmitis.

STATISTICAL ANALYSIS

Median and range for group A and Group B were calculated. Postoperative visual recovery in between the two groups was compared by Mann Whitney u test.Mean and standard deviation for group A and group B were calculated.Postoperative astigmatism in between the two groups was compared by chi square test.

OBSERVATION AND RESULTS

A prospective, comparative study of clear corneal versus scleral tunnel incision in phacoemulsification was conducted at R.L.Jalappa hospital attached to Sri Devaraj Urs Medical College. 80 cases were studied, of which 40 cases underwent clear corneal incision and remaining 40 cases underwent scleral tunnel incision.

TABLE 1: AGE DISTRIBUTUION

AGE	**GROUP A(CLEAR CORNEAL INCISION)**		**GROUP B(SCLERAL TUNNEL INCISION)**	
RANGE(YRS)	NO. OF PATIENTS	%	NO. OF PATIENTS	%
51-60	8	20	10	25
61-70	**22**	**55**	**21**	**52.5**
71-80	10	25	9	22.5
>80	-		-	
TOTAL	**40**	**100**	**40**	**100**

P=0.9, chi-square test

In the present study out of 40 patients in each group majority of the patients were in the age range of 61-70 yrs i.e. 22 (55%) patients in group A and 21 (52.5%) patients in group B. 8 (20%) patients in group A and 10 (25%) patients in group B in the age range of 51-60yrs. 10 (25%) patients in group A and 9 (22.5%) patients in group B were in the age range of 71-80yrs. p value by chisquare test showed 0.9, indicating no statistical significance.

GRAPH NO 1: AGE DISTRIBUTION

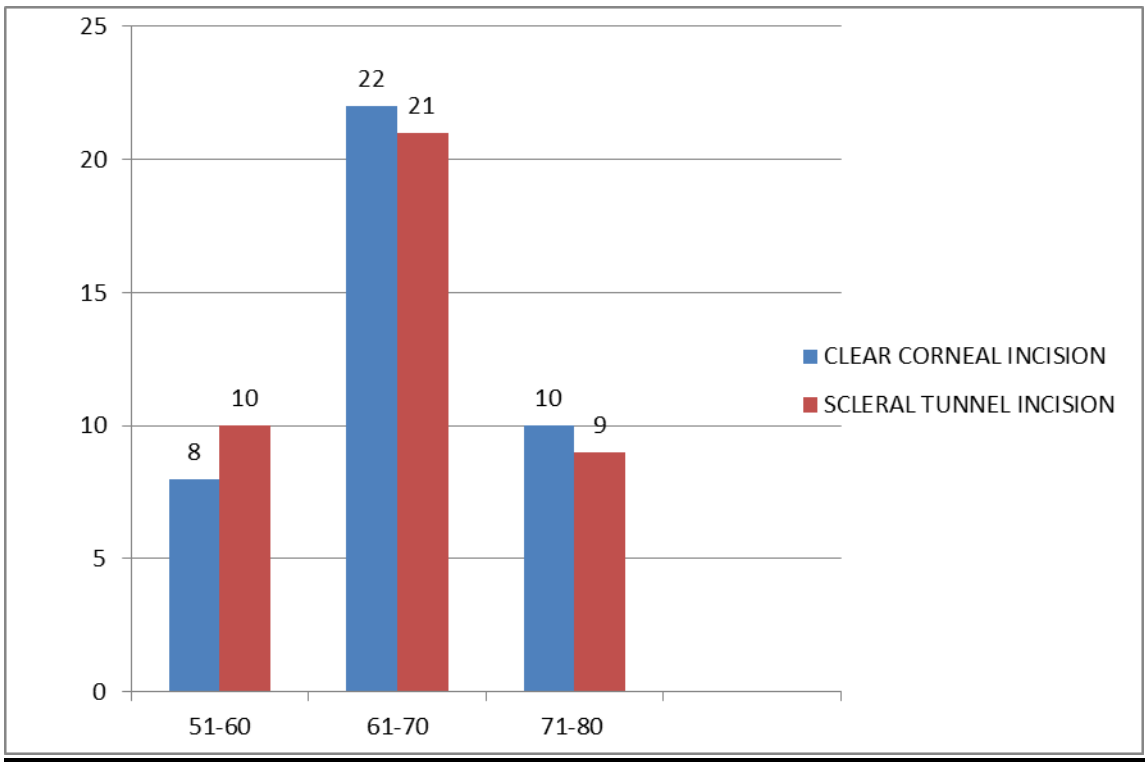


TABLE NO 2:SEX DISTRIBUTION

	GROUP A(CLEAR CORNEAL INCISION		**GROUP B(SCLERAL TUNNEL INCISION)**	
SEX	NO.OF PATIENTS	%	NO.OF PATIENTS	%
MALE	20	50	22	55
FEMALE	20	50	18	45
TOTAL	**40**	**100**	**40**	**100**

P=0.08, chi-square test

In the present study in group A 20(50%) patients were male and 20(50%) were female.In group B 22(55%) patients were male and 18(45%) patients were

female. p value by chisquare test showed 0.08, indicating no statistical significance in between the gender distribution.

GRAPH 2:SEX DISTRIBUTION

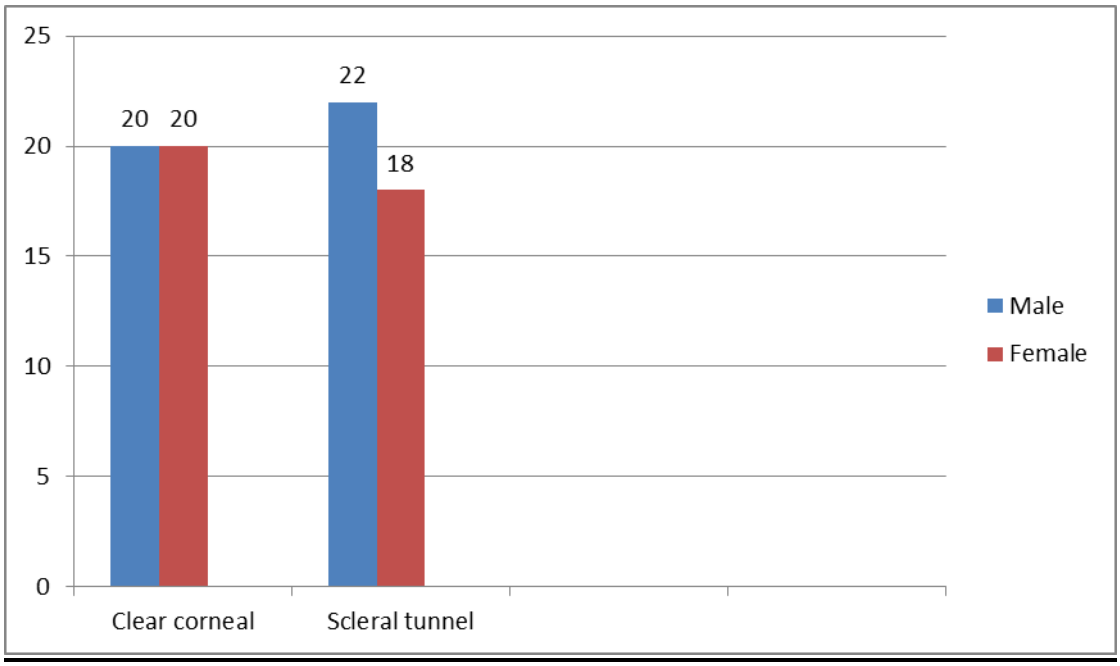


TABLE 3:EYE INVOLVED

	GROUP A(CC)		**GROUP B(ST)**	
EYE	NO OF PATIENTS	%	NO OF PATIENTS	%
RIGHT	22	55	20	50
LEFT	18	45	20	50
TOTAL	40	100	40	100

P=0.6, chi-square test

In the present study we see that out of 80 eyes which got operated, 42(52.5%) was in right eye and 38(47.5%) was in left eye. p value by chisquare test showed 0.6, indicating no statistical significance.

GRAPH 3:EYE INVOLVED

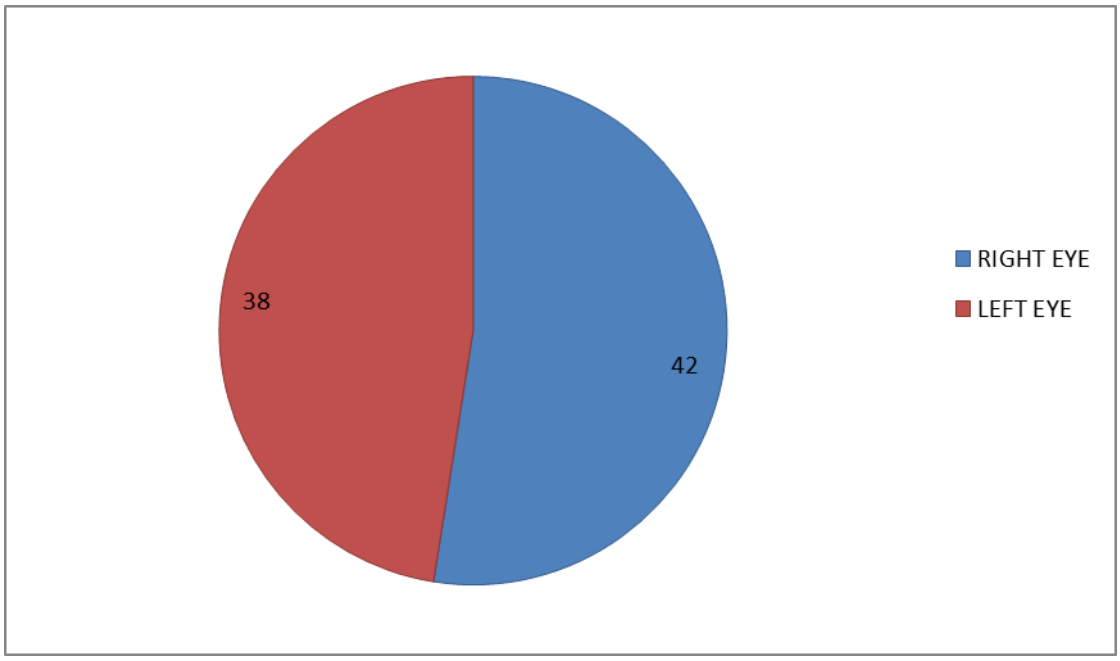


TABLE 4:DISTRIBUTION OF TYPE OF CATARACT

TYPE OF CATARACT	NO OF PATIENTS	%
PSC WITH NS 1	22	27.5
PSC WITH NS 2	29	36.25
PSC WITH NS 3	29	36.25
TOTAL	80	100

Out of 80 patients who got operated for cataract surgery in our study we see that equal distribution of PSC WITH NS 2 and PSC WITH NS 3 cataracts that is 29 (36.25%) patients and in PSC WITH NS 1 there are 22 (27.5%) patients.

GRAPH 4:DISTRIBUTION OF TYPE OF CATARACT

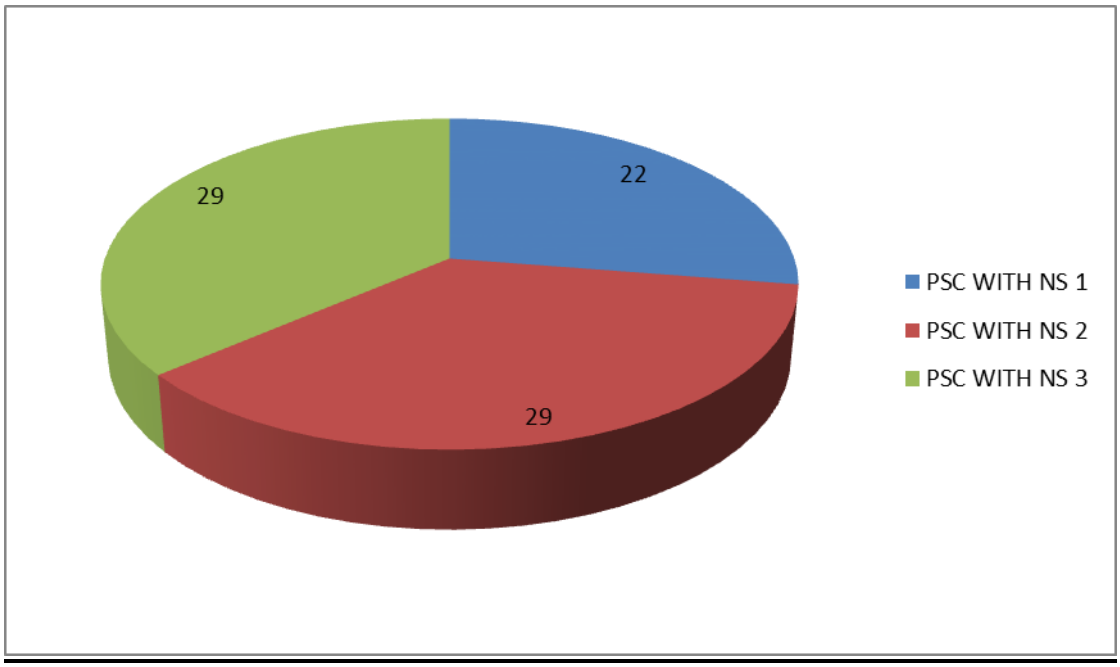


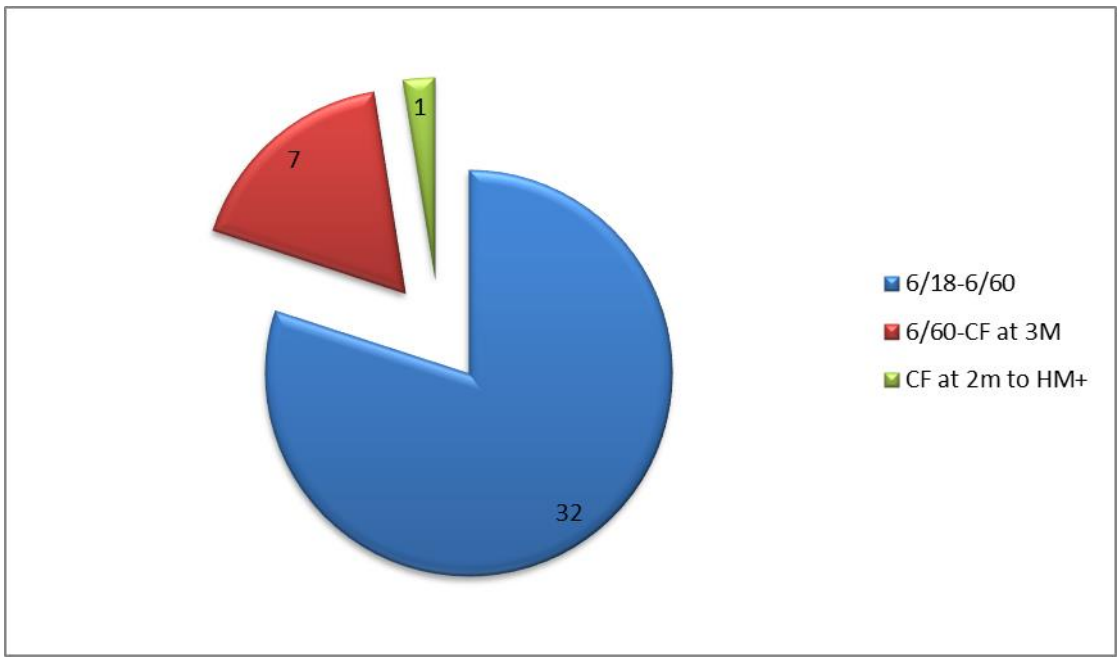
TABLE 5:PREOPERATIVE VISUAL ACUITY

VISUAL ACUITY	GROUP A (CLEAR CORNEAL INCISION)		GROUP B(SCLERAL TUNNEL INCISION)	
	NO OF PATIENTS	%	NO OF PATIENTS	%
6/18-6/60	32	80	34	85
6/60-CF at 3M	7	17.5	4	10
CF at 2M –HM+	1	2.5	2	5
PL+, PR+	-	-	-	-
TOTAL	40	100	40	100

P=0.5, chi-square test

In the present study, preoperative visual acuity was recorded in both Group A i.e. Clear corneal incision and in group B i.e.scleral tunnel incision group.In group A(clear corneal incision) we see visual acuity was in the range of 6/18-6/60 in 32(80%) patients, 6/60-CF at 3M in 7(17.5%) patients, CF at 2 M - HM+ in 1(2.5%) patients .No patient had Vision status PL+,PR+. In group B(Scleral tunnel incision) we see visual acuity was in the range of 6/18-6/60 in 34(85%) patients, 6/60-CF at 3M in 4(10%) patients, CF at 2 M - HM+ in 2(5%) patients No patient had vision status PL+,PR+. p value by chisquare test showed 0.5 indicating no statistical significance.

GRAPH 5:PREOPERATIVE VISUAL ACUITY IN CLEAR CORNEAL GROUP



GRAPH 6:PREOPERATIVE VISUAL ACUITY IN SCLERAL TUNNEL GROUP

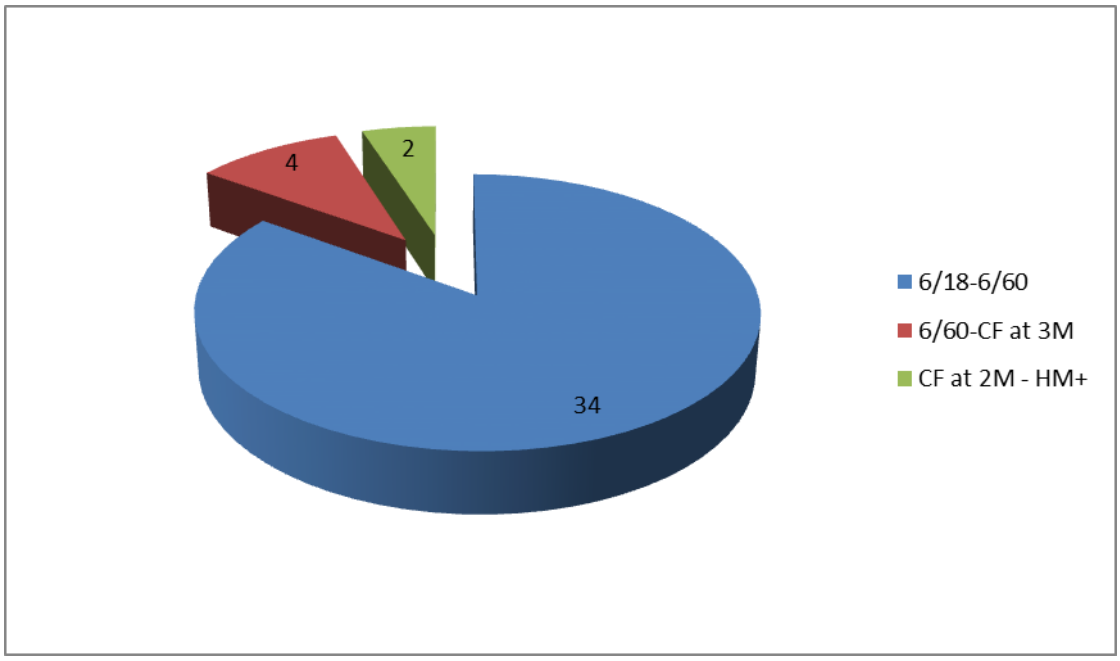


TABLE 6: POSTOPERATIVE UNCORRECTED VISUAL ACUITY IN GROUP A(CLEAR CORNEAL INCISION)

UCVA	1 DAY		1 WEEK		1 MONTH		3 MONTH	
	NO OF PATIENTS	%	NO OF PATIENTS	%	NO OF PATIENTS	%	NO OF PATIENTS	%
6/6-6/9	31	77.5	33	82.5	34	85	36	90
6/12	6	15	6	15	6	15	4	10
<6/12	3	7.5	1	2.5	0	0	0	0
TOTAL	40	100	40	100	40	100	40	100

In the present study uncorrected visual acuity was documented in both the groups. We see that in clear corneal incision group on first post operative day 31 (77.5%) patients had visual acuity in the range of 6/6-6/9, 6 (15%) patients had visual acuity of 6/12, 3 (7.5%) patients had visual acuity <6/12. On 1 week post operative 33(82.5%) patients had visual acuity in the range of 6/6-6/9, 6 (15%) patients had visual acuity of 6/12, 1(2.5%) patient had vision <6/12. On 1 month post operative 34(85%) patients had visual acuity in the range of 6/6-6/9 and 6 (15%) patients had visual acuity of 6/12. On 3rd month post operative 36 (90%) patients had visual acuity in the range of 6/6-6/9 and 4(10%) patients had visual acuity of 6/12.

GRAPH 7: POSTOPERATIVE UNCORRECTED VISUAL ACUITY IN GROUP A(CLEAR CORNEAL INCISION)

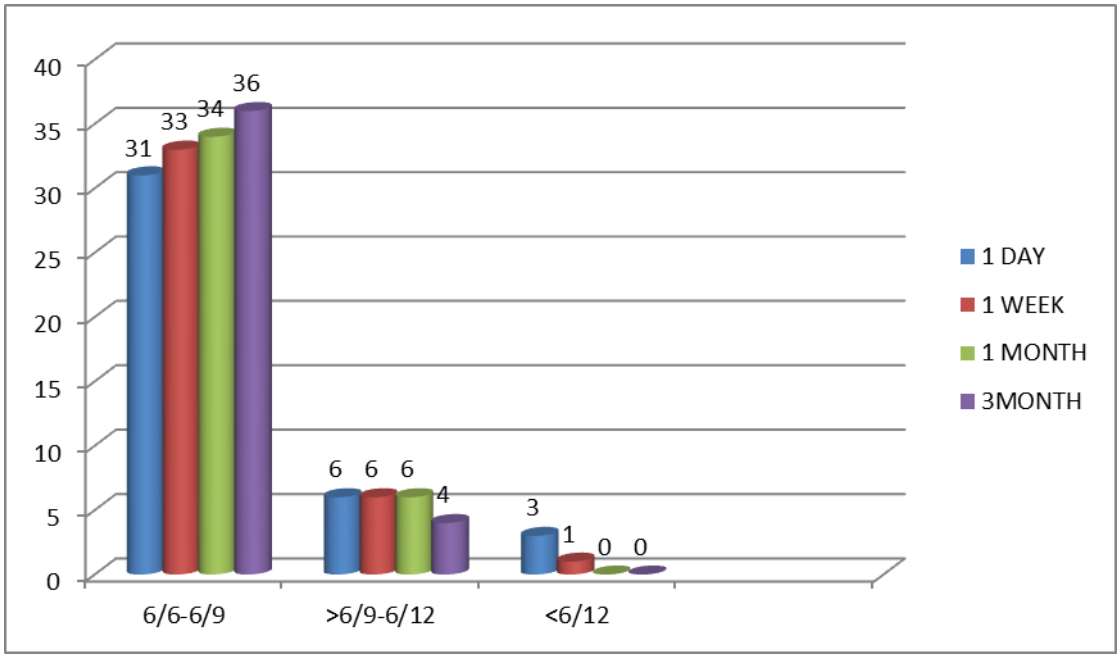


TABLE 7: POSTOPERATIVE UNCORRECTED VISUAL ACUITY IN GROUP B(SCLERAL TUNNEL INCISION)

UCVA	1 DAY		1 WEEK		1 MONTH		3 MONTH	
	NO	%	NO	%	NO	%	NO	%
6/6-6/9	27	67.5	29	72.5	33	82.5	33	82.5
6/12	10	25	9	22.5	4	10	7	17.5
<6/12	3	7.5	2	5	3	7.5	0	0
TOTAL	40	100	40	100	40	100	40	100

In scleral tunnel incision group on first post operative day 27 (67.5%) patients had visual acuity in the range of 6/6-6/9, 10 (25%) patients had visual acuity of 6/12, 3 (7.5%) patients had visual acuity <6/12. On 1 week post operative 29(72.5%) patients had visual acuity in the range of 6/6-6/9, 9 (22.5%) patients had visual acuity of 6/12, 2(5%) patient had vision <6/12. On 1 month post operative 33(82.5%) patients had visual acuity in the range of 6/6-6/9 , 4 (10%) patients had visual acuity of 6/12, 3(7.5%) patients had visual acuity < 6/12. On 3rd month post operative 33 (82.5%) patients had visual acuity in the range of 6/6-6/9 and 7(17.5%) patients had visual acuity of 6/12.

GRAPH 8: POSTOPERATIVE UNCORRECTED VISUAL ACUITY IN GROUP B(SCLERAL TUNNEL INCISION)

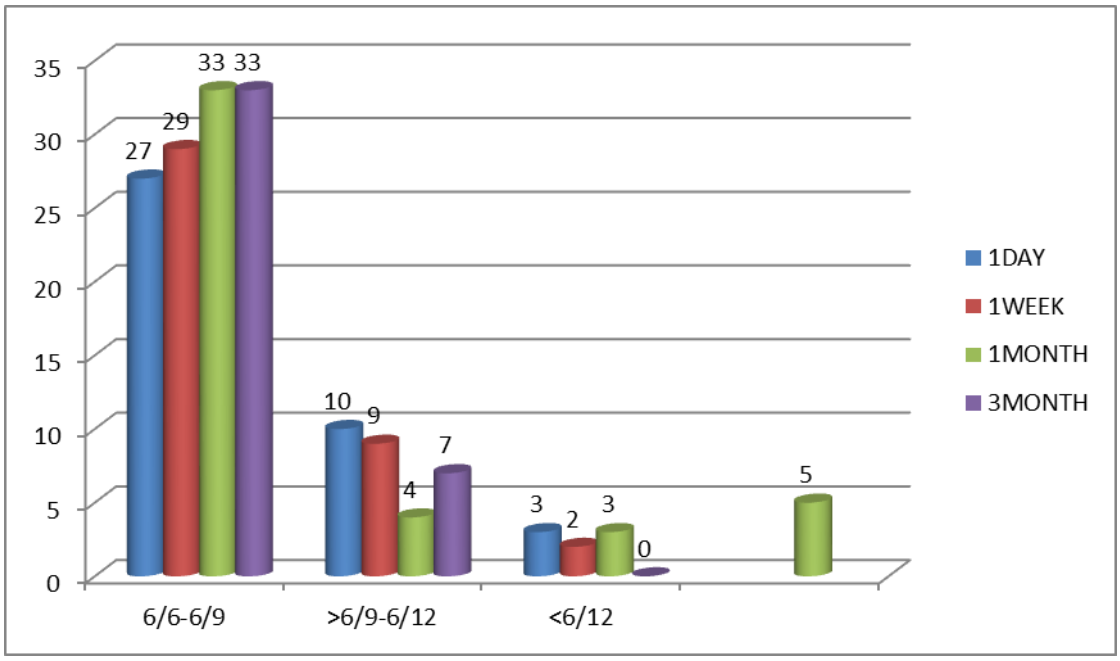


TABLE 8: COMPARISON OF POST OPERATIVE VISUAL ACUITY IN TWO INCISIONS OF PHACOEMULSIFICATION

Group	**1 day post operative**		**1 week post operative**		**1 month post operative**		**3 month post operative**	
	Median	Range	Median	Range	Median	Range	Median	Range
Clear Corneal incision	0.67	0.33-1	0.67	0.33-1	0.67	0.33-1	0.67	0.33-1
Scleral Tunnel Incision	0.67	0.25-1	0.67	0.33-3	0.83	0.33-1	0.67	0.5-1.5
p**	0.1		0.6		0.5		0.8	

**Mann Whitney u test (to compare visual acuity between 2 groups at each time interval)

In the present study comparison of postoperative visual acuity in the two incisions of phacoemulsification was done.Visual acuity was converted into decibal fraction for statistical analysis. Median and range at each time interval was calculated .p value calculated by Mann Whitney U test(to compare visual acuity between 2 groups at each time interval)showed, post operative 1 day as 0.1, 1 week as 0.6, 1 month as 0.5 and 3 month as 0.8.All these p values indicates there is no statistical difference in between the 2 groups.

TABLE 9:PREOPERATIVE ASTIGMATISM IN GROUP A(CLEAR CORNEAL INCISION GROUP)

ASTIGMATISM IN Diopters	**WTR**		**ATR**	
	NO OF PATIENTS	%	NO OF PATIENTS	%
0.25	5	19.2	3	21.4
0.50	5	19.2	3	21.4
0.75	8	30.7	3	21.4
1.00	8	30.7	5	35.7
TOTAL	26	100	14	100

In the present study the patients with preoperative astigmatism of <1.25D were included under study. We see that among 40 patients who got operated

in the clear corneal incision group ,26 (65%) patients were having with rule astigmatism. Out of these 26 (65%) patients - 5(19.2%) patients had astigmatism of 0.25D, 5 (19.2%) patients had 0.50D, 8 (30.7%) patients had 0.75D and 8 (30.7%) patients had 1.00D.14(35%) patients had against the rule astigmatism. Out of these 14 (35%) patients – 3 (21.4%) patients had astigmatism of 0.25D, 3 (21.4%) patients had 0.50D, 3 (21.4%) patients had 0.75D and 5 (35.7%) patients had 1.00D.

GRAPH 9: PREOPERATIVE ASTIGMATISM IN GROUP A(CLEAR CORNEAL INCISION GROUP)

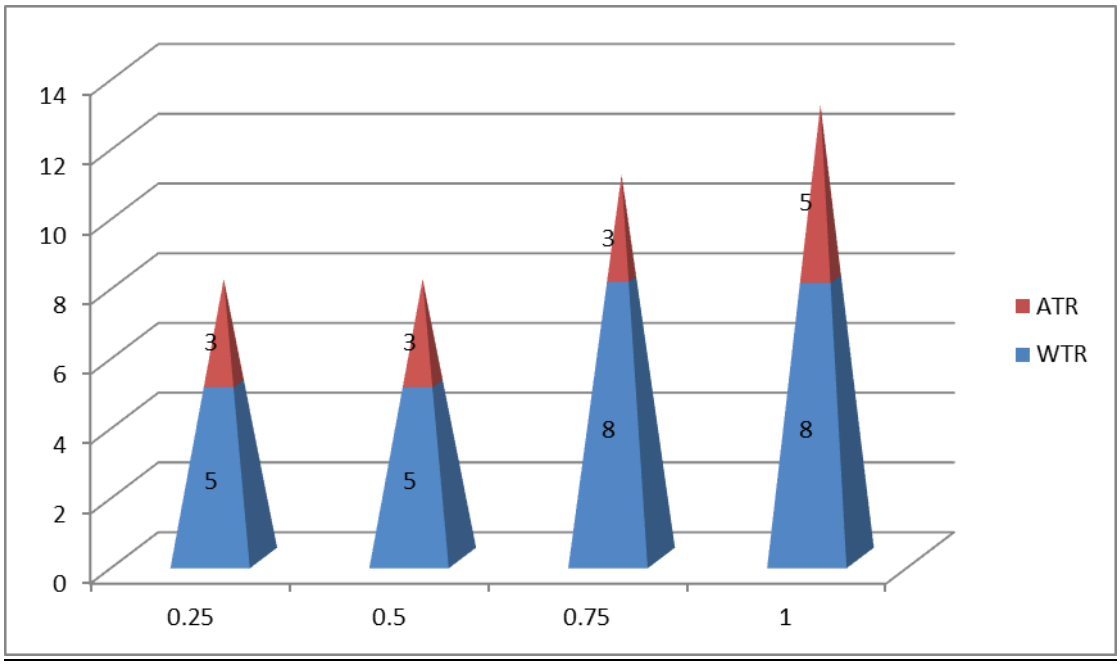


TABLE 10:PREOPERATIVE ASTIGMATISM IN GROUP B (SCLERAL TUNNEL INCISION GROUP)

ASTIGMATISM IN Diopters	**WTR**		**ATR**	
	NO OF PATIENTS	%	NO OF PATIENTS	%
0.25	6	22.2	2	15.3
0.50	6	22.2	3	23
0.75	8	29.6	2	15.3
1.00	7	25.9	6	46.1
TOTAL	27	100	13	100

In the scleral tunnel incision group we see that among 40 patients who got operated ,27 (67.5%) patients were having with rule astigmatism. Among this 27 (67.5%) patients - 6(22.2%) patients had astigmatism of 0.25D, 6 (22.2%) patients had 0.50D, 8 (29.6%) patients had 0.75D and 7 (25.9%) patients had 1.00D. 13 (32.5%) patients had against the rule astigmatism. Among this 13 (32.5%) patients – 2 (15.3%) patients had astigmatism of 0.25D, 3 (23%) patients had 0.50D, 2 (15.3%) patients had 0.75D and 6 (46.1%) patients had 1.00D.

GRAPH 10:PREOPERATIVE ASTIGMATISM IN GROUP B (SCLERAL TUNNEL INCISION GROUP)

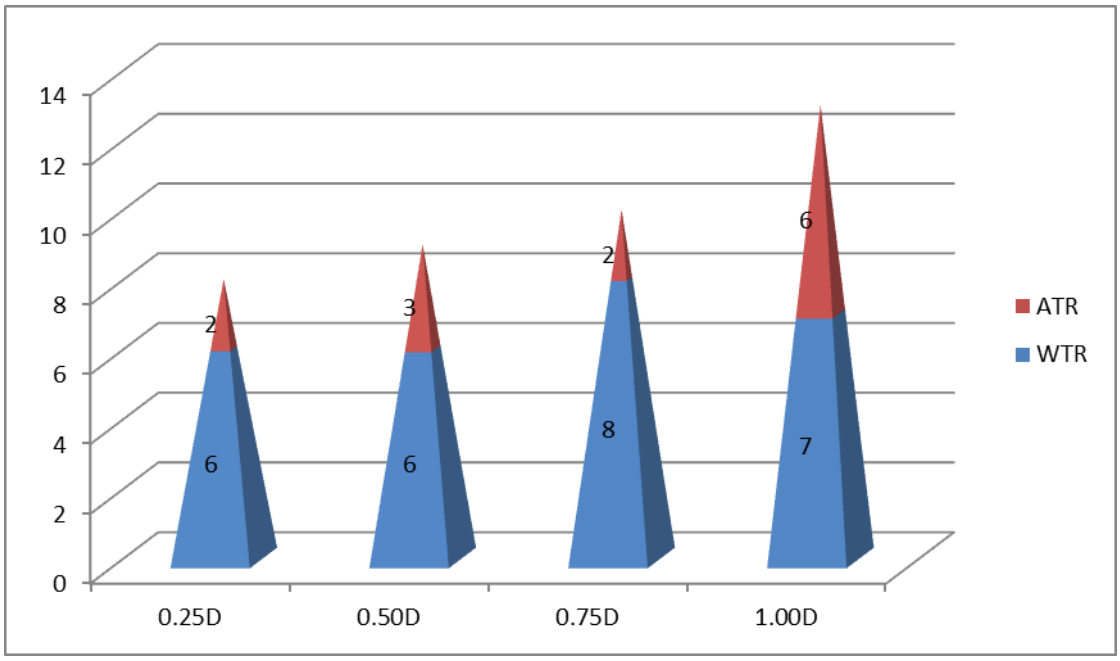


TABLE 11: PRE OPERATIVE WTR AND ATR BETWEEN TWO GROUPS :

	A	B
W	**26**	**27**
A	**14**	**13**

P=0.9, chi-square test

In the present study we see the preoperative WTR and ATR between 2 groups showing p value as 0.9 by chisquare test indicating no statistical significance.

TABLE 12:POST OPERATIVE ASTIGMATISM IN GROUP A(CLEAR CORNEAL INCISION GROUP)

RANGE(D)	1 DAY		1 WEEK		1 MONTH		3MONTH	
	NO OF PATIENTS	%	NO OF PATIENTS	%	NO OF PATIENTS	%	NO OF PATIENTS	%
O.25-0.50	28	70	28	70	31	77.5	33	82.5
0.51-0.75	8	20	8	20	7	17.5	5	12.5
0.76-1.00	4	10	4	10	2	5	2	5
TOTAL	40	100	40	100	40	100	40	100

Postoperative astigmatism was documented in Group A(Clear corneal incision group).We see that on first post operative day 28 (70%) patients had post operative astigmatism in the range of 0.25-0.50D, 8 (20%) patients in the range of 0.51-0.75D and 4 (10%) patients in the range of 0.76-1.00D. On 1 week post operative 28 (70%) patients had postoperative astigmatism in the range of 0.25-0.50D, 8 (20%) patients in the range of 0.51-0.75D and 4 (10%) patients in the range of 0.76-1.00D. On 1 month post operative 31 (77.5%) patients had postoperative astigmatism in the range of 0.25-0.50D, 7 (17.5%) patients in the range of 0.51-0.75D and 2 (5%) patients in the range of 0.76-1.00D. On 3 month post operative 33 (82.5%) patients had astigmatism in the range of 0.25-0.50D, 5 (12.5%) patients in the range of 0.51-0.75D and 2 (5%) patients in the range of 0.76D-1.OOD.

GRAPH 11 :POSTOPERATIVE ASTIGMATISM IN GROUP A(CLEAR CORNEAL INCISION GROUP)

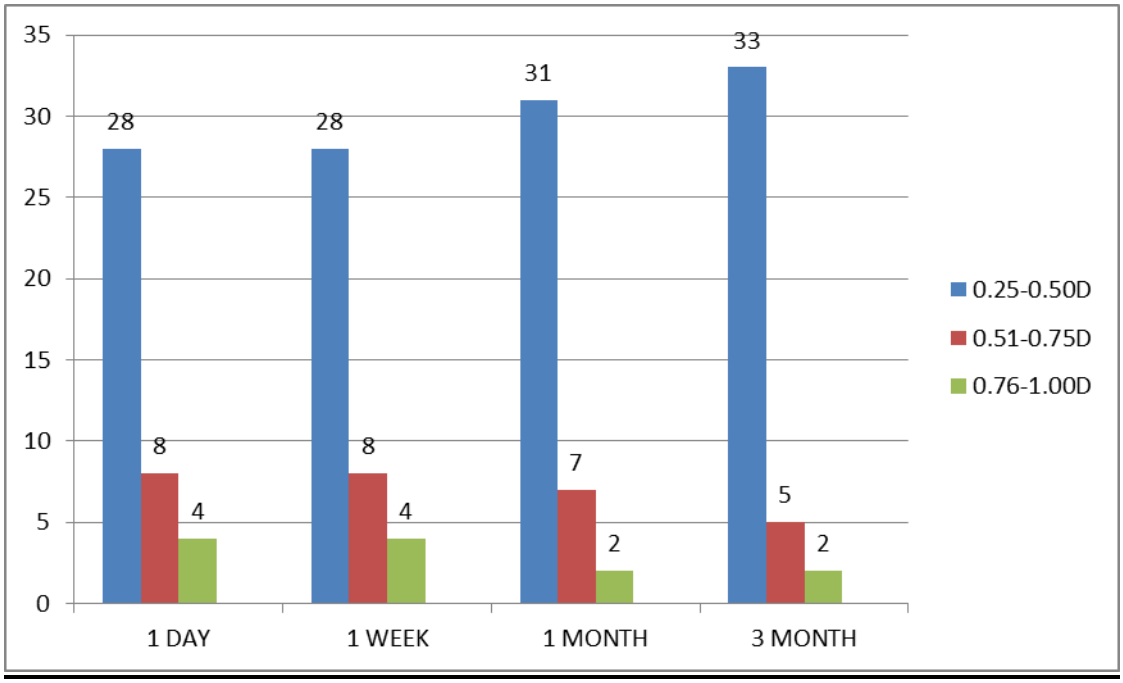


TABLE 13: TYPE OF POST OPERATIVE ASTIGMATISM IN GROUP A(CLEAR CORNEAL INCISION GROUP)

1 DAY		1 WEEK		1 MONTH		3 MONTH	
WTR	**ATR**	**WTR**	**ATR**	**WTR**	**ATR**	**WTR**	**ATR**
No of patients	No of patients	No of patients	No of patients	No of patients	No of patients	No of patients	No of patients
18	22	18	22	18	22	18	22

In the present study in postoperative astigmatism clear corneal incision group 18 were WTR and 22 were ATR at all time periods.

GRAPH 12: TYPE OF POST OPERATIVE ASTIGMATISM IN GROUP A(CLEAR CORNEAL INCISION GROUP)

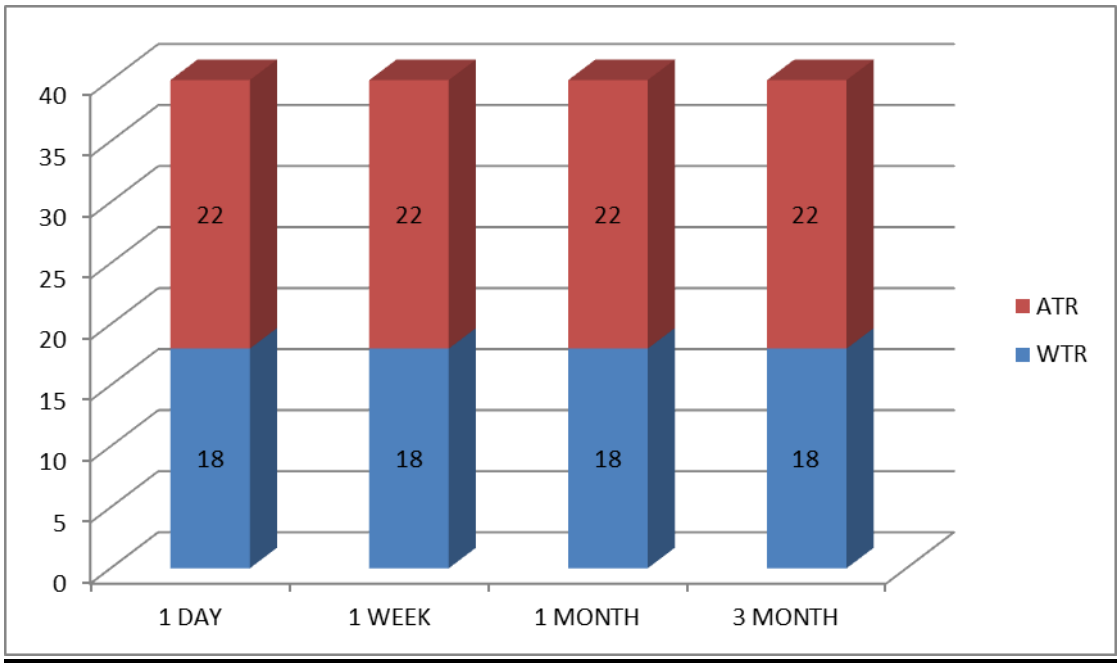


TABLE 14:POSTOPERATIVE ASTIGMATISM IN GROUP B(SCLERAL TUNNEL INCISION GROUP)

RANGE(D)	1 DAY		1 WEEK		1 MONTH		3MONTH	
	NO OF PATIENTS	%	NO OF PATIENTS	%	NO OF PATIENTS	%	NO OF PATIENTS	%
O.25-0.50	29	72.5	31	77.5	33	82.5	34	85
0.51-0.75	7	17.5	5	12.5	5	12.5	6	15
0.76-1.00	4	10	4	10	2	5	0	0
TOTAL	40	100	40	100	40	100	40	100

Postoperative astigmatism was documented in Group B(scleral tunnel incision group).We see that on first post operative day 29 (72.5%) patients had postoperative

astigmatism in the range of 0.25-0.50D, 7 (17.5%) patients in the range of 0.51-0.75D and 4 (10%) patients in the range of 0.76-1.00D. On 1 week post operative 31 (77.5%) patients had postoperative astigmatism in the range of 0.25-0.50D, 5 (12.5%) patients in the range of 0.51-0.75D and 4 (10%) patients in the range of 0.76-1.00D. On 1 month post operative 33 (82.5%) patients had postoperative astigmatism in the range of 0.25-0.50D, 5 (12.5%) patients in the range of 0.51-0.75D and 2 (5%) patients in the range of 0.76-1.00D. On 3 month post operative 34 (85%) patients had postoperative astigmatism in the range of 0.25-0.50D and 6 (15%) patients in the range of 0.51-0.75D.

GRAPH 13:POSTOPERATIVE ASTIGMATISM IN GROUP B(SCLERAL TUNNEL INCISION GROUP)

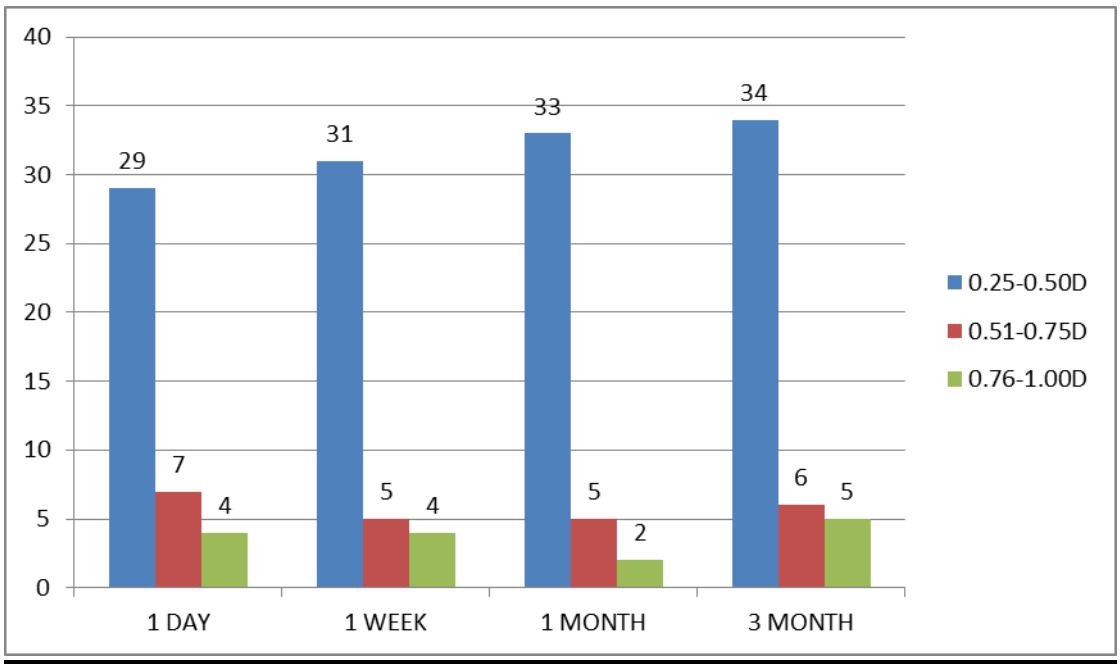


TABLE 15: TYPE OF POSTOPERATIVE ASTIGMATISM IN GROUP B (SCLERAL TUNNEL INCISION GROUP)

1 DAY		1 WEEK		1 MONTH		3 MONTH	
WTR	**ATR**	**WTR**	**ATR**	**WTR**	**ATR**	**WTR**	**ATR**
No of patients	No of patients	No of patients	No of patients	No of patients	No of patients	No of patients	No of patients
14	26	13	27	15	25	17	23

In the present study in scleral tunnel incision group on first postoperative day 14 were WTR and 26 were ATR, on 1week postoperative 13were WTR and 27 were ATR, on 1 month postoperative 15 were WTR and 25 were ATR and on third month postoperative 17 were WTR and 23 were ATR.

GRAPH 14: TYPE OF POSTOPERATIVE ASTIGMATISM IN GROUP B (SCLERAL TUNNEL INCISION GROUP)

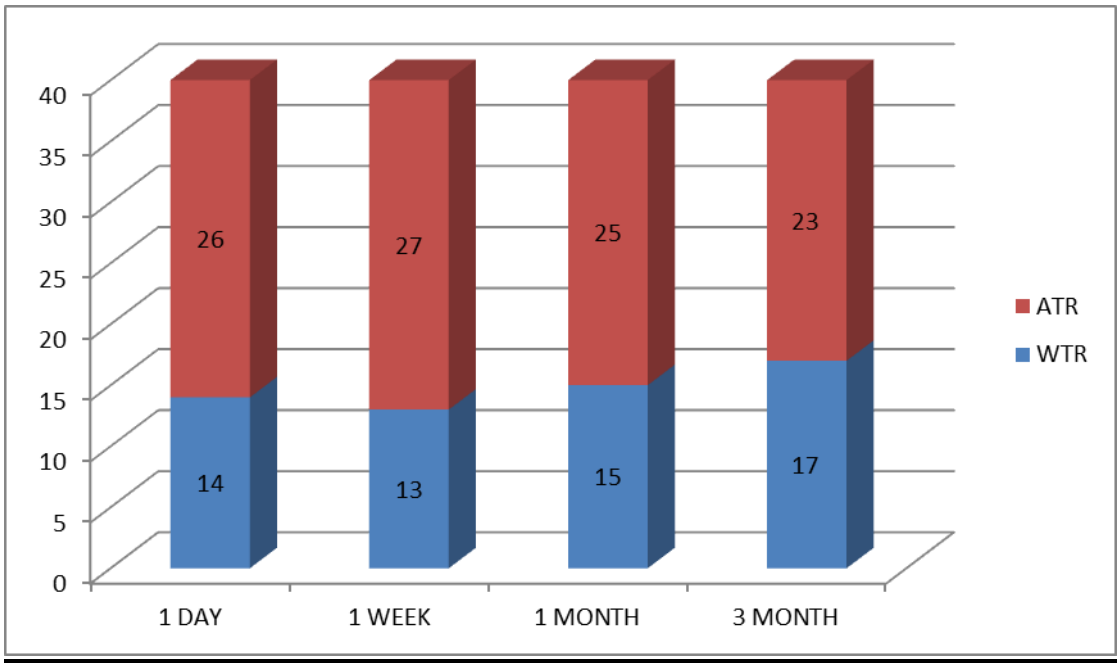


TABLE 16: COMPARISON OF AMOUNT OF POST OPERATIVE ASTIGMATISM IN BETWEEN TWO INCISIONS

POST OPERATIVE ASTIGMATISM	GROUP A	GROUP B	p VALUE
1 day	0.50±0.25	0.50±0.25	1.000
1 week	0.50±0.25	0.50±0.25	1.000
1 month	0.47±0.22	0.47±0.22	1.000
3 month	0.46±0.21	0.46±0.21	1.000

In the present study comparison of amount of postoperative astigmatism in the two incisions of phacoemulsification was done. p value showed as 1.000 at all time periods indicating no statistical difference in between the two groups.

TABLE 17: COMPARISON OF TYPE(WTR AND ATR) OF POST OPERATIVE ASTIGMATISM IN BETWEEN TWO INCISIONS

P VALUES	1 DAY	1 WEEK	1 MONTH	3MONTH
Type of postoperative astigmatism(WTR and ATR) between group A and group B	0.3613	0.252	0.4957	0.8217

In the present study comparison of type(WTR and ATR) of postoperative astigmatism in the two incisions of phacoemulsification was done. p value showed ,1 day as0.3613, 1 week as 0.252 , 1 month as 0.4957 and 3 month as 0.8216 .All these p values indicate there is no statistical difference in between the 2 groups.

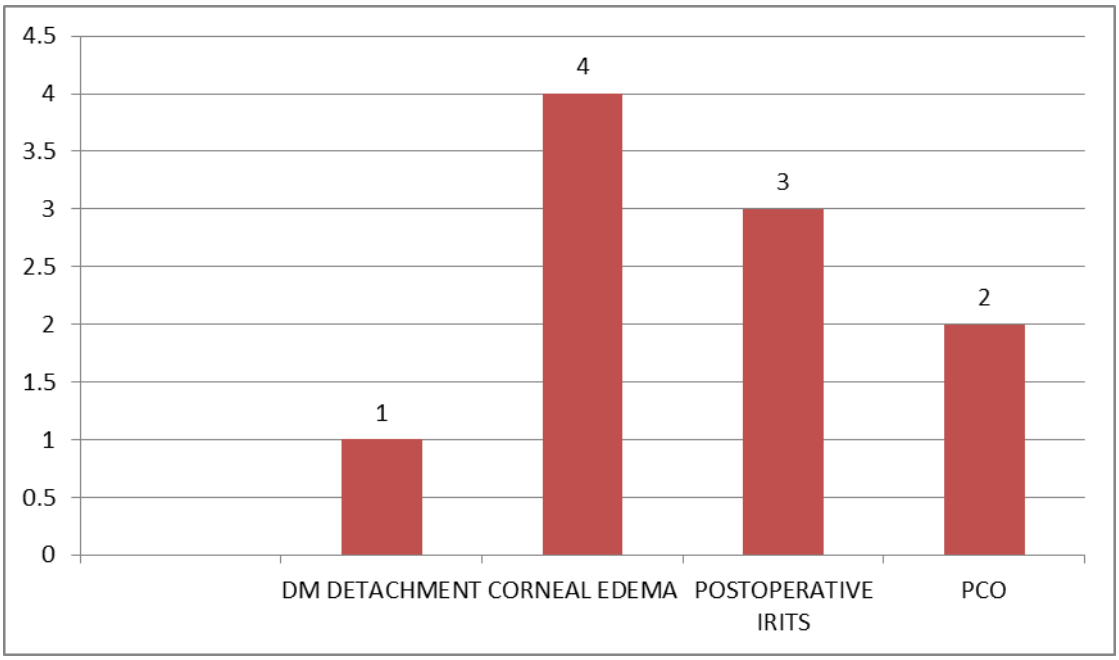
TABLE 18:COMPLICATIONS(INTRAOPERATIVE+POSTOPERATIVE) SEEN IN GROUP A(CLEAR CORNEAL INCISION) AND GROUP B(SCLERAL TUNNEL)

COMPLICATIONS	**GROUP A(CLEAR CORNEAL INCISION)**		**GROUP B(SCLERAL TUNNEL INCISION)**	
	NO OF PATIENTS	%	NO OF PATIENTS	%
DM DETACHMENT	1	2.5	2	5
CORNEAL EDEMA	4	10	3	7.5
POSTOPERATIVE IRITIS	3	7.5	4	10
PCO	2	5.0	2	5.0
TOTAL	10	25	11	27.5

In our study complications of phacoemulsification (intraoperative nd postoperative) in between Group A(Clear corneal incision) and Group B(Scleral tunnel incision) were noted. We see that in group A(Clear corneal incision) complications were seen in 10 (25%) patients out of 40 patients who got operated, among them 1 (2.5%) patient had DM Detachment, 4(10%) patients had corneal edema, 3(7.5%) pts had post operative iritis and 2(5%) patients had

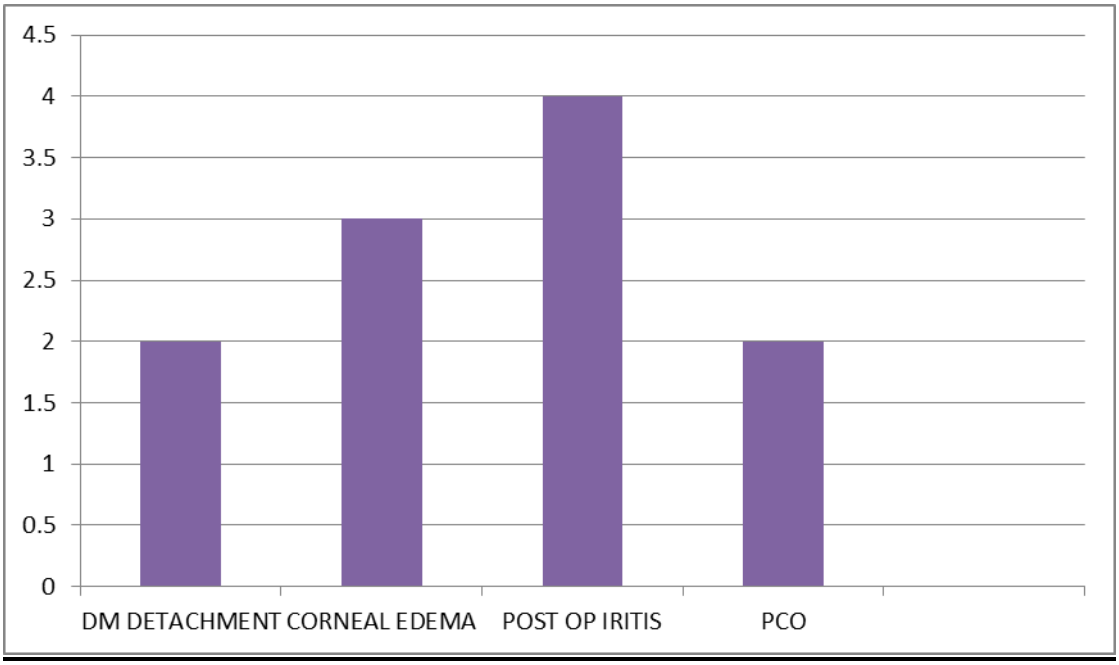
PCO. In group B(Scleral tunnel incision) complications were seen in 11 (27.5%) patients out of 40 patients who got operated, among them 2 (5%) patients had DM detachment , 3(7.5%) patients had corneal edema, 4(10%) patients had post operative iritis, and 2(5%) patients had PCO.

GRAPH 15:COMPLICATIONS(INTRAOPERATIVE+POSTOPERATIVE) SEEN IN GROUP A(CLEAR CORNEAL INCISION)



GRAPH 16:COMPLICATIONS(INTRAOPERATIVE+POSTOPERATIVE)

SEEN IN GROUP B(SCLERAL TUNNEL INCISION)



DISCUSSION

This study was done to compare the effects of clear corneal versus scleral tunnel incision on visual outcome, post operative astigmatism and to analyse if any intraoperative and postoperative complications noted between two groups of incisions in phacoemulsification.

Eighty patients attending to out patient department of ophthalmology, R.L.JALAPPA HOSPITAL AND RESEARCH CENTRE, attached to SRI DEVARAJ URS MEDICAL COLLEGE, TAMAKA, KOLAR with senile cataracts fulfilling the inclusion criteria framed were selected for phacoemulsification under peribulbar anaesthesia between December 2011 to July 2013. The patients were randomly divided into two groups of 40 patients each(Group A-Clear corneal incision and group B-scleral tunnel incision). Detailed preoperative evaluation of ocular and systemic examination was done.

Of the total (Table 1) 80 patients selected for the study majority of the patients in both the groups were in the age range of 61-70 yrs and majority were male patients. Preoperative Snellen's chart visual acuity recording in both Group A i.e. Clear corneal incision and in group B i.e.scleral tunnel incision group was done.Bausch and Lomb keratometry was done to detect the keratometric value in both horizontal and vertical meridian.Pre operative astigmatism was calculated by scalar analysis.All patients with preoperative astigmatism <1.25D were included in the study.

After all necessary preoperative investigations patients were posted for phacoemulsification surgery.In group A clear corneal incision was made and in group B scleral tunnel incision was made followed by phacoemulsification with foldable IOL implantation.

Post operative uncorrected and best corrected visual acuity was recorded in both the groups using Snellen's chart. Uncorrected visual acuity in group A (clear corneal incision group)(table 6) on first post operative day 31 (77.5%) patients had visual acuity in the range of 6/6-6/9, 6 (15%) patients had visual acuity of 6/12, 3 (7.5%) patients had visual acuity <6/12. On 1 week post operative 33(82.5%) patients had visual acuity in the range of 6/6-6/9, 6 (15%) patients had visual acuity of 6/12, 1(2.5%) patient had vision <6/12. On 1 month post operative 34(85%) patients had visual acuity in the range of 6/6-6/9 and 6 (15%) patients had visual acuity of 6/12. On 3rd month post operative 36 (90%) patients had visual acuity in the range of 6/6-6/9 and 4(10%) patients had visual acuity of 6/12. In scleral tunnel incision group (table 7) on first post operative day 27 (67.5%) patients had visual acuity in the range of 6/6-6/9, 10 (25%) patients had visual acuity of 6/12, 3 (7.5%) patients had visual acuity <6/12. On 1 week post operative 29(72.5%) patients had visual acuity in the range of 6/6-6/9, 9 (22.5%) patients had visual acuity of 6/12, 2(5%) patient had vision <6/12. On 1 month post operative 33(82.5%) patients had visual acuity in the range of 6/6-6/9 , 4 (10%) patients had visual acuity of 6/12, 3(7.5%) patients had visual acuity < 6/12. On 3rd month post operative 33 (82.5%) patients had visual acuity in the range of 6/6-6/9 and 7(17.5%) patients had visual acuity of 6/12.Best corrected visual acuity was calculated after subjective refraction.

Comparison of postoperative visual acuity in the two incisions of phacoemulsification was done. Visual acuity was converted into decibal fraction for statistical analysis .Median and range at each time interval was calculated .p value calculated by Mann Whitney U test(to compare visual acuity between 2 groups at each time interval)showed, post operative 1 day as 0.1, 1 week as 0.6, 1 month as 0.5

and 3 month as 0.8.All these p values indicates there is no statistical difference in between the 2 groups.

Based on the above findings we observe that 33(82.5%) patients out of 40 patients with clear corneal incision had visual acuity ranging between 6/6 -6/9 at the end of 1st week compared to 29(72.5%) patients out of 40 patients with scleral tunnel. Less visual acuity patients were evaluated and Best corrected visual acuity was achieved post operatively with spectacle correction.

In study done by **Karpo KO, Albanis CV, Pearlman JB, Goins KM** with clear corneal and scleral tunnel incison showed that Best corrected visual acuity of 20/40 or better was achieved in 82.5% of all eyes with temporal clear corneal incisions and in 75.3% of all eyes with superior scleral tunnel ($P < 0.05$).The difference in BCVA between the two groups was not statistically significant.[50] This study is in comparable with our study, though we found that clear corneal incision induces faster visual recovery compared to scleral tunnel, statistically there was no significant difference.

In a study done by **Oshima Y, Tsujikawd K, Oh A, Harino S** showed that eighty percent of the eyes in each group(clear corneal incision and scleral tunnel incision) achieved an uncorrected visual acuity of 20/40 or better from the second day postoperatively. No statistically significant difference in visual rehabilitation or other parameters was noted between the groups throughout the study.[51]

Postoperative astigmatism were recorded by Bausch and Lomb keratometry at post operative 1 day, 1 week, 1 month and 3 month. In group A (Clear corneal incision) (table 12) we see that on first post operative day 28 (70%) patients had post operative astigmatism in the range of 0.25-0.50D, 8 (20%) patients in the range

of 0.51-0.75D and 4 (10%) patients in the range of 0.76-1.00D. On 1 week post operative 28 (70%) patients had postoperative astigmatism in the range of 0.25-0.50D, 8 (20%) patients in the range of 0.51-0.75D and 4 (10%) patients in the range of 0.76-1.00D. On 1 month post operative 31 (77.5%) patients had postoperative astigmatism in the range of 0.25-0.50D, 7 (17.5%) patients in the range of 0.51-0.75D and 2 (5%) patients in the range of 0.76-1.00D. On 3 month post operative 33 (82.5%) patients had astigmatism in the range of 0.25-0.50D, 5 (12.5%) patients in the range of 0.51-0.75D and 2 (5%) patients in the range of 0.76D-1.OOD. In Group B(scleral tunnel incision group) (table 14) we see that on first post operative day 29 (72.5%) patients had postoperative astigmatism in the range of 0.25-0.50D, 7 (17.5%) patients in the range of 0.51-0.75D and 4 (10%) patients in the range of 0.76-1.00D. On 1 week post operative 31 (77.5%) patients had postoperative astigmatism in the range of 0.25-0.50D, 5 (12.5%) patients in the range of 0.51-0.75D and 4 (10%) patients in the range of 0.76-1.00D. On 1 month post operative 33 (82.5%) patients had postoperative astigmatism in the range of 0.25-0.50D, 5 (12.5%) patients in the range of 0.51-0.75D and 2 (5%) patients in the range of 0.76-1.00D. On 3 month post operative 34 (85%) patients had postoperative astigmatism in the range of 0.25-0.50D and 6 (15%) patients in the range of 0.51-0.75D.

In the present study in postoperative astigmatism clear corneal incision group 18 were WTR and 22 were ATR at all time periods.In scleral tunnel incision group on first postoperative day 14 were WTR and 26 were ATR, on 1week postoperative 13were WTR and 27 were ATR, on 1 month postoperative 15 were WTR and 25 were ATR and on third month postoperative 17 were WTR and 23 were ATR. Comparison of type(WTR and ATR) of postoperative astigmatism in the two incisions of phacoemulsification was done. p value showed ,1 day as0.3613, 1 week as 0.252 , 1

month as 0.4957 and 3 month as 0.8216 .All these p values indicate there is no statistical difference in between the 2 groups.

On comparing 33(82.5%) patients out of 40 patients with clear corneal incision had minimal postoperative astigmatism(0.25-0.50D) compared to 34 (85%) patients out of 40 patients in scleral tunnel incision in 3 month keratometry follow up (p value 1.000).No significant difference was found in post operative astigmatism in between the two groups in keratometry 3 month post operative in study conducted.

In a study done by **Joshi MR, Shakya S** showed that mean astigmatism in patients with corneal incision in first week was 1.43D and 1.24D in those with scleral incision. At the end of third week and eight week corneal incision had mean astigmatism of 0.97D and in scleral incision group the mean astigmatism was 0.91D.[52] In our study mean astigmatism at first week postoperative was 0.50D in both the groups and at third month it was 0.46D in both the groups which showed no statistical difference in between them.

In a study done by **He Y, Zhu S, Chen M, Li D** showed that the changes of corneal astigmatic diopter in Groups A(clear corneal temporal incision) and B(Scleral tunnel temporal incison) after 3month postop from keratometric reading were 1.04 + 0.76 and 0.94 + 0.27, respectively (P = .84 >.05), which showed no statistical significancant difference.[53] In our study we reported postoperative astigmatism after 3 months in both the groups were 0.46± 21D (p value-1.000) which showed no statistical difference.

In a study done by **Oshima Y, Tsujikawd K, Oh A, Harino S** showed that mean scalar shift of keratometric cylinder in the corneal incision group was 1.19 diopters (D) at 2 days postoperatively, 0.86 D at 1 week, and 0.56 D at 3 months and

in the scleral incision group, 1.09 D at 2 days, 0.76 D at 1 week, and 0.65 D at 3 months.[51] In our study we found that mean postoperative corneal astigmatism on 1st day postoperative was 0.50± 0.25D(p value 1.000), at 1 week postoperative was 0.50±0.25D (p value 1.000), at 1 month postoperative was 0.47±0.22 (p value 1.000), and at 3 month postoperative was 0.46±0.21D (p value 1.000), in both the groups which showed no statistical difference.

In a study done by **Olsen T, Johansen MD, Bek T, Hjortdal J** showed that postoperative astigmatism (vector analysis, keratometry) was 1.41 D ± 0.66 (SD) and 0.55 ± 0.31 D in the corneal incision group and the scleral incision group, respectively ($P < .01$).[54]

A study performed by **Bilinska et al** evaluated the astigmatic effect of scleral tunnel incisions and clear corneal incisions in adults. The lowest mean postoperative corneal astigmatism was achieved in the group with the superotemporal clear corneal incision. This study demonstrated that clear corneal incisions induce less astigmatism than scleral tunnel incisions.[55] But in our study we found that there is no significant statistical change in postoperative astigmatism in between the two groups(p value 1.000)

In a study done by **Einollahi B et al** showed that scleral tunnel incision is better than clear corneal incision in minimizing postoperative astigmatism.[56]

Susie et al[57] in their analysis of postoperative corneal astigmatism after phacoemulsification through a clear corneal incision, concluded that the mean postoperative corneal astigmatism was 0.23 D.

In our study complications like DM detachment, Post operative iritis, corneal edema were noticed in both the groups which resolved after 1 month.PCO was seen in 4 cases which were treated with Nd YAG capsulotomy.

In a study done by **Oshima Y, Tsujikawd K, Oh A, Harino S** showed that complications including corneal endothelial cell loss and wound incompetence requiring suturing were observed in the temporal clear corneal incision group.[51] In our study we reported 4(10%) cases of corneal edema in clear corneal group and 3(7.5%) cases in scleral tunnel group.We didnt report any case of wound incompetence.

In a study done by **Karpo KO, Albanis CV, Pearlman JB, Goins KM** showed that vitreous loss in 6.0% with temporal clear corneal incisions and in 11.8% of with superior scleral tunnel incisions ($P < 0.02$). Posterior capsule breaks occurred in 11.5% of the temporal clear corneal incisions group versus 17.7% in the superior scleral tunnel group ($P < 0.0453$). [50] In our study we didn't report any posterior capsule breaks or vitreous loss.

In a study done by **Michaeli A, Rootman DS, Slomonic AR** showed that cumulative mean central endothelial cell loss for the scleral tunnel group was 1.8% +/- 21.5%, and for the clear corneal group 0.13% +/- 18.3% ($p>0.05$).Clear cornea and scleral tunnel incisions seem to result in no significant difference in endothelial cell loss and or central corneal thickness at 3 months post-op.[58] In our study we reported 4(10%) cases of corneal edema in clear corneal group and 3(7.5%) cases in scleral tunnel group.

Cooper et al evaluated the incidence of postoperative endophthalmitis in clear corneal incisions with or without sutures vs. scleral tunnel incisions. In this study culture-positive acute post-cataract endophthalmitis were compared to randomly

selected control patients who underwent uncomplicated cataract surgery. This study demonstrated that clear corneal incisions were associated with a threefold greater risk of endophthalmitis than scleral tunnel incisions.[59] In our study we didn't report any case of endophthalmitis in both the groups.

CONCLUSION

In our study we found that 33(82.5%) patients out of 40 patients with clear corneal incision had postoperative visual acuity ranging between 6/6 -6/9 at the end of 1st week compared to 29(72.5%) patients out of 40 patients with scleral tunnel.

33(82.5%) patients out of 40 patients with clear corneal incision had minimal postoperative astigmatism(0.25-0.50D) compared to 34 (85%) patients out of 40 patients in scleral tunnel incision in 3 month keratometry follow up.

Complications like DM detachment, Post operative iritis, corneal edema were noticed in both the groups which resolved after 1 month.PCO was seen in 4 cases which were treated with Nd YAG capsulotomy.

We found that clear corneal incision induces faster visual recovery compared to scleral tunnel . No significant statistical difference was found in post operative astigmatism after a 3 month follow up period in between the two groups.

SUMMARY

This study was done to compare the effects of clear corneal versus scleral tunnel incison on vision recovery and post operative astigmatism.

Eighty patients attending to out patient department of ophthalmology, R.L.JALAPPA HOSPITAL AND RESEARCH CENTRE attached to SRI DEVARAJ URS MEDICAL COLLEGE, , TAMAKA, KOLAR with senile cataract fulfilling the inclusion criteria framed were selected for phacoemulsification with foldable IOL implantation under peribulbar anaesthesia between December 2011 to July 2013 .

The patients were randomly divided into two groups of 40 patients each (group A-Clear corneal incision and group B -scleral tunnel incision).After detailed preoperative evaluation, phacoemulsification with foldable IOL implantation was performed.

Visual acuity unaided,with pinhole vision, best corrected visual acuity, keratometry and complications if any were recorded in each patient postoperatively on first day, first week, first month and third month.

Pre and postoperative astigmatism was evaluated by Baush and Lomb keratometry readings.Statistical analysis was applied to compare the effects of visual recovery and postoperative astigmatism. Complications if any in between the two groups were also studied.

33(82.5%) patients out of 40 patients with clear corneal incision had postoperative visual acuity ranging between 6/6 -6/9 at the end of 1st week compared to 29(72.5%) patients out of 40 patients with scleral tunnel.

33(82.5%) patients out of 40 patients with clear corneal incision had minimal postoperative astigmatism(0.25-0.50D) compared to 34 (85%) patients out of 40 patients in scleral tunnel incision in 3 month keratometry follow up.

Complications like DM detachment, Post operative iritis, corneal edema were noticed in both the groups which resolved after 1 month.PCO was seen in 4 cases which were treated with Nd YAG capsulotomy.

We found that clear corneal incision induces faster visual recovery compared to scleral tunnel . No significant statistical difference was found in post operative astigmatism after a 3 month follow up period in between the two groups.

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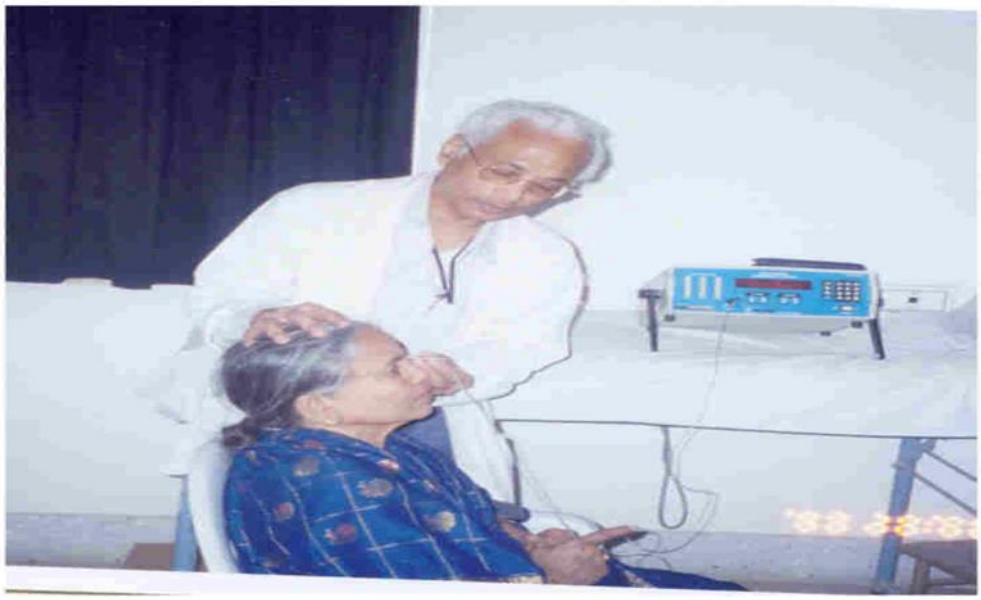
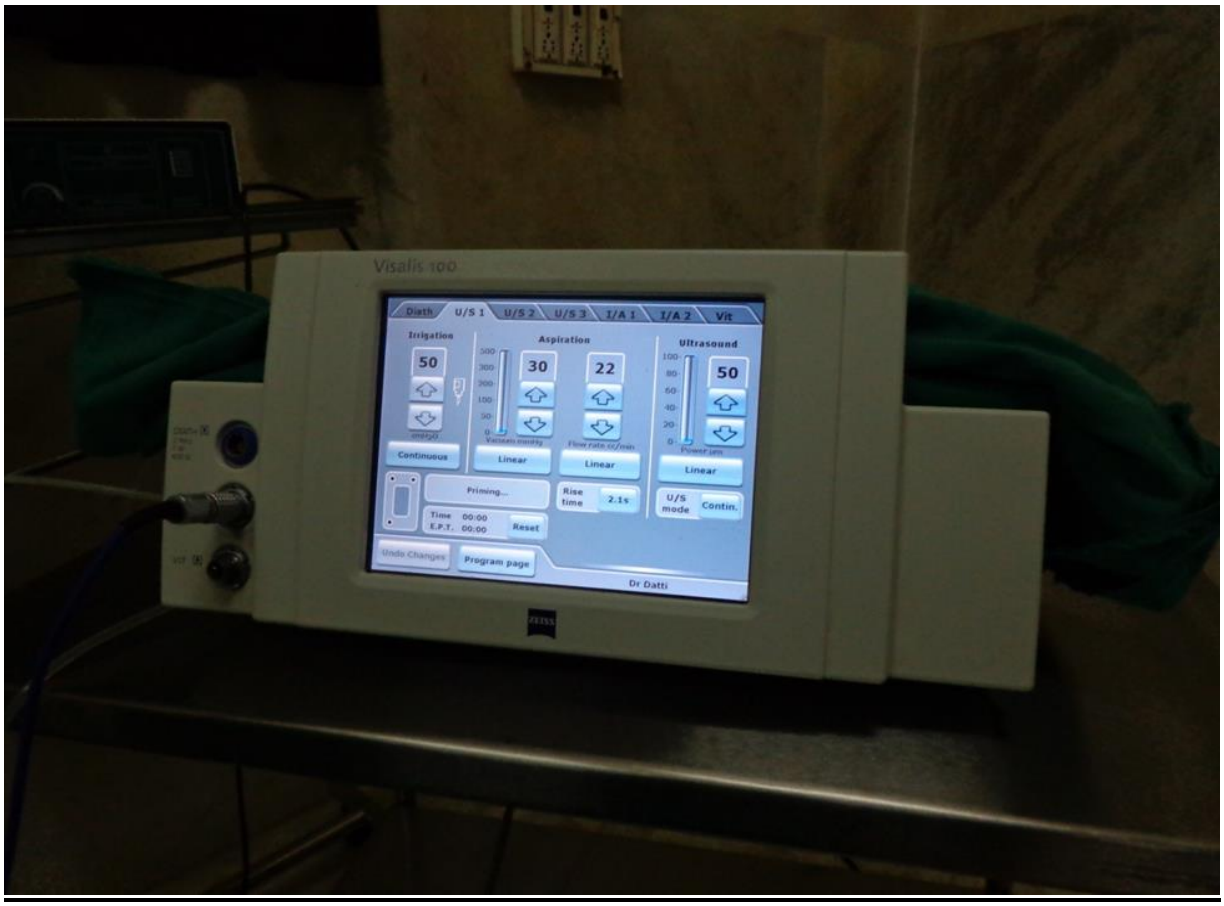
ANNEXURE 1: PHOTOGRAPHS

PHOTOGRAPH 1: RETINOSCOPY

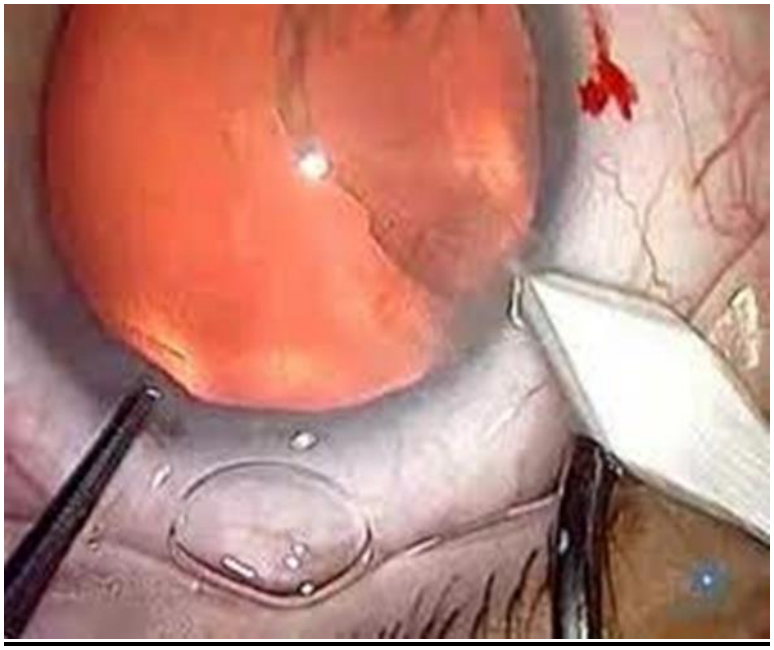
PHOTOGRAPH 2:KERATOMETRY



PHOTOGRAPH 3: A SCAN BIOMETRY



PHOTOGRAPH 4:PHACOEMULSIFICATION UNIT



PHOTOGRAPH 5: CLEAR CORNEAL INCISION

PHOTOGRAPH 6: SCLERAL TUNNEL INCISION

PHOTOGRAPH 7: PHACOEMULSIFICATION

PHOTOGRAPH 8: IMPLANTATION OF FOLDABLE IOL

ANNEXURE 2:

PROFORMA :

TITLE: COMPARATIVE STUDY OF CLEAR CORNEAL INCISION VERSUS SCLERAL TUNNEL IN PHACOEMULSIFICATION

CASE NUMBER:

NAME:

AGE: SEX: I.P. NO./O.P. NO.:

DATE OF ADMISSION: DATE OF DISCHARGE:

FINAL DIAGNOSIS:

PRESENTING COMPLAINTS:

HISTORY OF PRESENTING COMPLAINTS:

PAST HISTORY:

FAMILY HISTORY:

PERSONAL HISTORY:

GENERAL PHYSICAL EXAMI NATION:

SYSTEMIC EXAMINATION:

OCULAR EXAMINATION:

HEAD POSTURE

FACIAL SYMMETRY

OCULAR POSTURE

VISION RIGHT EYE LEFT EYE

-UNCORRECTED

-PINHOLE

-CORRECTED

	RIGHT EYE	LEFT EYE
OCULAR ADNEXA		
CONJUNCTIVA		
CORNEA		
AC		
IRIS		
PUPIL		
LENS		
FUNDUS		
BSCAN		
GONIOSCOPY		
IOT		
LACRIMAL SYRINGING		
DIAGNOSIS		

PLANNED SURGERY:

BIOMETRY:

K1:

K2:

PREOPERATIVE ASTIGMATISM:

-WTR/ATR

AL:

IOL:

OPERATIVE NOTES:

-TYPE OF INCISION

DATE:

PROCEDURE:

INTRAOPERATIVE COMPLICATIONS:

POSTOPERATIVE VISUAL ACUITY

1 DAY POST OP	1 WEEK	1 MONTH	3 MONTH

POSTOPERATIVE ASTIGMATISM

1 DAY POSTOP		1 WEEK		1 MONTH		3 MONTH	
WTR	ATR	WTR	ATR	WTR	ATR	WTR	ATR

ANNEXURE 4: KEY TO MASTER CHART

S No.: Serial number

HOS.NO.: Hospital number

PREOP VA: Preoperative visual acuity

PREOP K: Preoperative keratometry

K1: Keratometry reading in horizontal meridian

K2: Keratometry reading in vertical meridian

WTR: With the rule astigmatism

ATR: Against the rule astigmatism

IN : Type of Incision

CC : Clear corneal incision

ST : Scleral tunnel incision

R : Right eye

L : Left eye

POST OP UCVA: Postoperative uncorrected visual acuity

1D: 1Day

WK: 1Week

1M: 1Month

3M: 3Month

BCVA: Best corrected visual acuity

INTRAOP COMP: Intraoperative complications

POSTOP COMP: Postoperative complications

ANNEXUR III MASTER CHART

S.No.	NAME	HOS.NO.	AGE	SEX	DIAGNOSIS	EYE	PRE OP VA	PREOP K		PREOP ASTIGMATISM		IN	POST OP UCVA					POST OP K WITH POST OP ASTIGMATISM														INTRAOP COMP.	POST OP COMP.
								K1	K2	WTR	ATR		1 D	1WK	1M	3M	BCVA	1 D				1 WK				1 M				3 M					
																		K1	K2	WTR	ATR	K1	K2	WTR	ATR	K1	K2	WTR	ATR	K1	K2	WTR	ATR		
1	Krishnappa	810553	61	M	PSC+NS 1	L	6\60	43.25	42.25		1	CC	6\6	6\9	6\6	6\6	6\6	42.25	42		0.25	42.25	42		0.25	42.25	42		0.25	42.25	42		0.25		
2	Henry	821169	71	M	PSC+NS 2	R	6\18	40.25	41	0.75		CC	6\9	6\9	6\9	6\6	6\6	41.25	41		0.25	41.25	41		0.25	41.25	41		0.25	42	42.25	0.25			
3	Paarijaatha	828818	63	F	PSC+NS 2	R	6\18	41.5	41		0.5	CC	6\6	6\9	6\6	6\6	6\6	40	40.75	0.75		40	40.75	0.75		40	40.75	0.75		39.75	39		0.75		
4	Hanumantharayappa	828814	67	M	PSC+NS 3	R	6\18	42	42.25	0.25		CC	6\9	6\9	6\9	6\9	6\9	44	43.5	0.5		44	44.5	0.5		44	44.5	0.5		44	44.5	0.5			
5	Anjineya.G.	838012	68	M	PSC+NS 3	L	6\24	44.5	45	0.5		CC	6\6	6\9	6\9	6\9	6\6 ,-0.5DS,-0.25DC at 90degree	40.75	40		0.75	40.75	40		0.75	40.75	40		0.75	40.75	40		0.75		
6	Anjinamma	838829	65	F	PSC+NS 1	L	6\24	42	42.75	0.75		CC	6\9	6\9	6\6	6\9	6\9	43	43.25	0.25		43.75	44	0.25		43	43.25	0.25		43	43.25	0.25			
7	Munireddy K.T.	850551	52	M	PSC+NS 2	L	6\60	40	41	1		CC	6\6	6\9	6\6	6\6	6\6	44	44.75	0.75		45	45.75	0.75		44	44.75	0.75		44	44.75	0.75			
8	Yellamma	851600	72	F	PSC+NS 3	R	6\60	41.25	42.25	1		CC	6\12	6\12	6\12	6\12	6\9,-0.25DS,-0.50DC at 90 degrees	41.5	41		0.5	41.5	41		0.5	41.5	41		0.5	41.5	41		0.5	DM Detachment	
9	Sangappa	854686	69	M	PSC+NS 3	R	6\36	41	41.75		0.75	CC	6\9	6\9	6\9	6\9	6\9	45	46	1		45.75	46.75		1	41.5	41		0.5	41.5	41		0.5		PCO
10	Murugahan	868228	66	M	PSC+NS 3	R	6\60	41	41.25		0.25	CC	6\12	6\12	6\12	6\12	6/9,-0.50DS	41	40		1	39	40	1		42	42.5	0.5		42	42.5	0.5			
11	Saraswathamma	916954	53	F	PSC+NS 2	R	6\24	40	40.5		0.5	CC	6\6	6\9	6\6	6\6	6\6	41.25	41		0.25	41.75	42		0.25	41.25	41		0.25	41.25	41		0.25		Corneal edema
12	Pramila	920213	70	F	PSC+NS 3	L	6\60	42	43		1	CC	6\6	6\6	6\9	6\9	6\9	40	41	1		43	42	1		40	41	1		40	41	1			
13	Nagamma	926166	64	F	PSC+NS 3	R	6\24	43.75	43	0.75		CC	6\6	6\6	6\6	6\6	6\6	42.5	42		0.5	42	42.5		0.5	42.5	42		0.5	42.5	42		0.5		
14	Munihanumappa	928229	54	M	PSC+NS 1	R	CF AT 5m	43.25	43	0.25		CC	6\6	6\6	6\9	6\9	6\9	44.25	44		0.25	44	44.25	0.25		44.25	44		0.25	44	44.25	0.25			
15	Lakshmamma	782740	73	F	PSC+NS 2	L	6\60	42	43	1		CC	6\18	6\6	6\9	6\6	6\6	44	45	1		43	42		1	44	45	1		43	42		1		
16	Narayanaswamy	782741	70	M	PSC+NS 2	L	6\24	40	41	1		CC	6\9	6\9	6\9	6\9	6\9	43.25	43		0.25	44.25	44		0.25	43.25	43		0.25	43.25	43		0.25		Corneal edema
17	Venkatamma	782742	74	F	PSC+NS 2	R	CF AT 3	40	40.75	0.75		CC	6\6	6\9	6\6	6\6	6\6	42	42.5	0.5		43	43.5	0.5		42	42.5	0.5		42	42.5	0.5			
18	Muniyamma	782745	70	F	PSC+NS 2	R	CF AT 3	40	40.5	0.5		CC	6\9	6\9	6\6	6\9	6\9	42.5	42		0.5	43.5	43		0.5	43.5	43		0.5	43.5	43		0.5		
19	Rathnamma	782746	62	F	PSC+NS 3	L	6\24	42	42.25	0.25		CC	6\9	6\9	6\6	6\9	6\6, -0.75DS	41	41.25	0.25		41	41.25	0.25		41	41.25	0.25		41	41.25	0.25			
20	Venkatarayappa	782752	55	M	PSC+NS 3	L	6\24	43	43.75	0.75		CC	6\9	6\9	6\6	6\9	6\6,+1.0DS	40.25	40		0.25	40.24	40		0.25	40.25	40		0.25	40.25	40		0.25		
21	Venkatalakshmama	789599	56	M	PSC+NS 1	L	CF AT 5	42	43	1		CC	6\12	6\12	6\12	6\9	6\9	40.25	40		0.25	40.25	40		0.25	40.25	40		0.25	40.25	40		0.25		
22	Suryakala	894884	77	F	PSC+NS 2	R	6\18	41.75	41.25		0.25	CC	6\6	6\6	6\6	6\9	6\9	41.75	42	0.25		42	42.25	0.25		42.25	42.5	0.25		42	42.25	0.25			Corneal edema
23	Venkata Reddy	796072	62	M	PSC+NS 3	R	6\24	42.5	42		0.5	CC	6\9	6\9	6\9	6\6	6\6	42.25	42		0.25	42.25	42		0.25	42.25	42		0.25	42.25	42		0.25		
24	Sakamma	796109	63	F	PSC+NS 1	R	6\36	42.75	42		0.75	CC	6\9	6\6	6\6	6\6	6\6	43.5	43		0.5	43.5	43		0.5	43.5	43		0.5	43.5	43		0.5		
25	Sahna Begum	798026	64	F	PSC+NS 2	R	CF AT 3	43	43.75	0.75		CC	6\6	6\9	6\6	6\6	6\6	43	43.25	0.25		43	43.25	0.25		43	43.25	0.25		44	44.25	0.25			
26	Rahabat Ali	798037	57	M	PSC+NS 3	L	CF AT 5	44	45	1		CC	6\9	6\6	6\6	6\6	6\6	44	44.5	0.5		44	44.5	0.5		44	44.5	0.5		44	44.5	0.5			
27	Nanjappa	813520	72	M	PSC+NS 3	L	6\60	42	41		1	CC	6\6	6\9	6\6	6\6	6\6	40.75	40		0.75	40.75	40		0.75	40	39.5		0.5	41.5	41		0.5		
28	Puttaswamy	813525	58	M	PSC+NS 1	L	6\60	40	39.25		0.75	CC	6\18	6\18	6\6	6\12	6\6,-1.0DS, -0.25DC at 90 degrees	40.5	40		0.5	40.5	40		0.5	40.5	40		0.5	41.5	41		0.5		
29	Muniyamma	834081	65	F	PSC+NS 2	R	6\24	40	40.5	0.5		CC	6\12	6\12	6\12	6\12	6\9,-0.75DS -0.50DC at 180 degrees	43	43.25	0.25		43	43.25	0.25		43	43.25	0.25		43	43.25	0.25			Corneal edema
30	Basavaraj	850561	59	M	PSC+NS 3	R	6\18	41.25	42.25	1		CC	6\9	6\6	6\6	6\9	6\9	42	42.25	0.25		43	43.25	0.25		42	42.25	0.25		42	42.25	0.25			PCO
31	Satyavathi	913368	71	F	PSC+NS 1	R	6\24	42	42.75	0.75		CC	6\18	6\9	6\6	6\9	6\9	43.75	43		0.75	43.75	43		0.75	43.75	43		0.75	41.5	41		0.5		
32	Krishnamma	913369	66	F	PSC+NS 3	L	CF AT 2	44.25	44		0.25	CC	6\6	6\6	6\9	6\9	6\9	44.5	44		0.5	44.5	44		0.5	44.5	44		0.5	44.5	44		0.5		Post op irits
33	Subramanyam	914386	75	M	PSC+NS 1	L	6\36	43.5	44	0.5		CC	6\12	6\12	6\12	6\9	6\9	45	45.5	0.5		45	45.5	0.5		45	45.5	0.5		45	45.5	0.5			
34	Padmavathama	915477	67	F	PSC+NS 2	R	6\60	43	43.25	0.25		CC	6\9	6\9	6\6	6\9	6\9	45.25	45		0.25	45.25	45		0.25	44.25	44		0.25	45.25	45		0.25		Post op iritis
35	Ananthakrishna	816893	71	M	PSC+NS 3	R	CF AT 4	41	41.75	0.75		CC	6\6	6\6	6\6	6\9	6\6, -0.50DS, -0.25DC at 180 degrees	46.75	46		0.75	46.75	46		0.75	44.75	44		0.75	42.5	42		0.5		
36	Suryakala	817555	76	F	PSC+NS 3	R	6\60	40.75	41.75	1		CC	6\12	6\12	6\12	6\9	6\9	42	42.25	0.25		42	42.25	0.25		42	42.25	0.25		41	41.25	0.25			
37	Shek Basha	826720	68	M	PSC+NS 1	L	6\60	41.25	42.25		1	CC	6\9	6\9	6\6	6\9	6\9	42	42.5	0.5		41	41.5	0.5		42	42.5	0.5		41	41.5	0.5			Post op iritis
38	Kamalamma	829555	70	F	PSC+NS 1	R	6\60	41.25	42.25		1	CC	6\6	6\9	6\6	6\9	6\9	41.5	41		0.5	41.5	41		0.5	41.5	41		0.5	41.5	41		0.5		

S.No.	NAME	HOS.NO.	AGE	SEX	DIAGNOSIS	EYE	PRE OP VA	PREOP K		PREOP ASTIGMATISM		IN	POST OP UCVA					POST OP K WITH POST OP ASTIGMATISM															
																		1 D				1 WK				1 M				3 M					
								K1	K2	WTR	ATR		1 D	1WK	1M	3M	BCVA	K1	K2	WTR	ATR	K1	K2	WTR	ATR	K1	K2	WTR	ATR	K1	K2	WTR	ATR	INTRAOP COMP.	POST OP COMP.
39	Rajeshwari	929683	69	F	PSC+NS 1	L	6\60	42	42.5	0.5		CC	6\9	6\6	6\6	6\6	6\6	42	42.75	0.75		42	42.75	0.75		41	41.75	0.75		41	41.75	0.75			
40	Harinath Shetty	930838	61	M	PSC+NS 2	L	6\60	44	44.25	0.25		CC	6\6	6\9	6\9	6\9	6\9	41.75	41		0.75	41.75	41		0.75	41.75	41		0.75	41.75	41		0.75		
41	Ramsingh	876792	51	M	PSC+NS 1	R	6\60	43	43.75	0.75		ST	6\6	6\9	6\6	6\9	6\9	44.5	44		0.5	44	43.5		0.5	44	44.5	0.5		44	44.5	0.5			
42	Radhakrishnan	876794	54	M	PSC+NS 2	R	6\36	42	42.25	0.25		ST	6\12	6\12	6\12	6\9	6\9	44.75	45	0.25		44.75	45	0.25		45.25	45		0.25	45.25	45		0.25	DM Detachment	Corneal edema
43	Jayamma	831148	61	F	PSC+NS 2	L	6\24	40	40.5	0.5		ST	6\9	6\9	6\9	6\6	6\6	44.5	45.5		1	44	43		1	44	43		1	43.5	44	0.5			
44	Gopal Krishna	89146	71	M	PSC+NS 1	L	6\18	40	40.75	0.75		ST	6\6	6\9	6\6	6\6	6\6	44	44.25		0.25	43.25	43		0.25	43.25	43		0.25	43.25	43		0.25		
45	Jayamma	895111	74	F	PSC+NS 2	L	6\60	40	41	1		ST	6\9	6\9	6\9	6\6	6\6	41.75	40	0.75		40.75	40		0.75	40.75	40		0.75	39.25	40	0.75			
46	Bharathi	898392	64	F	PSC+NS 2	R	6\36	42	43	1		ST	6\12	6\12	6\12	6\12	6\6,-0.75DS, -0.50DC at 180 degrees	42	43.5		0.5	42	42.5	0.5		42	42.5	0.5		43	43.5	0.5		DM Detachment	Corneal edema
47	Yelloji rao	898997	65	M	PSC+NS 1	R	6\24	43.25	43	0.25		ST	6\6	6\9	6\6	6\9	6\9	42.5	42	0.5		42.5	42		0.5	42.5	42		0.5	42.5	42		0.5		
48	Muniyamma	899242	66	F	PSC+NS 2	R	6\18	43.75	43	0.75		ST	6\24	6\12	6\18	6\9	6\9	41.5	41		0.5	41.5	41		0.5	41.5	41		0.5	41.5	41		0.5		
49	Shanthabai	579281	52	F	PSC+NS 1	L	6\36	42	43		1	ST	6\9	6\9	6\9	6\9	6\9	41.75	41		0.75	40.25	41	0.75		41.75	41		0.75	41.75	41		0.75		
50	Lalitha reddy	791576	55	M	PSC+NS 2	L	6\24	40	40.5		0.5	ST	6\6	6\9	6\6	6\9	6\9	44	44.25	0.25		44.25	44		0.25	44	44.25	0.25		44	44.25	0.25			
51	Gopal Krishna	891461	68	M	PSC+NS 3	R	CF AT 3	41	41.25		0.25	ST	6\12	6\12	6\12	6\12	6\6,-0.50DS	43.75	44		0.25	44.25	44		0.25	44.25	44		0.25	44.25	44		0.25		PCO
52	Gangappa	949606	69	M	PSC+NS 1	R	6\18	41	41.75		0.75	ST	6\9	6\9	6\9	6\9	6\9	41.25	42		0.75	41.25	42	0.75		41.25	42	0.75		42.75	42		0.75		
53	Sridhar	730628	67	M	PSC+NS 3	L	6\36	41.25	42.25	1		ST	6\12	6\12	6\12	6\12	6\6,-0.75DS, -0.50DC at 180 degrees	43.25	43	0.25		42.25	42		0.25	42.25	42		0.25	43.25	43.5	0.25			PCO
54	Basamma	725327	53	F	PSC+NS 1	L	6\24	40	41	1		ST	6\6	6\9	6\6	6\9	6\9	44	44.5		0.5	46	45.5		0.5	44	44.5	0.5		44	44.5	0.5			
55	Venkataramanappa	733234	56	M	PSC+NS 3	R	CF AT 5	42	42.75	0.75		ST	6\9	6\9	6\9	6\9	6\9	45	44.75		0.25	45	45.25	0.25		44.25	44		0.25	44.25	44		0.25		
56	Shakuntala	739673	72	F	PSC+NS 3	L	6\18	44.5	45	0.5		ST	6\12	6\12	6\6	6\9	6\9	42	43	1		44.5	43.5		1	42	43	1		42	42.75	0.75			
57	Gowramma	739669	73	F	PSC+NS 1	R	6\36	42	42.25	0.25		ST	6\6	6\6	6\6	6\9	6\9	41.25	41		0.25	41.25	41		0.25	41.25	41		0.25	41.25	41		0.25		
58	Basha	758909	63	M	PSC+NS 1	R	6\24	41.5	41		0.5	ST	6\6	6\9	6\6	6\9	6\9	42.5	42		0.5	41	41.5	0.5		41	41.5	0.5		41	41.5	0.5			
59	Zafurnnisa	760861	62	F	PSC+NS 1	R	CF AT 5	40.25	41	0.75		ST	6\6	6\6	6\9	6\9	6\9	40.5	41	0.5		41.5	41		0.5	41.5	41		0.5	41.5	41		0.5		
60	Venkatachalapathi	762809	57	M	PSC+NS 1	R	6\36	43.25	42.25		1	ST	6\6	6\9	6\6	6\9	6\9	44	43		1	44	45	1		41.5	41		0.5	41.5	41		0.5		
61	Venkataramanachari	780839	63	M	PSC+NS 2	L	6\24	42	43	1		ST	6\6	6\6	6\6	6\6	6\6	42.25	42		0.25	42.25	42		0.25	43.25	43.5	0.25		43.25	43	0.25			
62	Narayanaswamy	780810	62	M	PSC+NS 3	R	6\24	43	43.75	0.75		ST	6\9	6\9	6\9	6\9	6\9	41.5	42	0.5		42.5	42		0.5	42.5	42		0.5	42.5	42		0.5		
63	Kittappa	780845	58	M	PSC+NS 3	R	6\18	43	43.25	0.25		ST	6\12	6\12	6\6	6\12	6\6,-0.75DS, -0.50DC at 180 degrees	43	42		1	42.5	42		0.5	42.5	42		0.5	42.5	42		0.5		Corneal edema
64	Muniyamma	782147	75	F	PSC+NS 3	L	6\18	43	43.5	0.5		ST	6\6	6\6	6\6	6\6	6\6	42	42.25	0.25		42	41.75	0.25		42	41.75	0.25		42	42.25	0.25			
65	Moozappa	782162	61	M	PSC+NS 3	L	6\60	41	41.5	0.5		ST	6\9	6\9	6\6	6\9	6\9	43	43.5	0.5		42.5	42		0.5	42.5	42		0.5	42.5	42		0.5		
66	Sarojamma	782136	61	F	PSC+NS 3	L	6\36	41	40		1	ST	6\12	6\12	6\6	6\12	6\9,-0.50DC at 90 degrees	44.5	44		0.5	43.5	43		0.5	43.5	43		0.5	43.5	43		0.5		Post op iritis
67	Krishnamma	782152	62	F	PSC+NS 2	R	6\24	41.25	40.25		1	ST	6\6	6\6	6\6	6\6	6\6	43	42.75		0.75	44	44.75	0.75		43	44.75	0.75		44	44.75	0.75			
68	Narayanappa	782156	65	M	PSC+NS 3	R	6\24	41.25	40.25		1	ST	6\12	6\12	6\9	6\9	6\9	43.5	44	0.5		42.5	42		0.5	42.5	42		0.5	42.5	42		0.5		Post op iritis
69	Munivenkatappa	782154	59	M	PSC+NS 3	L	6\18	43	43.75	0.75		ST	6\24	6\18	6\18	6\12	6\6,-0.75DS, -0.50DC at 180 degrees	43	42.5		0.25	42.75	42.5		0.25	42.25	42		0.25	42.25	42		0.25		
70	Venkatagiriyappa	782149	76	M	PSC+NS 2	L	CF AT 2	42	42.75	0.75		ST	6\9	6\9	6\6	6\6	6\6	43	43.75	0.75		42.25	43	0.75		43.75	43		0.75	44.25	43		0.75		
71	Venkataswamy	782159	64	M	PSC+NS 3	R	6\36	42	42.5	0.5		ST	6\6	6\6	6\9	6\9	6\9	41.5	41		0.5	42	41		0.5	40	40.5	0.5		40	40.5	0.5			
72	Shafun bee	782148	66	F	PSC+NS 2	L	6\18	42	42.25	0.25		ST	6\12	6\12	6\6	6\6	6\6	41.25	41		0.25	40.75	41	0.25		41.25	41		0.25	41.25	41		0.25		
73	Mariyappa	782155	60	M	PSC+NS 2	L	6\18	41.5	41		0.5	ST	6\9	6\9	6\9	6\9	6\9	43	42		0.5	43	42		0.5	41	41.5	0.5		41	41.5	0.5			
74	Sridevi	794080	77	F	PSC+NS 3	R	CF AT 3	41	41.5	0.5		ST	6\12	6\6	6\6	6\6	6\6	40	40.75	0.75		39.75	39		0.75	39.75	39		0.75	39.75	39		0.75		Post op iritis
75	Gangamma	796088	69	F	PSC+NS 3	L	HM+	41.25	41		0.25	ST	6\24	6\18	6\18	6\12	6\6,-1.0DS,-0.75DC at 90 degrees	40.25	40		0.25	40.25	40.5	0.25		39.25	39		0.25	40.25	40		0.25		Post op iritis
76	Nanjamma	936028	77	F	PSC+NS 2	R	6\60	39	39.25	0.25		ST	6\6	6\9	6\9	6\9	6\9	39	38.5		0.5	40.25	39.75		0.5	39	38.5	0.5		39	39.5	0.5			
77	Sharadamma	937895	76	F	PSC+NS 2	R	6\60	39.75	39		0.75	ST	6\9	6\6	6\6	6\6	6\6	42	41.75		0.25	41.25	41		0.25	41.25	41		0.25	41.25	41		0.25		
78	Nagaraj	938210	68	M	PSC+NS 2	L	6\60	38	39	1		ST	6\6	6\6	6\9	6\9	6\9	42.75	42		0.75	40.25	41	0.75		42.75	42	0.75		42.75	42	0.75			
79	Narayanamma	939068	67	F	PSC+NS 2	L	6\60	39	40	1		ST	6\9	6\9	6\6	6\6	6\6	42.5	43	0.5		41.5	41		0.5	41.5	41		0.5	41.5	41		0.5		
80	Narayanaswamy	948851	70	M	PSC+NS 2	L	6\24	41	40		1	ST	6\6	6\9	6\9	6\9	6\9	42.25	42		0.25	42.25	42		0.25	43.75	42	0.25		42	42.25	0.25			