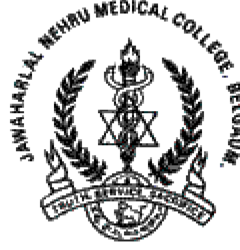

"A ONE YEAR CROSS-SECTIONAL STUDY TO MEASURE SURGICALLY INDUCED CORNEAL ASTIGMATISM IN SUPERIOR FROWN SMALL INCISION CATARACT SURGERY IN SENILE CATARACT PATIENTS"

BY

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Dissertation submitted to the
KLE University, Belgaum, Karnataka

In partial fulfilment of the requirements for the degree of
MASTER OF SURGERY
IN
OPHTHALMOLOGY

Under the guidance of
Dr. S. B. PATIL
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DATE-

PLACE-

(Dr. VISHAL S.KAKHANDKI)

LIST OF ABBREVATIONS USED

@	At
AC	Anterior chamber
ACIOL	Anterior chamber intraocular lens
ANOVA	Analysis of variance
ATR	Against the rule
ATW	Against the wound
BCVA	Best corrected visual acuity
Bp	Blood pressure
CCC	Continuous curvilinear capsulorrhexis
CRI	Corneal Relaxing incision
D	Diopter
DOA	Date of admission
DOD	Date of Discharge
DOS	Date of surgery
e/d	Eye drops
ECCE	Extra capsular cataract extraction
ECG	Electro cardio gram
FBS	Fasting blood sugar
HBsAg	Hepatitis B surface antigen
HIV	Human immunodeficiency virus
ICCE	Intra capsular cataract extraction
IOL	Intra ocular lens
IOP	Intra ocular pressure
IP	In patient
Kd	Diopteric curvature
LASIK	Laser in situ keratomilieusis
LE	Left Eye
LRI	Limbal relaxing incision
MSICS	Manual small incision cataract surgery.
OBL	Oblique

PCIOL	Posterior chamber Intra ocular lens
PEX	Pseudo exfoliation
PMMA	Poly methyl methacrylate
PR	Projection of rays
PRK	Photo refractive keratectomy
RBS	Random blood sugar
RE	Right Eye
SD	Standard deviation
SIA	Surgery induced Astigmatism
SICS	Small incision cataract surgery
SIRC	Surgically induced refractive change
SLE	Slit lamp examination
SRK	Sanders-Retzlaff-Kra ff
UCVA	Uncorrected visual acuity
WTR	With the rule

ABSTRACT

BACKGROUND AND OBJECTIVES:

To measure surgically induced astigmatism in senile cataract patients undergoing superior frown incision SICS (6mm) without sutures at Prabhakar Kore's KLES Hospital, Belgaum.

METHODS:

This was a prospective cross-sectional study in which Manual superior frown incision SICS (6mm) was carried out in 150 consecutive patients having senile cataract. The patients were followed up on the 30th day of operation .Surgically induced astigmatism was calculated using the pre-operative and post-operative keratometry readings by vector method (SIA software) using appropriate statistical analysis

RESULTS:

The mean surgically induced astigmatism in 150 patients undergoing superior frown incision (6mm) SICS was + 0.51 D +/- 0.24 D 180 (ATR)

CONCLUSION:

Surgically induced astigmatism in patients undergoing superior frown incision (6mm) SICS was less leading to better uncorrected visual acuity(UCVA)in the post-operative period. ATR astigmatism was induced in the majority of the cases

Keywords- small incision cataract surgery (SICS), Astigmatism, keratometry.

TABLE OF CONTENTS

SL.NO.	SECTIONS	PAGE NO.
1.	INTRODUCTION	1
2.	OBJECTIVES	3
3.	REVIEW OF LITERATURE	4
4.	METHODOLOGY	36
5.	RESULTS	46
6.	DISCUSSION	54
7.	CONCLUSION	57
8.	SUMMARY	58
9.	BIBLIOGRAPHY	59
10.	ANNEXURES	66

ANNEXURE I : INFORMED CONSENT

ANNEXURE II : PROFORMA

ANNEXURE III : MASTER CHART

LIST OF TABLES

SL.NO	TABLES	PAGE NO.
1	Sex incidence	46
2	Age distribution	47
3	Pre-operative astigmatism	48
4	Pre-operative visual acuity	49
5	Post-operative astigmatism	50
6	Post-operative visual acuity	51
7	Surgically induced astigmatism	52

LIST OF FIGURES

SL.NO.	FIGURES	PAGE. NO.
1	Types of incisions in SICS	10
2	Incisional funnel	26
3	Incisional architecture	38
4	Anterior chamber entry	39
5	Hydrodissection	39
6	Nucleus delivery by Sandwitch technique	40

LIST OF GRAPHS

SL.NO.	GRAPH	PAGE.NO.
1	Sex incidence	**46**
2	Age distribution	**47**
3	Pre-operative astigmatism	**48**
4	Pre-operative visual acuity	**49**
5	Post-operative astigmatism	**50**
6	Post-operative visual acuity	**51**
7	Surgically induced astigmatism	**52**

INTRODUCTION

Of the total estimated 38 million blind people in the world, nine to twelve million are in India. 50 to 80% of these people are blind because of cataract[1,2]. In addition to the backlog, an additional 3.8 million become blind each year because of cataract[3] In 2000, 3.5 million cataract operations were performed[4] but this remains insufficient to treat the backlog and the newly blind.

Cataract surgery has been there since 20 centuries. It has evolved from couching in ancient times to modern day manual SICS and phacoemulsification. Phacoemulsification has become the routine procedure for cataract surgery in industrialized countries, as it offers faster visual recovery and better UCVA than sutured manual ECCE[5].

In India, cataract blindness is more prevalent in poor, rural and illiterate people than in urban, wealthy and literate. Hence phacoemulsification has a limited role here. In order to obtain the advantages of a self sealing sutureless incision at low cost, ophthalmologists in India are performing manual SICS as an alterntive[6].

A number of studies in past years have shown that surgically induced astigmatism, particularly ATR astigmatism is the commonest cause of worsening UCVA after cataract surgery[7, 8].

Cataract surgery has improved to the point where it is no longer only to improve the BCVA but to give the best possible UCVA to the patient. Post operative astigmatism sill exists to be the main cause of poor uncorrected visual acuity in the

Post-operative period. Hence refinements in surgical technique are needed to reduce or eliminate the problem of SIA.

The various forces that are important in understanding the cause for astigmatism include incision, sutures; wound healing, cautery, position configuration, nutrition, age and eyelid action. The incision is a major cause of these shifts. This effect is directly related to the length, location and depth of the incision.

Incisional funnel: The incisional funnel is an imaginary pair of curved lines representing the relationship between astigmatism and incision length. They diverge outwards from the limbus, separating as the distance from the limbus increases. Incisions made within this funnel will for all practical purposes be astigmatically neutral. Short incisions can be made closer to the limbus and longer incisions farther away, and all will have the equivalent effect on corneal stability.

This study has therefore been done to evaluate the astigmatism induced by superior frown incision (6mm) SICS.

OBJECTIVES

1. Determination of amount and type of surgically induced astigmatism in superior frown incision(6mm) SICS

REVIEW OF LITERATURE

HISTORICAL ASPECTS:

Cataract surgery in antiquity:

Cataract surgery has been performed since 20 centuries. Sushruta practiced couching as early as 800 BC. He used a blunt needle, passed through the sclera, behind the iris, to dislocate the lens downwards or backwards. The proof of success was the ability of patient to see form and figures again.

Cataract surgery developed from couching to modern day manual small incision cataract surgery and phacoemulsification after the development of IOL by Ridley.

Charles Kelman developed phacoemulsification in 1967 in which the lens nucleus was emulsified ultrasonically, allowing surgery to be performed through a smaller incision.

Colvord and co-workers (1980) advocated a single plane entry from sclera to anterior chamber.

Richard Kratz first developed the scleral tunnel incision in 1980.

In 1982 Kraff and Sanders proved that smaller incisions were better than larger, producing less early induced astigmatism and less late healing astigmatic shift.

During evolution of phacoemulsification, a number of surgeons under leadership of Peter Kansas graduated into small incision techniques. Kansas described manual phacosection.

Michael McFarland published the development of a sutureless incision in March 1990. Ernest later recognized that the corneal lip of this sclero corneal tunnel acted as a one way valve which imparted self sealing property to this incision.

In April 1990, Pallin described the Chevron incision and Jack Singer popularized the frown incision.

Blumenthal described hydroexpression of nucleus in 1992.

Fine introduced a new planar temporal clear corneal incision in 1992.

Amar Aggarwal (2001) developed Phaconit where he removed the nucleus through a 0.9mm incision.

History of Astigmatism:

Thomas young in 1801 was the first to describe ocular astigmatism. However it was some years later before Airy in 1827 corrected astigmatism using cylindrical lens. Corneal astigmatism was characterized by Knapp and also Donders in 1862. In 1864 Donders described regular astigmatism. Donders also described astigmatism after cataract surgery and soon after Snellen in 1869 suggested that placing the incision on steep axis would reduce corneal astigmatism.

ANATOMY OF CORNEA, SCLERA AND LIMBUS

Anatomy of cornea:

The cornea is a transparent, avascular, watch glass like structure forming anterior one sixth of the outer fibrous coat of the globe.

The anterior sur face of cornea is elliptical with an average horizontal diameter of 11.7mm and vertical diameter of 11mm. The posterior surface of cornea is circular with an average diameter of 11.5mm. It is 0.52 mm thick in the centre and 0.67mm thick at the periphery. The central 3-5mm of cornea “the optical zone” has an anterior radius of curvature of 7.8mm and a posterior radius of curvature of 6.5mm.

The total refractive power of cornea is 45D which is three fourths the total refractive power of the eye. Its refractive index is 1.37.

Microscopically the cornea has 5 layers. These are, an anterior epithelium of 5-90µ thickness, the Bowman’s membrane which is 8-14µ thick, the stroma which forms 90% of corneal thickness and is 0.5mm in thickness, a 40µ thick descemet’s membrane and a single layer of endothelium facing the anterior chamber.

The epithelium of cornea continues across the limbus as the conjunctival epithelium and the stroma of cornea continues across the limbus as the stroma of sclera[9].

SURGICAL ANATOMY OF LIMBUS:

Limbus is the transition zone between the peripheral cornea and anterior sclera. It is defined differently by anatomists, pathologists and clinicians, structures included in the limbus are:

1. Conjunctival and limbal palisades
2. Tenon's capsule
3. Episclera
4. Corneo scleral stroma
5. Aqueous outflow apparatus.

The transition from sclera to cornea occurs over the limbus and this zone is 1-1.5mm thick.

The surgical limbus is divided into 2 zones:

1. An anterior bluish grey zone overlying clear cornea and extending from end of Bowman's layer to Schwalbe's line.
2. A posterior white zone overlying the trabecular meshwork and extending from Schwalbe's line to scleral spur[10].

Anatomy of sclera:

It is an opaque fibrous structure covering posterior four fifth of the globe. It is invested anteriorly by the Tenon's capsule. The tenon's capsule and conjunctiva overlying it fuse near the limbus with the sclera.

The sclera is thinnest (0.3mm) behind the insertion of rectus muscles. It is thickest (1mm) at the posterior pole. Its thickness anterior to rectus muscle insertions is 0.6mm and is 0.4-0.5 mm thick at the equator.

It is an avasuclar structure except for episcleral vessels and intrascleral vascular plexus located just posterior to the limbus. A number of emissary channels penetrate the sclera for passage of arteries, veins and nerves.

Miroscopically it has 3 layers:

1. Episclera is a vascular structure which merges superficially with the conjunctiva and deep with anterior superficial sclera.
2. Stroma has collagen fibers, fibroblasts and ground substance. These collagen fibers are arranged irregularly with variable thickness and inter fibrillar distance, accounting for the opaque nature of sclera and its elasticity[10].
3. Lamina fusca is the deep pigmented layer of sclera.

Collagen Arrangement in Cornea:

The collagen lamellae in the cornea are oriented orthogonal to each other in the stroma with regular spacing in between them. These lamellae run from limbus to limbus across the cornea. The fibers near the limbus are all oriented tangential to the limbus and the limbal fibers are in the form of a well defined annulus which extends 1mm into the sclera. This annulus varies in width with position around the cornea. It being 1.5mm wide superiorly, 2mm wide inferiorly and maximum value midway between superior and nasal and superior and temporal cornea[11].

INCISIONS AND WOUND HEALING IN MSICS

Prior to the advent of silk sutures, suture less cataract incisions were the norm in ophthalmology but they were not self sealing. The earliest mentions of self sealing cataract incisions were made by Richard P. Kratz in 1980 and by Louis J. Girard in 1984. In March 1990 Michael McFarland developed the first self sealing cataract incision.

In present day cataract surgery various incisions are used. These may be scleral, posterior limbal, anterior limbal, or corneal. In manual small incision cataract surgery, scleral incision is the standard choice. Why the incisions in MSICS are self sealing?

In MSICS, sclero corneal tunnel incision is constructed. In this incision the internal incision in anterior chamber is remote from the external scleral incision and the two are connected together by a sclero corneal tunnel. When the internal pressure of the eye is re-established, the high IOP, compared to the lower atmospheric pressure causes the tunnel to collapse and self seal[12].

The various incisions which are used in MSICS vary according to their site, dimensions, design and architecture. The site of incision can be superior or super temporal or temporal. The dimensions of the incision can vary from a 3.5mm incision while using foldable IOLs to a 6mm or longer incision in case of rigid IOL's. Other factors which affect incision size are

- Type of cataract
- Technique of nucleus delivery
- Skill of surgeon
- Design of wound.

In the wound design, the internal incision is always larger than the external, giving a shape of a funnel to the wound. The inner lip of the wound normally has a width of eight to nine mm.

The various shapes of incisions in use for MSICS are

- Horizontal incision or straight incision
- Frown shaped incision
- V shaped incision
- M shaped incision
- Horizontal incision with straight backwards extension
- Horizontal incision with backward extensions perpendicular to the limbus.

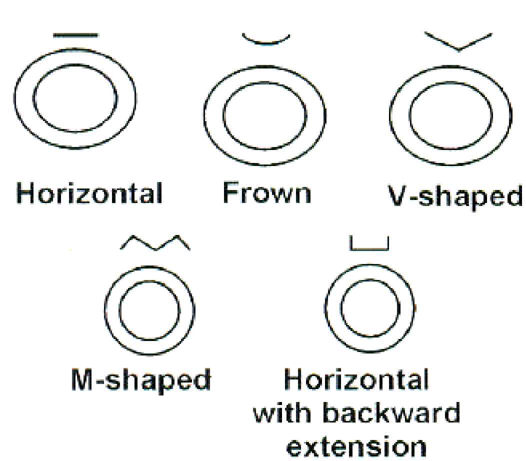


Fig.1: Types of incisions in MSICS

Manual Small Incision Cataract Surgery:

Anaesthesia:

Most surgeons prefer peribulbar anesthesia. However other techniques which are being used are topical anesthesia with 4% paracaine drops, subconjunctival injection of 2% xylocaine with sensorcaine, sub-tenon perfusion with a canula, application of a wet cotton plaque dipped in xylocaine at the wound site, intracameral preservative free xylocaine.

Technique:

After painting and draping the patient, traditionally a superior rectus bridle suture was placed but presently the surgery is done without a superior rectus suture with globe being stabilized by a grip on conjunctiva or tenons capsule.

- A peritomy is made with scissors and hemostasis is achieved with either thermal or wet field cautery.

Technique of wound construction:

The desired size of external incision is measured with calipers about 1.5- 2mm behind the limbus and the incision is made using a diamond or steel blade. Scleral dissection is then carried out, using a crescent knife, towards the limbus, taking care to always keep the heel of crescent knife down. The dissection is carried straight into clear cornea for 1mm, the tunnel is extended on either side and lateral scleral pockets are also made. A side port is made 2-3 clock hours away from the chosen incision site using a 15° blade. The eye is filled with viscoelastic through the side port to increase the IOP and make the globe firm. This later helps in easier creation of the capsulotomy. A capsulotomy using can-opener method, a CCC method, or envelope

technique is done with a 26-G needle fashioned into a capsulotome. Viscoelastic is injected in AC.

The anterior chamber is now entered from the centre of the internal edge of the tunnel using a 3.2/2.8mm angled sharp tip keratome. The keratome is entered angled downwards with tip pointing towards the centre of pupil. As soon as the tip enters AC the blade is made parallel to iris plane. This is now enlarged on either side using a blunt tip 5.5mm enlarging keratome. The extension is made parallel to limbus and never cutting the limbus.

Hydroprocedures namely hydrodissection and hydrodelineation are done for minimizing the size of the nucleus and loosening the cortical matter. Most often, with this, one edge of the nucleus usually pops out.

There are various methods in use for nucleus delivery in MSICS. The most safe and commonly used method is visco-expression. Other methods are sandwich method, snare method, phacosection method, fish hook method. The nucleus is delivered out of the wound using one of the methods, taking care not to damage the endothelium.

Irrigation and aspiration of AC is done either by manual or by automated system to remove the cortical matter.

Anterior and posterior capsules are polished and viscoelastic is injected. The selected PCIOL of appropriate size and power is implanted in the sulcus in cases with can-opener capsulotomy and is implanted in the bag in cases with CCC and the IOL is dialed and centered.

A thorough AC wash is given to remove the viscoclastic.

Method of closure:

The main wound if properly constructed is self sealing if IOP increases, hence BSS is injected into AC through the side port to seal the incision. The side port can be closed by stromal hydration or can be left as such[13, 14].

Cataract Incisions and SIA:

An incision of the cornea or sclera creates tissue gape. This gape causes corneal flattening along the meridian of the incision and steepening in the meridian 90° away, with several factors determining the magnitude of this effect[15].

When an incision is made on the scleral surface the two edges of the incision usually separate. This incisional gape is a normal physiological reaction to the natural elasticity of sclera and scleral shrinkage from cautery. This gape does not affect corneal astigmatism. If a flap is tunneled up to the cornea but not into anterior chamber there is still no net effect on astigmatism. The entry into the anterior chamber permits the cornea to change shape. Hence the part of a sclerocorneal tunnel which leads to corneal instability is the corneal entry site and not the external groove and tunnel[16].

Healing of Self Sealing Sclero-Corneal Tunnel:

Scleral pocket incision healing is complex because the initial groove and peripheral portion of the pocket are in the sclera. The pocket then goes through the limbus into the peripheral cornea, and anterior chamber entry is corneal. Healing process is different in each of these three zones.

Immediately after an incision, corneal fibres swell in an effort to seal the opening but scleral fibres tend to contract rather than swell. About two days after a scleral tunnel incision, histocytes and vascular elements from the episclera and

subconjunctival tissue moves into the incision and proliferating fibrous tissue begins to form, running at right angles to the clear cut scleral edges. After several weeks, the fibres begins to align themselves like scleral fibres but the scar is always histologically distinguishable. The sclera itself remains relatively inert.

In the limbal portion of the incision, which is entirely midstromal, stromal fibrocytes are inactive and play little or no role in wound healing. Healing of the limbal stroma also apparently depends upon fibrous ingrowth from the episclera. The stroma may take 2 years or more time to become normal again.

In the peripheral corneal stroma, the healing process is different. Initially after the incisional injury, there is a three to five days lag phase during which the corneal fibrocytes transform into fibroblast which then form new connective tissue. At least a month is required for consolidation.

At entry into anterior chamber , the cut edges of Descemet's membrane do not reunite. 24 to 48 hours after injury, endothelial cells at the edge of the wound begin to proliferate by dividing and cover the retracted edges of Descemet's membrane, continuing to proliferate, they form a scar over the incisional area. The proliferating endothelial cells produce a new basement membrane which, after two to three years, thickens to form a new Descemet's membrane about half of the original thickness. Evidence suggests that scleral tunnel incisions probably do not heal any faster than limbal incisions[17].

ASTIGMATISM

It is refractive error in which no point focus of light is formed because of unequal refraction of light rays in different meridia by the diopteric system of the eye[9].

It accounts for about 13% of the refractive errors of human eye[18].

COMPONENTS OF ASTIGMATISM:

Astigmatism can be an error of curvature, of centering, of refractive index or retinal.

Curvature astigmatism if of any high degree, has its seat most frequently in cornea. This is usually congenital and its occurrence in small degrees is almost invariable. Curvature astigmatism of lens also occurs with great frequency but in the majority of such cases such anomalies are small.

Astigmatism due to decentering occurs when the lens or the IOL is placed obliquely or slightly out of line in the optical system.

A small amount of index astigmatism occurs physiologically in lens and is usually slight[19].

Retinal astigmatism occurs due to oblique placement of macula. Astigmatism is regular when the refractive power changes uniformly from one meridian to another.

In with the rule (WTR) astigmatism the two principal meridian are placed at right angles to one another but the vertical meridian is steeper than horizontal. Normally the vertical meridian is rendered 0.25D steeper than horizontal.

Against the rule astigmatism refers to a condition where the horizontal meridian is steeper than the vertical meridian.

Oblique astigmatism is a type of regular astigmatism where the two principal meridia are not the horizontal and vertical though these are at right angles to each other.

Bioblique astigmatism is a type of regular astigmatism in which the two principal meridia are not at right angles to each other.

Irregular astigmatism is one in which there is an irregular change of refractive power in different meridia. There are multiple meridia which admit no geometrical analysis.

Depending upon the position of two focal lines in relation to retina, regular astigmatism is further classified as;

1. **Simple astigmatism**: the rays are focused in the retina in one meridian and either in front (simple myopic astigmatism) or behind (simple hypermetropic astigmatism) the retina in the other meridian.
2. **Compound astigmatism**: the rays of light in both meridia are focused either in front (compound myopic) or behind (compound hypermetropic) the retina.
3. **Mixed astigmatism**: the light rays in one meridian are focused in front and those in the other meridian behind the retina[20].

Quantitatively WTR astigmatism is defined as one which is corrected by a plus cylinder at 90°±30° and ATR astigmatism as that which is corrected by a plus cylinder at 180°±30°, the remaining 60° representing oblique astigmatism[21].

The widely adopted use of Zernike polynomials to describe the detailed components of the eye's optics has made the use of term irregular astigmatism largely redundant[18].

Another useful concept for incisions placed elsewhere other than superior is with the wound and against the wound. WTW astigmatism has its steepest radius in the meridian of the incision, the steepest axis in ATW astigmatism is 90° away from incisional axis[22].

Prevalence of astigmatism and changes with age:

In first months of life, infants show a high prevalence of high (6D average) ATR astigmatism (corneal) The steepest most astigmatic corneas occur in newborns with the lowest birth weight and lowest post conceptional age. As infants grow, emmetropisation of astigmatism occurs. Astigmatism shifts to low levels of WTR after 4 years age and pressure from eyelids on cornea over time has been suggested as a cause. Huynh and associates studied a large population of 6 year old children and found 75% of them having WTR astigmatism and only 4.8% had astigmatism >1D.

Young adults typically display small degrees of WTR astigmatism and in older adults shift occurs and ATR astigmatism becomes more prevalent. Anstice found that internal astigmatism remains stable throughout life and changes in astigmatism throughout life are primarily due to changes in corneal curvature[10].

Causes of astigmatism:

1. Both genetic and environmental influences have a role in development of astigmatism.
2. Eye lid pressure has been proposed as a cause of WTR astigmatism by Grosvenor. Wilson, Bell and Chotai showed that the position of the lids have an influence on degree and direction of astigmatism. Vihlen and Wilson

showed that with age the tension of eyelids decreases and astigmatism shifts towards ATR.

3. Nystagmus – people with nystagmus usually have high degrees of corneal WTR astigmatism.
4. Visual tasks – Certain visual tasks like prolonged reading habit in down gaze have a potential for inducing ATR astigmatism.
5. Surgically induced astigmatism occurs after surgeries for cataract, trabeculectomy, ptosis, scleral buckling, pterygium excision[18].

EFFECT OF ASTIGMATISM ON VISION:

Astigmatism induces distortion of image. The retinal image is distorted because of a differential magnification in the two principal meridians. There is 0.3% image distortion per diopter of astigmatism[23].

In WTR astigmatism, the power of weaker principal meridian produces a vertical line focus. In printed matter the vertical strokes of the letter are more important for recognition e.g. b,d,h, also there is less space between letters than between lines.

Hence it is useful to have a better focus in vertical meridian as is there in myopic WTR astigmatism, resulting in better snellen visual acuity[24].

In addition, a number of psychophysiological responses are more sensitive to vertically oriented stimuli e.g., stereoscopic threshold, depth determinations.

Another benefit of WTR astigmatism is that less cylinder is required in spectacle correction than ATR astigmatism of same magnitude. In corrected, astigmatic eye, retinal image distortion arises due to unequal spectacle magnification

in the two principal meridia, representing 1.6% distortion per dioptre cylinder correction[11].

More over spectacle cylinder will be less than the ocular astigmatism when the spherical equivalent is positive and greater than the ocular astigmatism when spherical equivalent is negative. So in general myopic ATR astigmatism will result in proportionally larger spectacle correction, which will produce more distortion[23]. A certain degree of myopic astigmatism is useful as it may produce a situation of pseudoaccommodation in psuedophakic patient[25, 26].

According to the optical model produced by Sawusch and Guyton. The least amount of summated blur throughout the range of object distances from 0.5 – 6m was -1.00DS/+0.75DC and was closely followed by - 0.75DS/+0.50DC [24].

Uncorrected astigmatism causes blurred image, glare, monocular diplopia. Spectacle correction may create distortion by meridional magnification. Old patients may experience difficulty adapting to axis shift induced by surgery. Any of these effects may create patient discomfort and dissatisfaction with an otherwise uneventful surgery[22].

METHODS TO MEASURE ASTIGMATISM:

1)Refraction:

Refraction evaluates the entire optical system of the eye and includes any aberrations of the lens, posterior cornea, IOL or posterior capsule[9]. Retinoscopy can determine both the magnitude as well as the axis of cylinder in astigmatism with remarkable precision[27].

Refractions are normally performed at the spectacle plane and not at the corneal plane. For surgically induced refractive changes determined by refraction to be compared with SIRCs determined by keratometry or topography, they must be vertexed to corneal plane. Spectacle vertex distance is usually 12mm. When correctly vertexed to cornea, astigmatism at corneal plane is almost 1/4D less. This relationship is always true for compound myopia. For compound hyperopia it is just opposite, i.e., astigmatism is always more by 1/4D at corneal plane than at spectacle plane[28]. If there is zero residual spherical equivalent refraction, the cylinder will be equal to corneal astigmatism[29].

The main refractive media of the eye are the cornea and the lens. The refractive state of the lens can be variable, particularly with cataract development30. Hence retinoscopy does not give an accurate refractive status of the eye in cataract patients as well as in patie nts with pseudophakia.

2) Keratometry:

It is the optical process of determining the curvature of central cornea. Keratometry is expressed as diopteric power (D) or as diopteric curvature (Kd) of the cornea. These measurements give the cornea's contribut ion to the overall refractive state of the eye.

Corneal curvature has been of interest for centuries. A description of corneal curvature was first given in 1619 by Christoph Scheiner. The first keratometer was built in 1769 by Jesse Ramsden. Then in 1854 Von Helmholtz improved upon this design. This device was built around a low power telescope that permitted measurement of the first surface corneal reflection. The ratio of apparent size of reflected image mire to the size of actual mire allows corneal curvature to be

determined precisely. The first practical keratometer suited for clinical use was developed in 1881 by Javal and Schiotz.

Principle of keratometer:

Strictly speaking, neither corneal curvature, nor the radius of curvature are measured directly, but these values are calculated by the apparent size of the image of the mire viewed by reflection from the anterior corneal tear film surface, which acts as a convex mirror. For a convex mirror.

$$r = 2 \times h'/h$$

Where,

r = radius of curvature of a spherical mirror

h' = Image size

h = object size

When this formula is applied to the cornea, the radius of curvature is always expressed as a positive number in millimeters.

Diopteric power (D) is calculated from r, as:

$D = (n' - n)/r$

n = refractive index of air = 1.000

n' = refractive index of cornea[31]

The standardized keratometric index of refraction is 1.3375. Hence keratometers measure the anterior corneal surface but give the total diopteric power of front as well as the back surface of cornea[32].

Keratometers use a microscope to magnify the image. However because the eye is constantly moving about, it is difficult to measure the image size against a reticule.

This problem is overcome by using the principle of visible doubling. This can be achieved either by using variable doubling with fixed object size or by varying the size of external object with fixed doubling[33].

TYPES OF KERATOMETERS:

Qualitative keratometers: These were first described in 1880.These are based on the principle of placido disks. They do not objectively measure the radius of curvature; hence a better description might be operative keratoscope. Examples include Hyde astigmatic ruler and troutman surgical keratometer.

Quantitative keratometers: These were first described by Hemholtz in 1854 These are based on the principle of keratometry and measure corneal curvature at different meridians. Thus the amount as well as axis of astigmatism can be determined. Examples include Javal Schiotz keratometer, Bausch and Lomb, Terry Surgical keratometer9 and Carvalho computerized surgical keratometer[34].

Hand held keratometers :

They give the advantage of portability and flexibility to perform measurements in different positions [35].

Bausch and Lomb keratometer :

It is based on the principle of constant object size and variable image size. The object is circular, illuminated mire with two plus and two minus signs. Light from the mire strikes the patients cornea and produces a diminished image behind it. This image becomes the object for the remainder of optical system.

The objective lens focuses the light from the mire image along the central axis. A four aperture diaphragm is situated near the objective lens. Beyond it are 2 doubling prisms – light passing through left aperture is deviated above the optical axis

by base up prism. Light passing through right aperture is deviated by base down prism. Upper and lower apertures double the central image whenever the instrument is not focused. This image doubling is unique to this keratometer allowing

simultaneous measurement of corneal power in two meridian without rotating the instrument. Range of this keratometer is from 36-52 D. Lower limit can be extended to 30D and upper limit to 62D by interposing a -1 D and a +1.25D lens respectively in front of objective.

LIMITATIONS OF KERATOMETRY:

1. The measurements are based on a false assumption that the cornea is a spherocylinder where as in reality, cornea is aspheric.
2. It measures a very small central area of cornea (3-4mm) ignoring peripheral zones.
3. It loses its accuracy when measuring very flat or very steep cornea.
4. Irregular astigmatism cannot be measured[33].

Although keratometric data are already at the corneal plane and do not require any vertex considerations, a different problem arises with the index of refraction used to convert the anterior radius of cornea to a refractive power. Most keratometers use a refractive index of 1.3375 for cornea. The cornea, like any meniscus lens, has a front surface power, a back surface power and an equivalent net power. The average index of refraction of the cornea is 1.376. The front surface power and the net power changes are the only clinically relevant considerations since there are no keratorefractive procedures intended to change only the back surface power.

For analyzing results in which both front and back surfaces have been changed equally, it is appropriate to use the net corneal index of refraction. Holladay has

suggested use of value 1.333 determined by Binkhorst. Using this value the net corneal power will be 98.76% of the standardized keratometric values. This 1.24% error is clinically negligible when calculating changes in corneal power produced by

surgical procedures, however it introduces a significant error of 0.56D in IOL calc ulations[28].

3) Corneal topography:

This developed due to the need to visualize localized distortions in corneal curvature. This provides a graphical representation of the contour of the cornea. Various techniques used for corneal topography are:

1) Keratoscopy

2) Slit scanning corneal tomography[32]

Refraction and keratometry indicate only one steep corneal meridian while corneal topography can identify one or more steep semimeridians which are not necessarily 180° apart[36].

SURGICALLY INDUCED ASTIGMATISM IN CATARACT SURGERY

Surgically induced astigmatism is the condition in which a patient's preoperative and postoperative keratometry values differ[37].

Since Donder's first description, it is well recognized that the wound produced by cataract surgery produces astigmatism. With the advent of sutured cataract sections and IOL implantation induced astigmatism became more of a concern.

During the evolution of change in astigmatism following cataract surgery, the patient's actual spherical equivalent rema ins constant. According to Gauss's law of elastic domes. For every change in curvature in one meridian there is an equal and opposite change 90° away. This corneal behavior is known as the coupling effect. Thus the corneal curvature changes not as if a single spherocylinder was placed at a single axis, but as if a plus cylinder was placed in the steeper meridian and a minus cylinder of equivalent magnitude was placed in the flatter meridian[20].

FACTORS AFFECTING SIA:

1) Incisional funnel: The incisional funnel is an imaginary pair of curved lines representing the relationship between astigmatism and incision length. They diverge outwards from the limbus, separating as the distance from the limbus increases. Incisions made within this funnel will for all practical purposes be astigmatically neutral. Short incisions can be made closer to the limbus and longer incisions farther away, and all will have the equivalent effect on corneal stability[16].

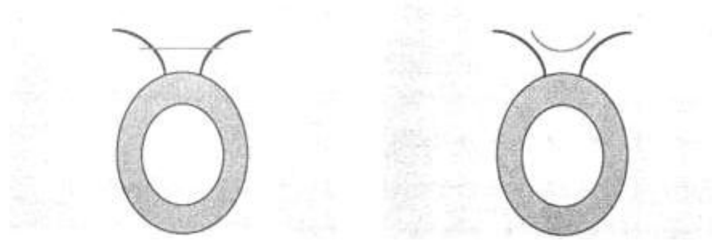


Fig.2: Incisional funnel

Incision length: The incision chord length of ECCE is generally 10-11mm. With phacoemulsification it varies from 3mm with foldable lenses to 5-7mm with rigid PCIOL. In MSICS it varies from 3.5mm to 7mm depending upon method of nucleus delivery, type of cataract and type of IOL[13].

Numerous studies have demonstrated that smaller incisions induce less astigmatism. Samuelson and associates studied induced astigmatism in cadaver eyes and found that there was a nearly linear increase in corneal flattening with increasing incision length. The maximal incision length that prevented flattening of more than 0.25D was 3mm[38].

Armeniades and co-workers found that of the length, location and shape of incision, incision length was the most important of these factors affecting
SIA[39].

More peripheral and shorter incisions induce less astigmatic change. Koch introduced the concept of an astigmatically neutral zone – the incisional funnel extending posteriorly from the limbus. This incorporates the linear relationship between the cube of incision length and astigmatism and the inverse relation between astigmatism and the distance of incision from the limbus to define a space within which incisions should be astigmatically neutral regardless of their length[16].

2) Location:

Thrasher and Boerner found significant difference in SIA in incisions located 1-1.5mm from limbus but found the SIA to be insignificant for incisions with different lengths located 2.5mm from the limbus[40]. The effect of incision placement in other than superior location was studied by Masket who noted reduced ATR astigmatism on using temporal incisions[41]. Anders and colleagues studied SIA in temporal scleral and superior scleral group, and found SIA of 0.65±0.23D and 0.97±0.41D respectively after 8 months[42].

Why astigmatism is more in superior than in superotemporal and temporal incisions can be explained by the fact that since cornea is 1mm wider than tall, hence superior incisions would be located closest to centre of cornea and temporal incisions the farthest. Moreover superior incisions are affected by the distractive forces of lid blinking and gravity[43, 44].

3) Incision Shape:

In curvilinear limbus parallel incision nothing prevents the inferior edge of the incision from falling away from superior edge. With a straight incis ion the two extremes are secured in the sclera and the inferior edge directly adjacent to the two extremes cannot sag hence potential for astigmatism is less. In frown incision the two ends are swept upwards, away from limbus, hence the effect is like the ends were slings, supporting the incision ends, hence very low potential for astigmatism is there[16].

The incisional funnel concept given by Koch explains the astigmatism induced by various incision shapes. The limbal parallel curvilinear incision falls out of the funnel and hence causes greater SIA as compared to the straight incision which

also falls out of the funnel but because more of it is contained within the funnel, hence it causes less astigmatism. The frown incision of same size causes least astigmatism because since its ends curve posteriorly hence it tends to lie completely within the incisional funnel[16]. The low astigmatism caused by the chevron / V shape incision has the same explanation.

4) Suture technique and material:

Various authors have noted the initial induced WTR astigmatism with interrupted or continuous suture closure and have attributed it to wound compression from tight sutures, wound edema, cautery and increased IOP after surgery[45]. Resolution of wound edema, cheese wiring of suture, loss of suture tensile strength contribute to suture decay and ATR astigmatism later.

Stainer and colleagues found WTR astigmatism 5 weeks. Postoperatively in 10-12mm incision closed with 10-0 nylon sutures.

Azar and associates studied the effects of 5.5 mm incisions in vertical meridian closed with 1 radial, 3 radial and no sutures. Postoperatively WTR astigmatism increased in sutured group. It was predominantly ATR in non sutured group.

5) Intraocular lenses:

Study has shown that IOL's are not a common source of astigmatism. Significant lens tilt is required to induce clinically significant astigmatism. A 20-D IOL must be inclined 10° from the vertical to cause a 1D cylinder.

6) Wound healing:

The gradual ATR changes associated with superior incisions may be secondary to wound healing changes but the time course for final wound healing in avascular cornea and sclera is unknown.

7) Cautery:

Bergman and associates found significant mean vertical WTR steepening after cauterization of 5.5mm and 11mm chord length incisions which they attributed to collagen shrinkage[22] but this effect is found to predominate in immediate post operative period and regresses later.

MODIFICATIONS OF ASTIGMATISM:

Various methods to modify astigmatism in MSICS are:

1. Using cataract incision to modify pre-existing astigmatism. Incision is made at 12 o'clock if preoperative keratometry shows WTR astigmatism. In presence of ATR astigmatism, incision is made on temporal side. If astigmatism is high, the incision is paralimbal, close to limbus and long in length. If there is no astigmatism, a small, frown incision away from limbus is made[46].
2. Astigmatic keratotomy: In this technique arcuate shaped corneal relaxing incisions (CRIs) are used, either single or paired, placed concentric to the visual axis, at 99% of peripheral pachymetry measurements. But these have limited predictability and often result in over correction. Moving the relaxing incision off the cornea to the limbus creates (LRIs) limbal relaxing incisions. These can be used with any type of cataract incision and result in smoother corneal topography and are quiet effective in astigmatism =3D.
3. Toric IOLs: These are foldable, toric, silicone IOLs which are implanted along with spherical IOLs in cataract patients with pre-existing astigmatism. Their limitations are that they are available in only two powers of 2D or 3.5D with an effective correction at corneal plane of 1.5D or 2.25D respectively. Moreover they have a tendency to rotate and studies show that 18-25% cases rotate by more than 20°, moreover they are not effective for astigmatism >3D.

4. Piggybacking toric lenses: These are used in cases with high astigmatism Problem here is that even a small amount of rotation affects the cylinder correction seriously. To prevent this, plate haptic lenses are used. This is a good method to reduce high preoperative astigmatism.
5. Toric lenses with LRIs: This method can be used to correct larger amounts of astigmatism. The advantage of using a toric lens is the reduction in the amount of incisional Surgery required[47].
6. Spectacle: An astigmatic error of =0.5D usually requires correction. Uncorrected, the snellen VA may reduce to 6/9 – 6/18 by an error of 1-2D. Patients who have adapted to a life time of cylinder axis may not tolerate spectacle correction of a surgically induced axis change. Moreover spectacle correction may produce meridional aniseikonia, which becomes problematic with binocular vision.
7. Contact lenses may be satisfactory for many patients but superior wound gape with horizontal steepening may cause inferior ride of lens[22].
8. Other methods to reduce astigmatism are PRK, wedge resection and LASIK.

CALCULATION AND ANALYSIS OF SIA:

To estimate the effect on corneal curvature induced by cataract surgery, the difference between preoperative and postoperative keratometry needs to be calculated. Various methods are used to calculate SIA from this. These methods are :-

1) Subtraction method:

This is the simplest method to calculate SIA. It compares the numerical value of astigmatism before and after surgery. The induced astigmatism is the difference between the two.

$$\Delta M = M1 - M2$$

Where

ΔM = Induced astigmatism

M1 = Pre operative corneal astigmatism.

M2 = Post operative astigmatism.

This method does not consider the axis of astigmatism. Hence in situations where the axis is different after surgery it gives erroneous results.

2) <u>Algebraic method:</u>

$$\Delta M_{alg} = M_{1alg} - M_{2alg}$$

Where

M_{1alg} and M_{2alg} change signs in accordance with the direction of the steeper corneal meridian. For steep meridian between 90°±45 a plus sign is added and for all other values of steep meridian, M is denoted a minus sign. This method describes WTR and ATR change but gives no information regarding the angle of the axis.

3) <u>Cravy's method</u> calculates SIA as:

$$\text{Cravy } \Delta K = (\Delta x) + (\Delta y)$$

Where,

$$\Delta x = x_1 - x_2$$

And $x_1 = M1 \cos a1$

$$x_2 = M_2 \cos a2$$

$\Delta y = y_1 - y_2$ where

$$Y_1 = M_1 \sin a1$$

$$Y_2 = M_2 \sin a2$$

This system reports the WTR and ATR changes.

4) The vector method described by Jaffe is based on a variation of a technique of finding the sum of oblique cylinders in which the cylinder is represented on a graph by a vector. Vector gives information regarding both amplitude and direction. The sum of two obliquely crossed cylinders can be found by treating the component powers of the two cylinders as vector in a vector diagram, but while doing so the vectors representing cylinder powers are directed at angles twice the actual angle of orientation before the eye. To calculate SIA after cataract surgery the preoperative and postoperative astigmatism values are treated as vectors and represented a vector diagram at twice their axis angles. If K_1 is preoperative astigmatism at axis $\phi 1$ and K3 is postoperative astigmatism at axis $\phi 3$ then K1 and K3 are represented in a diagram at axis 2ϕ, and $2\phi 3$. The ends of K1 and K3 are joined together which gives K2 (SIA).

A line is plotted parallel to baseline so the direction of K2 can be measured around the end of K1.

The resultant angle is then halved to get the axis of SIA.

In these calculations, it makes no difference whether one uses positive or negative cylinders as the signs are kept the same in each calculation.

5) A more highly precise method of measuring SIA uses rectangular and polar coordinates. The x,y polar coordinates are determined for preoperative (K1) postoperative (K3) astigmatism where

$X = K \cos \theta$

$Y = K \sin \theta$

K is the astigmatism.

θ is the angle of steep meridian. The rectangular coordinates for SIA (K2) are calculated as :

K2 = K3 – K1 = XK2, YK2

Finally K2 is calculated as $\sqrt{X^2K^2 + Y^2K^2}$

The axis of K2 is calculated as

θ = arc tan y/x

6) <u>The law of sines and cosines:</u> it is another trignometric method used to calculate SIA where amplitude of SIA (K2) is found by law of cosines and angle θ is found by law of sines.

7) <u>The lensometer method:</u> Here the SIA is calculated by using cylinders from trial lens set and combining the two at the correct axis on the lensometer and reading the answer off the instrument.

8) <u>The vector decomposition method:</u> This method reports the WTR and ATR components from the values generated from astigmatic magnitude not considering axis.[29, 48]

9) <u>The polar value method:</u> First described by Naeser is based on the concept of surgically induced flattening and torque of the preoperative cylinder. This converts keratometric values to a polar value, allowing expression of astigmatism as a single figure[49].

10) <u>Alpins method:</u> In 1997 Alpins gave a new method which encompasses all requirements of polar value method but belongs to rectangular coordinate group. This method uses both the preoperative corneal topographic and refractive values.[50]

11) <u>Holladay et al</u> in 1992 gave a ten step method involving complex calculations, based on the oblique cross cylinders for calculating SIA[.51]

In 1998 Holladay gave a new method based on a Cartesian coordinates system for calculation of individual and aggregate data. He also proposed that SIA data be displayed using doubled angle polar plots. In this method, each data set is converted to Cartesian coordinates of x and y.

Where,

X = cylinder x cos (2x axis)

Y = cylinder x sin (2x axis)

The mean value or the centroid of a set of x and y values is determined by finding mean of x and y values independently so that.

$$\text{Mean of } x = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$\text{Mean of } y = \frac{\sum_{i=1}^{n} y_i}{n}$$

Then these mean values are converted from Cartesian coordinates back to standard polar notation for astigmatism. Hence

$$\text{Cylinder} = \sqrt{x^2 + y^2}$$

$$\text{Angle} = \frac{1}{2} \times \arctan(y/x)$$

If xy > 0 then axis = angle

x<0 then axis = angle + 90°

x >0 and y <0 then axis = angle + 180°

The astigmatic data along with the centroids are depicted on Doubled angle polar plot. A centroid intuitively found at the centre of data cluster represents a high predictability of incision and an astigmatically neutral procedure[28].

The Jaffe Vector method calculates SIA accurately for individual patients but in analysis of aggregate data the astigmatic direction is disregarded. The Naeser, Alpins and the Holladay Cartesian coordinate based method have been proven to be the correct methods for reporting of aggregate astigmatic [48].

METHODOLOGY

This is a prospective study of 150 patients, assigned to undergo superior frown incision(6mm) MSICS. Study was done from January 2007 to December 2007 at KLE'S Prabhakar Kore's Hospital,Belgaum.The surgeries were done by different consultants in the Department of Ophthalmology, Jawaharlal Nehru Medical College,Belgaum.

Inclusion criteria-

1. Cataract patients undergoing superior frown incision (6mm) SICS at KLE'S Prabhakar Kore's hospital, Belgaum between **ages 45-80yrs**.
2. Grade I, II, III, IV Cataract
3. Patients with good fixation
4. Patients with keratometric astigmatism of < 3D in preoperative period.

Exclusion criteria-

1. Secondary cataracts due to trauma,glaucoma,uveitis,tumour
2. Complicated cataracts
3. Paediatric cataract
4. Cataracts with posterior segment pathology like diabetic retinopathy,hypertensive retinopathy,ARMD,optic disc pathology
5. Patients with corneal opacities.

After obtaining a written informed consent from each patient 150 patients fulfilling above criteria were taken.

Preoperative evaluation:

All patients were admitted one day prior to surgery. A detailed history was elicited and recorded.

- Visual acuity, both unaided as well as aided using spectacles or pin hole was checked with Snellen's visual acuity chart.
- A thorough anterior segment evaluation was done using the slit lamp.After pupillary dilatation; the cataract was assessed and graded. A thorough posterior segment evaluation was done and retinoscopy was performed.
- IOP was measured using a schiotz indentation tonometer (Photo No. 1). Patency of lacrimal passages was checked using lacrimal sac syringing (Photo No. 2).
- Keratometry was done using manual Bausch and Lomb keratometer (Photo No. 3).
- Axial length was measured with a sonomed 'A' scan unit and the IOL power was calculated using SRK II formula (Photo No. 4).

Routine investigations including BP , RBS/FBS, urine routine microscopy, and a general physical examination and systemic examination were done for all patients. All patients received 1 hourly topical antibiotic eye drop one day prior to surgery. Tropicamide 0.8% and phenylephrine 5% e/d + cyclopentolate 1% e/d + flurbiprofen 0.03% e/d were instilled for mydriasis, every 15 minutes, starting 2 hours prior to surgery.

Surgical technique:

All cases were done under local peribulbar anesthesia. Under all aseptic precautions the eye to be operated was painted with 10% povidone iodine(for skin) and spirit and was draped. A wire speculum was placed and one drop of 5% povidone iodine was instilled in the conjunctival cul-de-sac. A superior rectus bridle suture was placed and secured. A fornix based conjunctival flap was made at the chosen incision location with corneoscleral scissors and hemostasis was achieved by cautery of bleeding vessels.

The extent of incision was marked on the sclera with calipers and a 6 mm frown shape incision was made such that it was 1.5mm from the centre of incision(apex) to the surgical limbus and 2.5 mm from periphery with a 15 no. Bard Parker blade.A funnel shaped Sclero-corneal tunnel was constructed using a crescent knife and dissection continued 1mm into clear cornea (Photo No. 5).

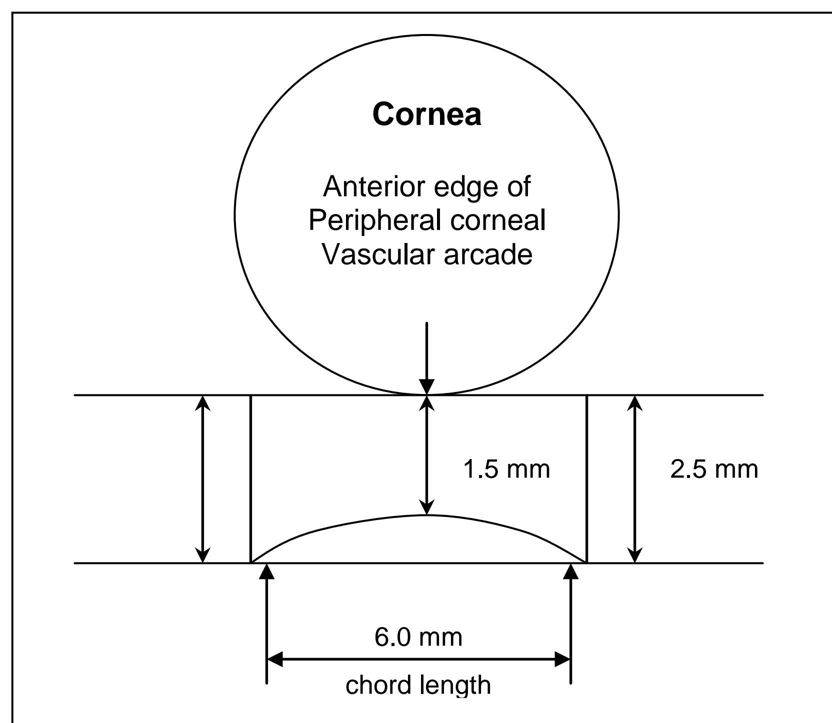


Fig. 3 Incision Architecture

Anterior chamber was entered from the anterior limit of sclero corneal tunnel using a 3.2mm entry keratome. The inner opening of tunnel was extended parallel to limbus up to periphery using the same 3.2mm keratome.

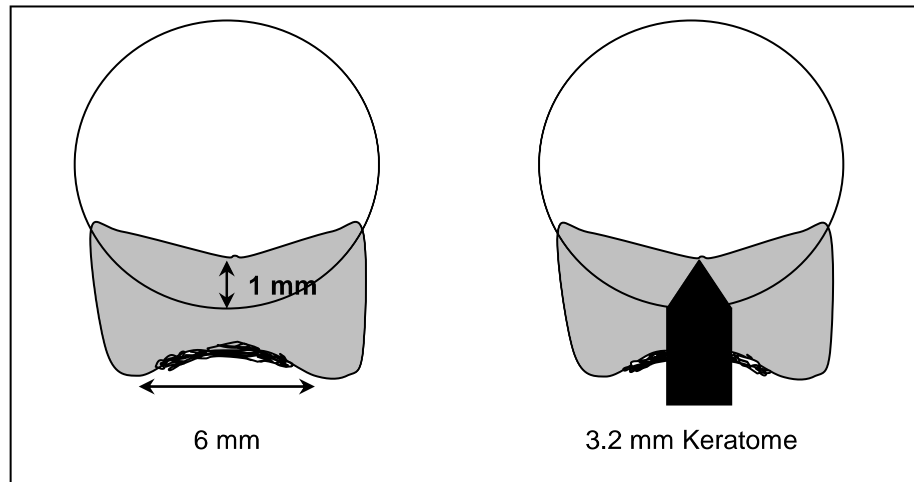


Fig. 4 Anterior Chamber Entry

Viscoelastic was injected into the anterior chamber to form the anterior chamber. A capsulotomy was done either by can opener technique or envelope technique or continuous curvilinear capsulorrhexis technique.

Hydrodissection and hydrodelineation was done where CCC was done...

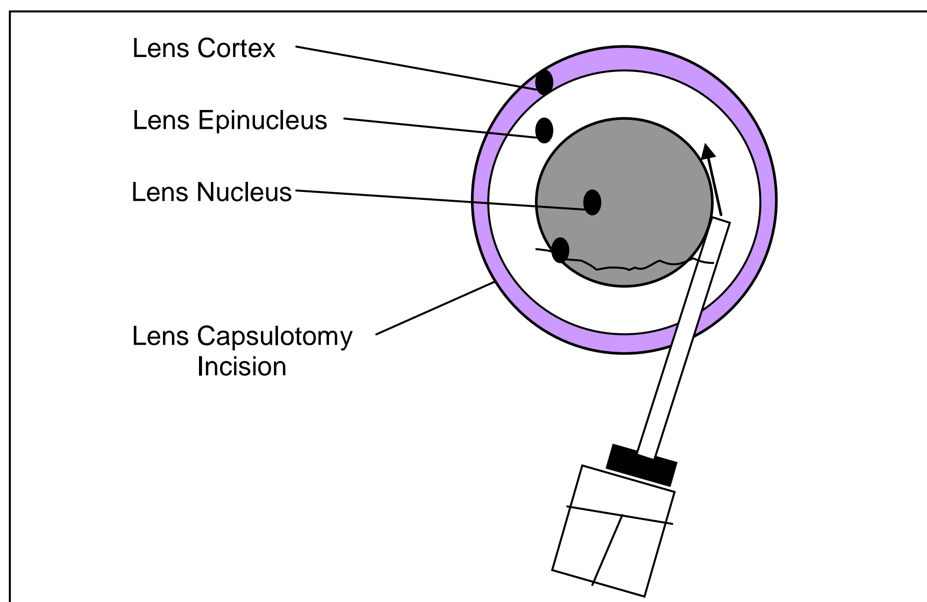


Fig. 5 Hydrodissection

Nucleus was prolapsed into anterior chamber and delivered out using sandwitch technique.

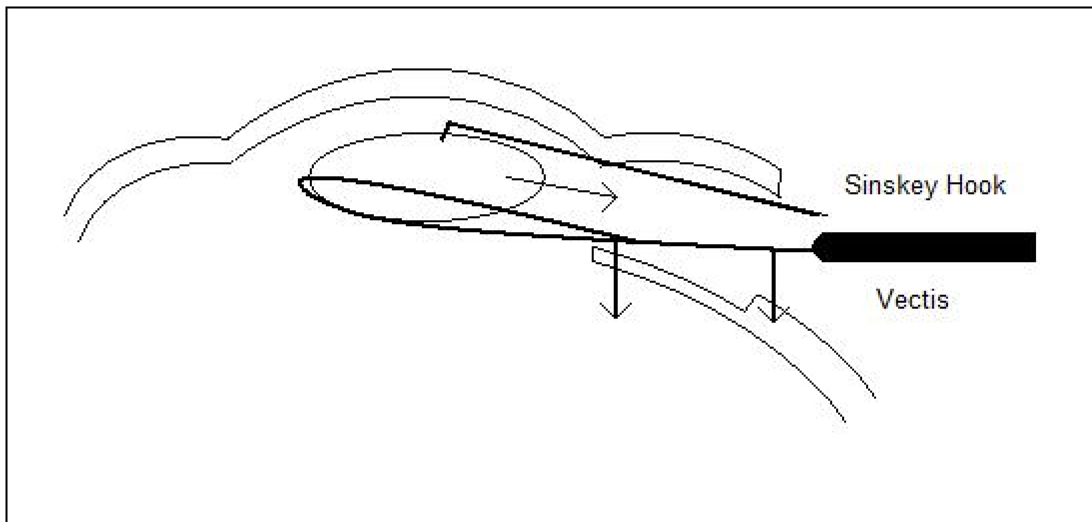


Fig. 6 Nucleus delivery by Sandwitch technique

Cortical matter was aspirated using a classical simcoe cannula. A 6.0mm optic, PMMA, IOL of appropriate power was implanted in the ciliary sulcus in can opener cases and in the bag in envelope or CCC cases. Viscoelastic was aspirated with simcoe. AC formed with ringer lactate and incision sealed by stromal hydration or left as such.The incision was checked for air and water tightness

Conjunctiva and Tenon's capsule were reposited back over the wound.Subconjuntival gentamycin-dexamethazone injection given.Pad and bandage

applied. Antibiotic-steroid eye drops was administered 6 times per day and gradually tapered over 6 weeks.Also a short acting mydriatic tropicamide with phenylephrine eye drops was given 2 times per day for 3 wks and then stopped.

A detailed postoperative examination of the patients was done on the 1st and 30th day. Keratometry and VA was checked on the follow-up day. Refraction readings were noted on the 30th day. Cases with steep axis at 90°±30° were considered WTR

and those with steeper axis at 0/180°±30 were considered ATR. Patients with steeper axis in between these were considered oblique astigmatism.

There were no intr-operative or postoperative complications.All patients were followed without dropout.

The amplitude of preoperative astigmatism and postoperative astigmatism was calculated from the difference in keratometric values in the steeper and flatter meridian, using the plus cylinder notation. Astigmatism was considered a vector with a magnitude equal to this value, directed towards the steeper meridian. The amplitude of SIA was also calculated from pre and postoperative vectors using the vector method(SIA software by Samar Basak).

STATISTICAL ANALYSIS-

Firstly the SIA was calculated in all 150 patients undergoing 6mm superior frown incision SICS using the pre-operative and post-operative astigmatism values by vector method(SIA SOFTWARE BY SAMAR BASAK). Then the mean of all the 150 SIA values was taken and the standard deviation calculated.

PHOTOS

PHOTOS

PHOTO- 1 IOP MEASUREMENT (SCHIOTZ)

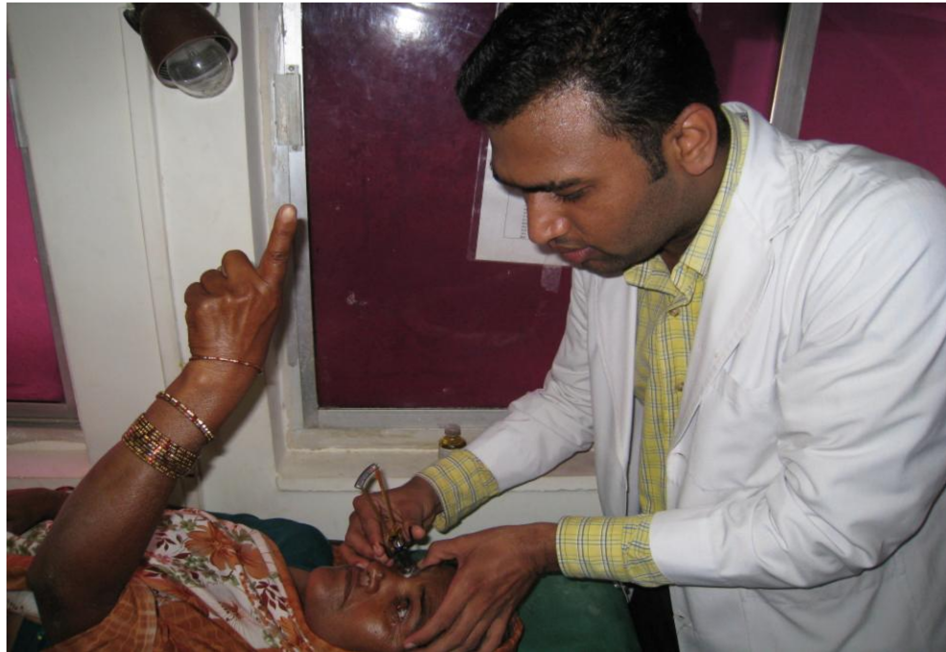


PHOTO-2 LACRIMAL SAC SYRINGING

PHOTO-3 MANUAL KERATOMETRY

PHOTO-4 A-SCAN BIOMETRY

PHOTO-5 SUPERIOR 6mm FROWN INCISION

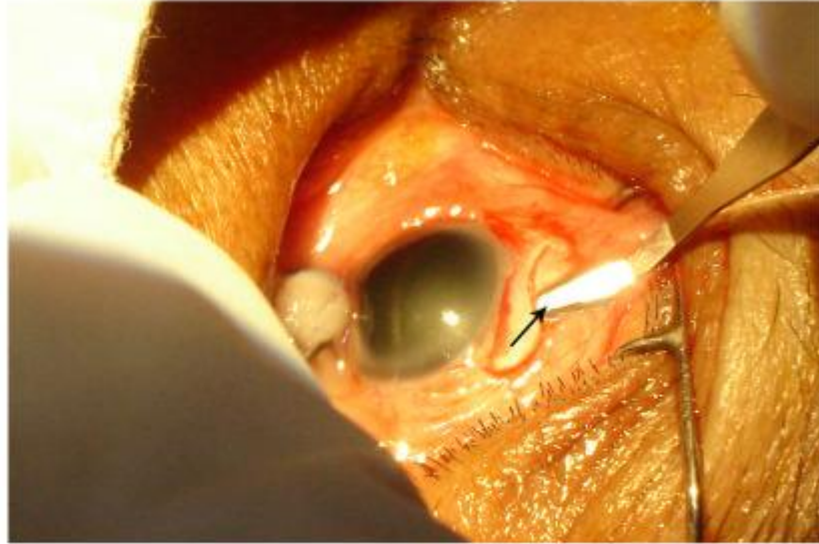


Fig 5: Case 15 superior frown incision

RESULTS

69 females and 81 males were enrolled in this study. The average patient age was 60 yrs (range 45-80 yrs). Surgically induced change in mean keratometric cylinder was calculated using vector method (SIA software by Samar Basak) on the 30th post operative day

TABLE-1: Sex Incidence

Sex	No. of Cases	Percentage
Male	81	54%
Female	69	46%

Of the 150 cases studied 81 cases(54%) were males and 69 cases(46%) were females.

GRAPH-1: Sex Incidence

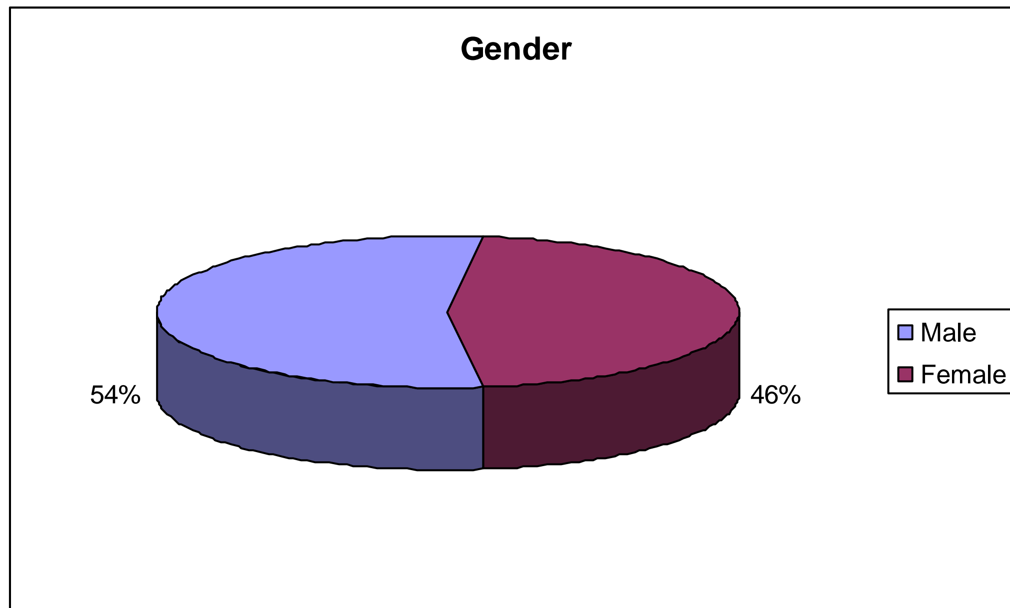
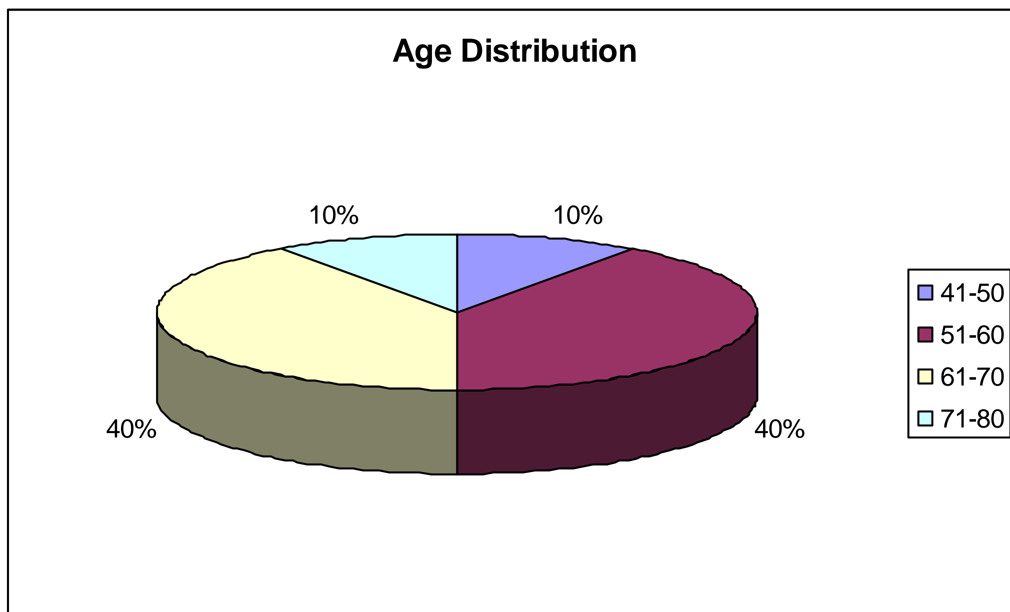


TABLE – 2: Age Distribution

Age (Years)	No. of Cases	Percentage
41-50	15	10%
51-60	60	40%
61-70	61	40%
71-80	61	10%

GRAPH-2: Age Distribution



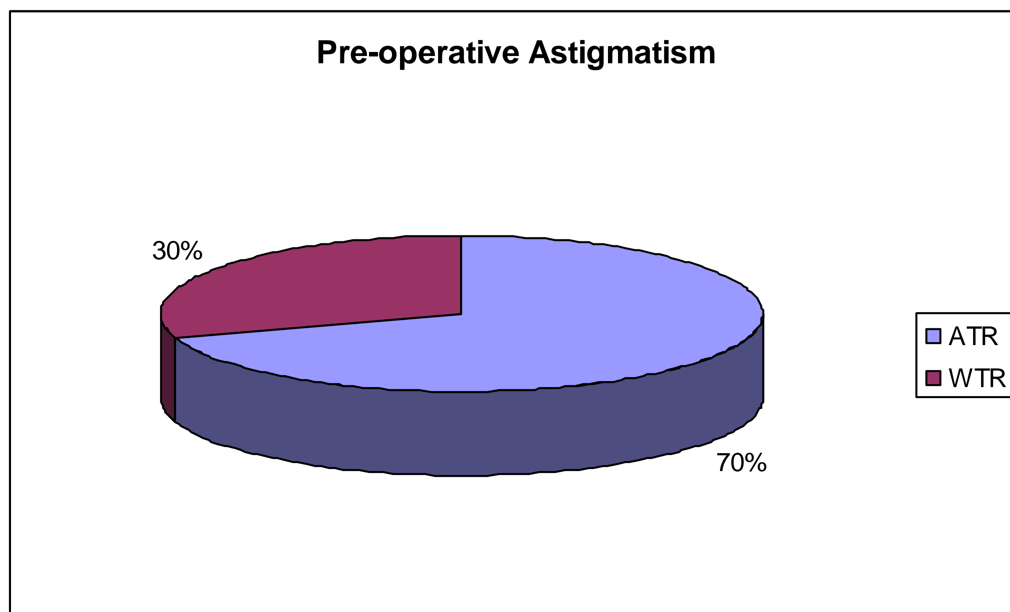
Most of the cases (80%) operated for cataracts were in age group of 51-70 years,10% of them were in the age group of 41-60years and remaining 10% were in the age group of 71-80years

Preoperative evaluation:

TABLE-3: Preoperative Astigmatism

Type	No. of patients	Percentage	Mean Astigmatism
ATR	106	70%	+0.77 D +/-0.47 (SD)
WTR	44	30%	+0.81D +/-0.37 (SD)

GRAPH-3: Preoperative Astigmatism



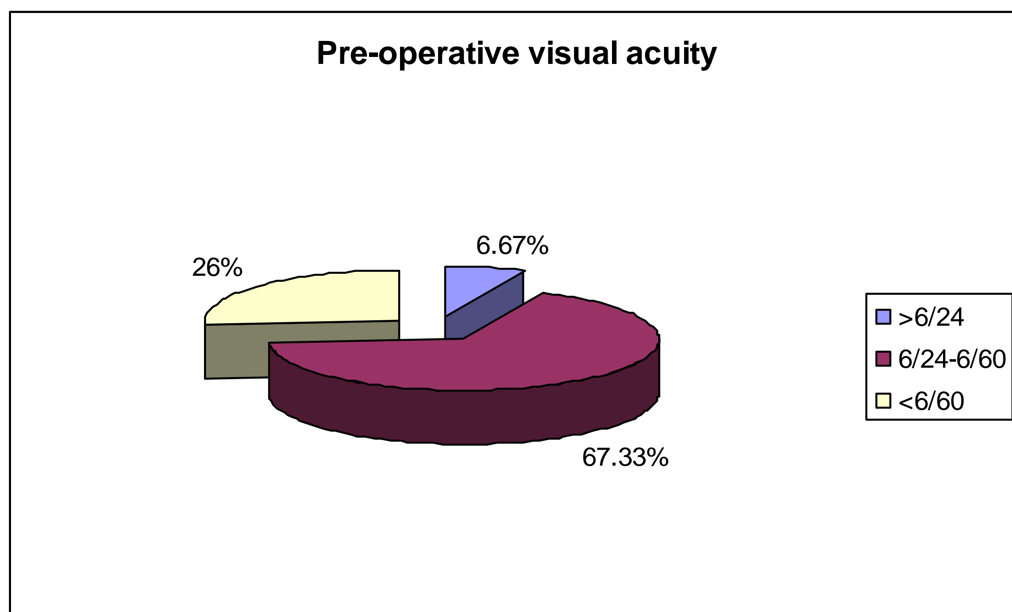
Of the 150 patients examined pre-operatively 106 patients(70%) had ATR astigmatism and 44(30%) had WTR astigmatism. The mean pre-operative ATR astigmatism was +0.77 D +/-0.47 (SD) and mean pre-operative WTR astigmatism was +0.81D +/-0.37 (SD).

Preoperative visual acuity evaluation:

TABLE-4: Pre Operative Visual Acuity (BCVA)

Range	No. of patients	Percentage
>6/24	10	6.67%
6/24-6/60	101	67.33%
<6/60	39	26%

GRAPH-4: Preoperative Visual Acuity



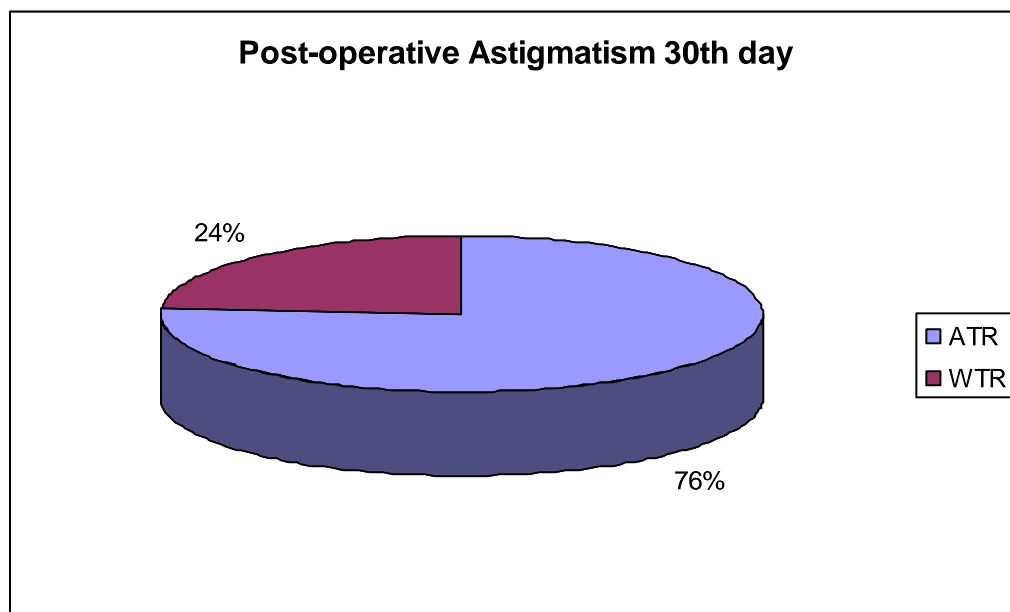
Most of the patients(67.33%) who were studied had the preoperative BCVA of 6/24-6/60. Very few patients(6.67%) had BCVA equal to or better than 6/24.About 26% of the patients had BCVA <6/60.

Postoperative Evaluation

TABLE-6: Postoperative Astigmatism 30th Day

Type	No. of patients	Percentage	Mean Astigmatism
ATR	114	76%	+1.19 D +/-0.55 (SD)
WTR	36	24%	+0.47 D +/- 0.21(SD)

GRAPH-6: Postoperative Astigmatism 30th day



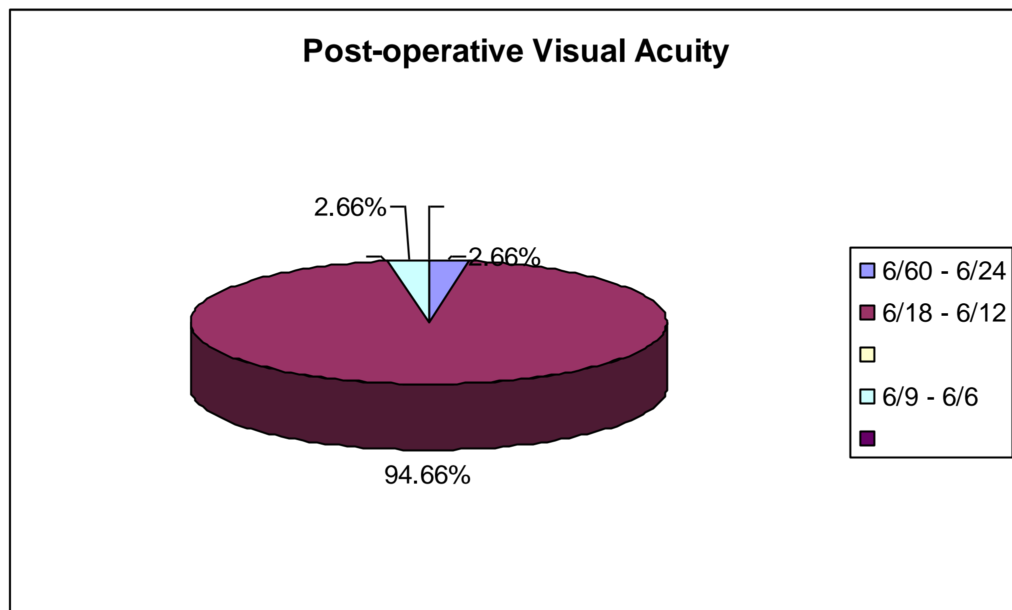
Of the 150 patients examined post-operatively on the 30th day 114(76%) had ATR astigmatism and 36(24%) had WTR astigmatism. The mean post-operative ATR astigmatism on the 30th day was +1.19 D +/-0.55 (SD) and the mean post-operative WTR astigmatism on the 30th day was +0.47 D +/- 0.21(SD).

Postoperative visual acuity examination (30th Day):

TABLE-7: Postoperative Visual Acuity (UCVA)

Postoperative Visual Acuity (30th Day)	Number of Patients	Percentage
6/60 - 6/24	4	2.66%
6/18 - 6/12	142	94.66%
6/9 - 6/6	4	2.66%

GRAPH-7: Postoperative Visual Acuity



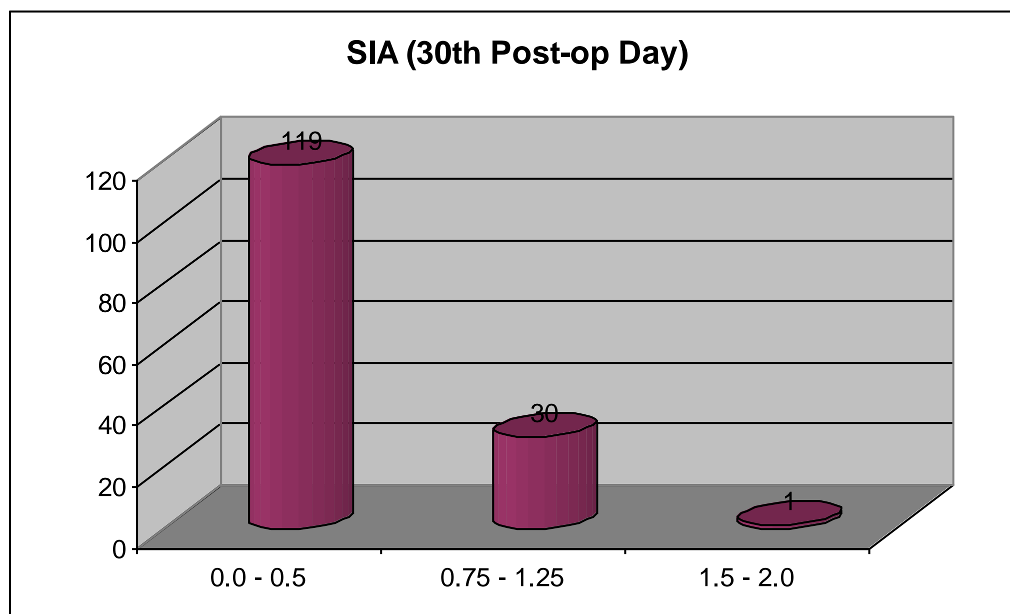
Of the 150 patients who under went 6mm superior frown incision SICS majority(94%) had visual acuity between 6/18 and 6/12 on the 30th post-operative day,2.66% had visual acuity between 6/60-6/24 and remaining 2.66% had visual acuity between 6/9-6/6

Surgically induced astigmatism (30th Post-op Day)

TABLE-8: Range of SIA

Range	Number of Patients	Percentage
0.0 - 0.5	119	79.33%
0.75 - 1.25	30	20.00%
1.5 - 2.0	1	0.67%

GRAPH-8: Range of SIA



Of the 150 patients who under went 6mm superior frown incision SICS majority of the patients had SIA in the range of 0.0-0.5 D which was very minimal.

Mean SIA (30th Post-operative day)

SIA was calculated using the pre-operative and post-operative Keratometric astigmatism by vector method (SIA Software by Dr. Samar Basak) in all the 150 patients. The mean SIA was then calculated for all the 150 patients

The mean SIA for 150 patients who under went 6mm superior frown incision SICS on the 30th post-operative day was **0.51 D +/-0.24 D (SD).**

DISCUSSION

Cataract is the main cause of preventable blindness in the world, as well as in India. The number of cataract surgeries being performed in India is staggering, 3.5 million cataract surgeries were performed in 2000 alone, still the problem persists. The main goals of cataract surgery are to provide a better uncorrected visual acuity and a rapid recovery after surgery to the patient .The major cause of poor unaided visual acuity following cataract surgery is the surgically induced astigmatism.

Hence, modern cataract surgery, in its quest for providing the best uncorrected visual acuity to the patient and minimizing surgically induced astigmatism has become a refractive surgery today. With the goal not only to remove the cataract but also to minimize astigmatism induced by surgery and to reduce the preoperative astigmatism, if any, in the patient. The results of this study show that there is minimal astigmatism in manual small incision cataract surgery with 6mm superior frown incision and that surgically induced astigmatism can be modified by modification of the shape incision shape and location.

Merriam J.C. et al (2001) studied the change in horizontal and vertical meridians of cornea after cataract surgery using 5 different incision types. They found that the 6mm superior sclera corneal tunnel induces ATR astigmatism and that temporal sclera corneal tunnels induce WTR astigmatism[43]. The induced astigmatism in 6mm sclero corneal tunnel group stabilized at 6 weeks.

Kimura H. et al (1999) studied 6-8.5mm incisions in MSICS using superior or super temporal sites. They found SIA of 1.41±0.72D in superior incision group and 1.02±0.66D in super temporal group by Vector method

Gross and Miller found more induced WTR astigmatism by vector analysis on the 1st postoperative day in suture less superior incision than with suture less temporal incision[53].

Singer studied 6 and 7mm suture less superior frown incisions 1.5mm from limbus and found mean SIA of 0.80D at day 1, 0.74D at 1 week, 0.71D at 1 month and 0.84D at 6 months[54]. These values are HIGHER than that in our study. This is probably as in this study surgery was done by different surgeons.

Burgansky et al (2001) compared astigmatism after SICS in 6mm, 6.5mm and 7mm superior V-shape incision. They found mean SIA of 0.60±0.30 in 6mm incisions by vector method. Jha KN, Vats DP (2006) studied 6mm superior straight sutureless incision and reported ATR astigmatism in majority of cases[56]. Hennig (2001) studied SICS using a 6-8mm chord length suture less frown incision and reported SIA of 0.66 ± 0.41D @ 97° by vector method. UCVA at postoperative day 1 was 6/18 or better in 76.8% patients and declined to 70.5 % at 6 weeks follow up[8].

Gokhale and Sawhney (2005) studied SIA in MSICS using a 6mm frown incision, 1.50mm from limbus at different locations. They reported SIA of 1.36 ± 1.03D in superior incisions, 0.51 ±0.49D in super temporal incisions and 0.40±0.40D in temporal incisions by vector method. They also analyzed SIA by Holladay Cartesian coordinate system and reported SIA of 1.28@2.9° in superior group, 0.20 D @ 23.7° in super temporal group and 0.37D @ 90° in temporal group[57].

Meek KM showed collagen arrangement in cornea by showing that the annulus of collagen fibres at the limbus is thickest between 9 o'clock and 12 o'clock[11]. Hence it can be postulated that the thicker annulus at super temporal location tends to prevent wound sliding and hence induces very little astigmatism.

According to Robert M. Sinskey et. al. the mean induced astigmatism for 6mm frown incision SICS on 30th post-operative day was 0.5 D +/- 0.42 (SD) which is similar to our study[58].

According to this study there was increase in ATR astigmatism in patients who had pre-existing ATR astigmatism where as there was decrease in WTR astigmatism in patients who had WTR astigmatism. The SIA on the 30th post-operative day was 0.5 D +/- 0.24 (SD) which was very minimal.

Thus, 6mm superior frown incision SICS leads to quick visual rehabilitation in the post-operative period as it induces minimal post-operative astigmatism.

LIMITATIONS

The Drawbacks of this study were: -

1. The surgeries were done not by a single surgeon but by multiple surgeons.

2. It was not a comparative study.

CONCLUSION

- Superior 6mm frown incision induces minimal astigmatism
- It provides best UCVA early in the postoperative period with excellent visual rehabilitation
- Superior frown incision increases pre-existing ATR and decreases pre-existing WTR.
- So, incision can be changed to other site (temporal) in cases of pre-existing ATR
- 6mm superior frown incision SICS is a handy technique for the surgeons to achieve minimal post-operative SIA.
- The learning curve of the frown incision is less and any surgeon practising superior straight incision can adopt it.

SUMMARY

A cross sectional study was done to know the amount of surgically induced astigmatism after 6mm superior frown incision SICS with rigid PMMA PCIOL at KLE's Prabhakar Kore's hospital and MRC, Belgaum.

A total of 150 patients who fulfilled the inclusion criteria were taken Keratometric readings were taken preoperatively and 30 days postoperatively. The difference between pre and post operative keratometric readings were calculated using the vector method (SIA Software by Dr. Samar Basak).

The average surgically induced astigmatism among 150 patients was 0.51 D with a standard deviation of 0.24 D.

The majority of the patients developed ATR on the 30th post operative day. Those patients who had WTR astigmatism in the preoperative period had decrease in the amount of astigmatism in the postoperative period where as those who had ATR astigmatism developed an increase in the amount of astigmatism.

So by using superior frown incision we can decrease the pre-existing WTR astigmatism leading to minimal post-operative SIA. This will ensure quick visual recovery and improved uncorrected visual acuity in the post-operative period.

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ANNEXURES

ANNEXURE-I

INFORMED CONSENT

I have been asked to be a subject in “A One year cross-sectional study to measure surgically induced corneal astigmatism in superior frown small incision cataract surgery in senile cataract patients” conducted by Dr. Vishal S. Kakhandki a postgraduate student in Department of Opthalmology, J.N. Medical College, Belgaum.

I am being asked to take part in this research study as, I have diminution of vision due to cataract. The study deals with the manual SIC and surgically induced astigmatism. This study involves 150 subjects.

This study is undertaken to evaluate surgically induced astigmatism after 6mm superior frown incision SICS with 6mm rigid PMMA PCIOL under LA. If I agree to participate in this study I will be asked to give detailed history of the disease I have and am willing to undergo necessary investigations that may be required.

Benefits:

6mm superior frown incision SICS is better in terms of least astigmatism and best visual out come.

Voluntary participant / Withdrawal:

Taking part in this study is voluntary. I may chose not to take part in this study, or if I decide to take part, I can later change my mind and withdraw from the study. My decision will not change the present or future health care or other services that I receive. The study doctor, may stop my participation in this study without my consent. While taking part in this study, I will be told of some important new findings

that may change my willingness to continue to take part. If I chose not to take part in this study I will continue to receive the standard treatment for patients with my condition.

Costs:

Expenses of investigations in the laboratory and stay in the hospital, will be free.

Confidentiality:

All information collected about me during the course of this study will be kept confidential to the extent permitted by law. I will be identified in the research records by a code number. Information which identifies me personally will not be released without my written permission. However my records may be reviewed by appropriate agencies as and when required. Information from this study may be published, but my identity will be kept confidential in any publications.

Questions:

If I have any questions in the future related to research or about my rights as a research subject Dr. V. D. Patil, Principal, J.N.M.C, Belgaum can be contacted on phone

Signature of the participant or legally authorized representative:

Participant's	Name:
	Signature:
Experimenter/Witness	Name:
DATE	Signature:

ANNEXURE-II

PROFORMA

Case No.

Name:

Age:

Sex: OP/IP No.

Address: Date of Admission:

Date of Discharge:

History of present illness:

1. Diminutation of vision R Eye L Eye

 Duration

 Gradual / Sudden

 Distant / Near vision

 Visual improvement with

 Bright Light / Dim light

 Painful / Polyopia

2. Diplopia / Polyopia
3. Coloured haloes
4. Watering
5. Redness
6. Black spot in front of eye
7. History of wearing glasses

Prescription	Sph	Cyl	Axis
R			
L			

Past history:

H/o injury

H/o pain/redness in the near past

H/o of wearing glasses Duration

Distant/near vision

H/o any previous surgery

H/o taking treatment for diabetes/hypertension/Bleeding disorders/Asthema

Family History:

Personal History:

General Physical Examination:

Pulse:	General appearance
BP	Pallor
CVS	
RS	
CNS	

Ocular Examination: **R Eye** **L Eye**

1)	Visual acuity distant		
		Pinhole	
		Near	
2)	Adenexa		
3)	Conjunctiva	Congestion	
		Chemosis	
4)	Cornea Clarity		
5)	Anterior chamber	Depth	
		Clarity	
6)	Iris	Colour	
		Pattern	
7)	Pupil	Shape	
		Reaction	
		Regularity	
8)	Lens	Cataractous -	Presenile cataract
			Immature cataract
			Mature cataract
			Hyper mature cataract
9)	Fundus		
10)	Intra ocular pressure		

Diagnosis:

Investigation:

General:

1) Urine – Sugar
   Albumin

2) Hb%

Ocular:

3) Lacrimal sac patency R Eye L Eye

4) Tension (IOP) R Eye L Eye

5) Others

6) Refraction / Retinoscopy

Prescription	Sph	Cyl	Axis
R			
L			

7) Slit Lamp Examination
   1. PSC
   2. Nuclear Grade
      1.
      2.
      3.
      4.
   3. Cortical

8) Keretometry (preoperative)

Eye		Right		Left	
KH	Axis	K2	Axis	Preop K1=K1-K2 Diopters	Axis

9) A scan biometry

Operative procedure – Superior frown incision SICS with non-foldable pciol

Anaesthesia - Perbulbar

Incision - 6mm superior frown 1.5 mm from the limbus

Intraocular lens type - 6mm rigid PMMA PCIOL

Operative complications

Post-op medications

Post-op complications

Follow up (30th day)

Post-op kerotometry

Post-op refraction

Analysis

ANNEXURE-III

KEY TO MASTER CHART

ATR	Against the Rule
BCVA	Best corrected visual acuity
CF	Finger Counting
CF-CF	Finger counting close to face
D	Diopter
PCIOL	Posterior chamber intraocular lens
WTR	With the rule
F	Female
V.A	Visual Acuity
IP No	In patient number
KV	Vertical Keratometric value
KH	Horizontal Keratometric value
L	Left
M	Male
P.h	Pin hole acuity
PL	Perception of light
R	Right
SIA	Surgically induced astigmatism
VA	Visual acuity
Sl.No.	Serial number

							Preop K				Preop Astig.			Post Op VA (30th Day)		Postop K. (30 th Day)		B C V A					Postop Astig. 30th day			SIA		
Sl.No	Name	Age	Sex	IP No.	Eye R/L	Preop VA	KH	KV	PCIOL-Powe	Diagnosis	Dioptres	Axis	Type	VA	Pinhole	KH	KV	Sphere	Cylinder	Axis	Correction	Neal Addtion	Dioptres	Axis	Type	Dioptress	Axis	Type
1	Anandi M	60	F	222790	L	CF 6mts	44.00	43.00	20.5	Lt simc	1.00	180	ATR	6/12	6/6P	44.00	42.50	-0.50	-1.00	90	6/6P	2.50	0.50	180	ATR	0.50	180	ATR
2	Kempanna	50	M	223027	R	CF 5mt	45.00	43.75	22.0	Rt-smc	1.25	180	ATR	6/18	6/9	45.00	43.00	-	-2.00	90	6/9	2.00	2.00	180	ATR	0.75	180	ATR
3	Shantavva	45	F	223254	R	CF 6mts	44.75	44.00	22.5	Rt-smc	0.75	180	ATR	6/18	6/9	44.75	43.50	-	-1.50	90	6/9	1.50	1.25	180	ATR	0.50	180	ATR
4	Balakrishna	68	M	222174	L	6/60->6/24	44.75	44.50	22.0	Lt simc	0.25	180	ATR	6/18	6/9	44.50	44.00	-	-1.00	90	6/9	2.50	0.50	180	ATR	0.25	180	ATR
5	Shivaji	60	M	222470	R	6/60-6/36	44.00	42.50	21.5	Rt simc	1.50	180	ATR	6/18	6/9	44.00	42.00	-	-2.00	90	6/9	2.50	2.00	180	ATR	0.50	180	ATR
6	Parvati T	65	F	222472	L	CF 4mts-6/60	44.75	45.00	22.0	Lt simc	0.25	90	WTR	6/18	6/9	44.75	44.75	-0.50	-	-	6/9	2.50	0.00	-	-	0.25	180	ATR
7	Shivakka	60	F	222389	L	6/60-6/24	44.50	45.00	22.5	Lt simc	0.50	90	WTR	6/12	6/9	44.50	44.75	-1.00	-0.50	90	6/9	2.50	0.25	90	WTR	0.25	180	ATR
8	Parvati K	60	F	221684	R	6/60-6/24	43.75	43.00	21.5	Rt simc	0.75	180	ATR	6/12	6/6P	43.75	42.50	-	-1.50	90	6/6P	2.50	1.25	180	ATR	0.50	180	ATR
9	Gouravva	60	F	221618	R	CF 6mts-6/36	44.75	44.00	21.0	Rt simc	0.75	180	ATR	6/18	6/9	44.75	43.75	-	-1.00	90	6/9	2.50	1.00	180	ATR	0.25	180	ATR
10	Yellavva	50	F	221667	L	CF 5mts-6/60	44.50	44.00	22.0	Lt simc	0.50	180	ATR	6/12	6/9	44.50	43.50	-	-1.50	90	6/9	2.00	1.00	180	ATR	0.50	180	ATR
11	Savitri	60	F	222144	R	CF 4mts	45.00	43.50	22.0	Rt-smc	0.50	180	ATR	6/12	6/6P	44.75	43.00	-	-1.50	90	6/6P	3.00	1.75	180	ATR	0.25	180	ATR
12	Laatsab	72	M	221396	R	CF 6mts-6/60	44.00	43.50	21.0	Rt simc	0.50	180	ATR	6/18	6/9	44.00	43.00	-	-1.00	90	6/9	2.50	1.00	180	ATR	0.50	180	ATR
13	Monda Patil	50	F	221410	L	6/60-6/24	45.00	44.00	22.0	Lt simc	1.00	180	ATR	6/18	6/9	45.00	43.50	-	-1.50	90	6/9	2.50	1.50	180	ATR	0.50	180	ATR
14	Irappa	60	M	220834	L	6/60-6/36	43.50	42.00	22.5	Lt simc	1.50	180	ATR	6/24	6/9	43.50	41.50	-	1.75	90	6/9	2.50	2.00	180	ATR	0.50	180	ATR
15	Chandravva	58	F	220826	R	CF 4mts-6/60	44.50	44.25	22.0	Rt simc	0.25	180	ATR	6/12	6/9	44.50	44.00	-	-0.50	90	6/9	2.50	0.50	180	ATR	0.25	180	ATR
16	Nasir	55	M	226792	L	6/60-6/24	43.50	43.00	21.0	Lt simc	0.50	180	ATR	6/18	6/9	43.50	42.50	-	-0.75	90	6/9	2.50	1.00	180	ATR	0.50	180	ATR
17	Laxmi	45	F	220095	L	CF 6mts-6/36	44.50	45.00	21.5	Lt simc	0.50	90	WTR	6/12	6/9	44.50	44.75	0.50	-0.50	90	6/9	1.50	0.25	90	WTR	0.75	180	ATR
18	Malati	56	F	220050	R	6/60-6/36	44.00	43.00	22.0	Rt simc	1.00	180	ATR	6/18	6/9	44.00	42.50	-	-1.50	90	6/9	2.50	1.50	180	ATR	0.50	180	ATR
19	Bahurao	63	M	220062	R	6/60-6/18	43.50	42.50	21.0	Rt simc	1.00	180	ATR	6/12	6/6	43.00	41.25	-	-2.00	90	6/6	2.50	1.75	180	ATR	0.75	180	ATR
20	Julekhan	65	F	784033	R	6/60-6/24	44.25	43.50	21.5	Rt simc	0.75	180	ATR	6/12	6/6	43.75	42.75	-1.00	-1.50	90	6/6	2.50	1.00	180	ATR	0.25	180	ATR
21	Siddavva	75	F	212428	L	CF 5mts-6/36	43.50	42.50	21.5	Lt simc	1.00	180	ATR	6/12	6/9	44.00	42.50	-1.00	-1.50	90	6/9	2.50	1.50	180	ATR	0.50	180	ATR
22	Gangavva	75	F	212031	R	CF 6mts-6/36	42.50	42.00	20.5	Rt simc	0.50	180	ATR	6/12	6/9	43.00	42.00	-	-1.00	90	6/9	2.50	1.00	180	ATR	0.50	180	ATR
23	Rachappa	75	M	212208	L	CF 6mts-6/36	45.00	45.50	22.0	Lt simc	0.50	90	WTR	6/12	6/9	45.25	45.00	-0.50	-0.50	90	6/9	2.50	0.25	90	WTR	0.75	180	ATR
24	Shivnaik	65	M	212205	R	CF 6mts-6/36	44.00	43.00	21.5	Rt simc	1.00	180	ATR	6/18	6/9	44.00	43.25	-1.00	-0.75	90	6/9	2.50	1.75	180	ATR	0.75	180	ATR
25	Narayan	60	M	223213	R	CF 5mts-No im	43.75	44.00	21.5	Rt-smc	0.25	90	WTR	6/12	6/9	43.75	43.50	-0.50	-0.50	90	6/9	2.50	0.25	180	ATR	0.50	180	ATR
26	Chandrashekar	45	M	212204	R	6/60-6/24	42.50	42.00	20.0	Rt simc	0.50	180	ATR	6/18	6/9	42.50	41.50	-	-1.50	90	6/9	1.50	1.00	180	ATR	0.50	180	ATR
27	Gangappa	75	M	212210	L	6/60-6/24	43.75	43.00	21.0	Lt simc	0.75	180	ATR	6/12	6/9	43.75	42.75	-0.50	-0.75	90	6/9	2.50	1.00	180	ATR	0.25	180	ATR
28	Gouravva	60	F	249061	R	6\60	45.00	44.50	22.0	Rt simc	0.50	180	ATR	6/12	6/6	45.00	44.00	-	-1.00	90	6/6P	2.50	1.00	180	ATR	0.50	180	ATR
29	Rachayya	75	M	250729	L	6/60-6/24	45.50	45.00	23.0	Lt simc	0.50	180	ATR	6/18	6/9	45.50	44.50	-	-1.00	90	6/9	2.50	1.00	180	ATR	0.50	180	ATR
30	Balamma	66	F	250700	R	6/60-6/36	44.75	45.50	22.0	Rt simc	0.50	90	WTR	6/12	6/6	44.75	45.00	-0.50	0.25	90	6/6	2.50	0.25	90	WTR	0.25	180	ATR
31	Shankuntala	60	F	249053	L	6/60-6/24	44.75	43.75	21.5	Lt simc	1.00	180	ATR	6/18	6/9	44.75	43.00	-	-1.50	90	6/9	2.50	0.75	180	ATR	0.75	180	ATR

32	Kempavva	50	F	249094	R	CF 6mts-Mo im	44.50	44.00	22.5	Rt-smc	0.50	180	ATR	6/18	6/9	44.50	43.75	-	-1.50	90	6/9	2.00	1.25	180	ATR	0.75	180	ATR
33	Indira	65	F	258335	L	CF 6mts-6/60	43.50	42.50	24.0	Rt simc	1.00	180	ATR	6/12	6/9	43.50	42.00	-1.00	-1.50	90	6/9	2.50	1.50	180	ATR	0.50	180	ATR
34	Rama A	70	M	258338	R	CF 6mts	45.25	45.00	24.0	Rt simc	0.25	180	ATR	6/12	6/6	45.25	44.50	-	-1.00	90	6/6	2.50	0.75	180	ATR	0.50	180	ATR
35	Jamenbee	70	F	258337	L	6/60-6/36	44.00	43.00	27.0	Lt simc	1.00	180	ATR	6/24	6/9	44.00	42.50	-0.50	-1.50	90	6/9	2.50	1.50	180	ATR	0.50	180	ATR
36	Sadashiv D	45	M	252713	R	HMCF	44.75	44.25	21.5	Rt-smc	0.50	180	ATR	6/12	6/9	44.75	44.00	-	-0.75	90	6/9	2.50	0.75	180	ATR	0.25	180	ATR
37	Siddagouda	68	M	252303	R	6/60-6/24	44.00	45.00	22.0	Rt simc	1.00	90	WTR	6/18	6/9	44.00	44.50	-	0.50	90	6/9	2.50	0.50	90	ATR	0.50	180	ATR
38	Basappa	67	M	250877	R	6/60-6/36	43.75	42.50	21.5	Rt simc	1.25	180	ATR	6/12	6/9	43.75	42.00	-	-1.75	90	6/6P	2.50	1.75	180	ATR	0.50	180	ATR
39	Rukmini	60	F	251307	R	CF 5mts	45.50	44.00	22.0	Rt-smc	1.50	180	ATR	6/12	6/9	45.50	43.50	-	1.50	90	6/6P	2.50	2.00	180	ATR	0.50	180	ATR
40	Honamavva	75	F	252275	L	PL+ PR+	43.50	44.00	19.0	Lt-smc	0.50	90	WTR	6/18	6/9	43.75	43.00	-	-0.75	90	6/9	2.50	0.25	180	ATR	0.25	180	ATR
41	Chennavva	65	F	252673	R	6/36-6/12	45.50	45.00	19.0	Rt simc	0.50	180	ATR	6/12	6/6P	45.50	44.00	-	-1.50	90	6/6P	2.50	1.50	180	ATR	1.00	180	ATR
42	Basavrajappa	55	M	252677	L	6/24-6/18	43.00	42.75	21.0	Lt simc	0.25	180	ATR	6/12	6/9	43.25	43.50	-	-0.75	90	6/9	2.50	0.75	180	ATR	0.50	180	ATR
43	Shantavva M	70	F	773406	L	PL+ PR+	44.25	43.75	22.5	Lt-smc	0.75	180	ATR	6/12	6/9	44.50	43.00	-	-1.50	90	6/9	2.50	1.50	180	ATR	0.75	180	ATR
44	Kashavva	65	F	252680	L	CF 11/2 mt	42.50	42.75	22.5	Lt-smc	0.25	90	WTR	6/18	6/9	42.50	42.25	-	-0.25	90	6/9	2.50	0.25	180	ATR	0.50	180	ATR
45	Jyothiba	55	M	258331	R	CF 5mts	44.75	43.50	18.5	Rt-smc	1.25	180	ATR	6/12	6/9	45.00	43.00	-	-2.00	90	6/9	2.50	2.00	180	ATR	0.25	180	ATR
46	Savitri	60	F	258342	L	6/60-6/36	43.25	43.25	24.0	Lt simc	0.00			6/12	6/9	43.25	43.00	-	-0.50	90	6/9	2.50	0.25	180	ATR	0.25	180	ATR
47	Parappa	77	M	258392	L	CF 6mts	46.00	45.00	19.5	Lt-smc	1.00	180	ATR	6/12	6/9	45.00	44.50	-	-1.50	90	6/9	2.50	1.50	180	ATR	0.50	180	ATR
48	Rama Patil	55	M	258330	L	CF 3mts	41.00	42.00	21.5	Lt-smc	1.00	90	WTR	6/12	6/9	41.00	41.75	-	0.75	90	6/9	2.50	0.75	90	WTR	0.25	180	ATR
49	Basavva	72	F	258331	R	6/60-6/36	45.25	46.00	19.5	Rt simc	0.75	90	WTR	6/12	6/9	45.25	45.75	-	0.75	90	6/9	2.50	0.50	90	WTR	0.25	180	ATR
50	Yallubai	75	F	258341	R	CF 6mts	44.00	42.50	22.5	Rt simc	1.50	180	ATR	6/12	6/9	44.50	42.50	-	-1.75	90	6/9	2.50	2.00	180	ATR	0.50	180	ATR
51	Yashodha	60	F	258334	R	CF 6mts	43.25	43.50	20.5	Rt simc	0.25	90	WTR	6/12	6/9	43.25	43.25	-	-	-	-	2.50	0.00	-	-	0.25	180	ATR
52	Yamanavva	60	F	225756	R	CF 1/2 mt	47.25	46.50	21.5	Rt-smc	0.25	180	ATR	6/18	6/12	47.25	46.00	-	-1.00	90	6/12	3.00	1.25	180	ATR	0.50	180	ATR
53	Neelavva	65	F	225567	R	6/60-6/36	43.50	44.50	21.0	Rt simc	1.00	90	WTR	6/18	6/9	43.75	44.50	-	0.75	90	6/9	2.50	0.75	90	WTR	0.25	180	ATR
54	Anasuya	67	F	225439	R	6mt->6/60	42.50	42.00	20.5	Rt simc	0.50	180	ATR	6/12	6/9	42.50	41.75	-	-0.75	90	6/9	2.50	0.75	180	ATR	0.25	180	ATR
55	irappa	76	M	225436	L	CF5mts-6|60	44.00	43.00	21.0	Lt smc	1.00	180	ATR	6|18	6|9	44.50	42.75	-	-2.00	90	6|9	3.00	1.75	180	ATR	0.75	180	ATR
56	Basappa	66	M	226439	R	6|60-6|18	43.50	42.00	20.5	Rt simc	1.50	180	ATR	6|12	6|9	43.75	41.50	-	-2.00	90	6|9	2.50	2.25	180	ATR	0.75	180	ATR
57	Sharabai	62	F	226439	L	6|60-6|18	44.00	43.00	21.0	Lt simc	1.00	180	ATR	6|12	6|9	44.50	43.00	-	-1.50	90	6|9	2.50	1.50	180	ATR	0.50	180	ATR
58	Shankar.k	45	M	225664	L	CF6mts-6|36	43.75	42.50	21.5	Lt simc	1.50	180	ATR	6|12	6|9	44.00	42.00	-	-2.00	90	6|9		2.00	180	ATR	0.50	180	ATR
59	Bailappa	55	M	226449	R	6|60-6|36	42.50	42.00	21.0	Rt simc	0.50	180	ATR	6|18	6|9	42.75	41.75	-	-0.75	90	6|9	2.50	1.00	180	ATR	0.50	180	ATR
60	Ranubai	60	M	225469	L	CF6mts-6|36	41.75	42.75	21.0	Rt simc	1.00	90	WTR	6|18	6|9	41.75	42.50	-	0.75	90	6|9	2.50	0.75	90	WTR	0.25	180	ATR
61	Chandra	55	F	226449	R	6|60-6|36	42.50	42.00	21.0	Rt simc	0.50	180	ATR	6|18	6|9	42.75	41.75	-	-0.75	90	6|9	2.50	1.00	180	ATR	0.50	180	ATR
62	Yallappa	80	M	225484	R	6|36-6|18	44.00	42.50	20.0	Rt simc	1.50	180	ATR	6|18	6|12	44.25	42.50	-	-2.00	90	6|9	2.50	1.75	180	ATR	0.25	180	ATR
63	Srikanth	65	M	224924	L	CF6mts-6|36	44.50	43.50	21.0	Lt-simc	1.00	180	ATR	6|12	6|9	45.00	43.50	-	-2.00	90	6|9	2.50	1.50	180	ATR	0.50	180	ATR
64	babu	58	M	225469	L	CF-3MT	39.75	40.75	21.0	Lt-smc	1.00	90	WTR	6|24	6|12	41.50	40.50	-	-1.50	90	6|9	3.00	1.00	180	ATR	2.00	180	ATR
65	Balappa	70	M	225489	R	CF-4MTS-6|60	43.25	42.25	21.0	Rt simc	1.00	180	ATR	6|12	6|9	44.00	42.50	-	-1.00	90	6|9	3.00	1.50	180	ATR	0.50	180	ATR
66	Satyavva.S.	60	F	225442	R	CF-6MT-6|60	47.00	45.75	22.0	Rt simc	1.25	180	ATR	6|12	6|9	46.75	45.25	-	-1.50	90	6|9	3.00	1.50	180	ATR	0.25	180	ATR
67	Shivabai	65	F	224648	L	CF5MT-6|60	43.75	43.00	21.5	Lt-simc	0.75	180	ATR	6|12	6|9	44.00	43.00	-	1.00	90	6|9	2.50	1.00	180	ATR	0.75	180	ATR
68	Anandi Y G	60	F	225437	R	CF4MT-6|60	42.50	42.50	21.0	Rt simc	0.00			6|12	6|12	43.00	42.50	-	1.00	90	6|9	2.50	0.50	180	ATR	0.50	180	ATR

69	Nanda patil	52	F	224941	R	CF6mts-6|36	44.00	43.00	20.5	Rt simc	1.00	180	ATR	6|12	6|9	44.50	43.00	-	1.00	90	6|9	2.50	1.50	180	ATR	0.50	180	ATR
70	Ramu.D	55	M	225354	R	6|60-6|18	43.00	42.50	21.0	Rt simc	0.50	180	ATR	6|12	6|9	43.50	42.50	-0.25	-0.75	90	6|9	2.50	1.00	180	ATR	0.50	180	ATR
71	Kallapa.K.	65	M	225463	R	6|60-6|18	44.00	43.00	21.0	Rt simc	1.00	180	ATR	6|12	6|9	44.50	43.00	-	-0.50	90	6|9	3.00	1.50	180	ATR	0.50	180	ATR
72	Janaba.J.	60	M	225440	R	6|60-6|36	43.50	43.00	21.5	Rt simc	0.50	180	ATR	6|12	6|9	43.50	42.50	-	-1.00	90	6|9	3.00	1.00	180	ATR	0.50	180	ATR
73	Dattatreya	55	M	225449	I	CFMTS-6|60	43.00	41.00	22.0	Lt-simc	2.00	180	ATR	6|12	6\9	43.75	40.75	-	-2.00	90	6|9	2.50	3.00	180	ATR	1.00	180	ATR
74	Mallawa	62	F	225438	F	CF-6MT-6|60	44.00	44.50	21.0	Rt simc	0.50	90	WTR	6|12	6|9	44.00	44.75	-	0.25	90	6|9	2.50	0.75	90	WTR	0.25	180	ATR
75	Abdul Gafar	62	M	225439	L	CF-4MT-6\60	43.50	43.00	21.5	Lt simc	0.50	180	ATR	6\18	6\9	44.00	43.00	-	-1.00	90	6\9	2.50	1.00	180	ATR	0.50	180	ATR
76	Kamala J	50	F	225477	R	CF-5MTS-6\60	43.00	43.50	20.5	Rt simc	0.50	90	WTR	6\12	6\9	42.75	42.25	-	0.50	90	6\9	2.00	0.50	90	WTR	0.00	0	
77	chandrabai	60	F	225436	R	CF-5MTS-6\60	44.00	43.00	21.0	Rt-simc	1.00	180	ATR	6|18	6|9	44.00	42.50	-	-1.50	90	6|9	2.50	1.50	180	ATR	0.50	180	ATR
78	Savakka	58	F	225474	R	6\60-6\36	42.75	42.75	20.5	Rt-simc	0.00	0	-	6|12	6|9	43.75	42.75	-	-1.50	90	6|9	2.50	1.00	180	ATR	1.00	180	ATR
79	Ismail	70	M	221390	R	6\60-6\36	41.75	41.25	21.0	Rt-simc	0.50	180	ATR	6|12	6|9	42.00	41.00	-	-1.00	90	6|9	3.00	1.00	180	ATR	0.50	180	ATR
80	Dattatreya	65	M	226376	R	CF-4mts	41.00	42.00	21.5	Rt-simc	1.00	90	WTR	6|18	6|12	41.50	42.00	-	0.50	90	6|12	2.50	0.50	90	WTR	0.50	180	ATR
81	Ramachandra	65	M	213770	L	PLPR+	43.50	43.25	21.5	Lt-smc	0.25	180	ATR	6|12	6|9	44.00	43.25	-	-1.00	90	6|9	2.50	0.75	180	ATR	0.50	180	ATR
82	Srikant	65	M	213473	R	6\60-6\36	43.50	43.25	21.0	Rt-simc	0.25	180	ATR	6|12	6|9	43.75	43.25	-	-0.75	90	6|9	2.50	0.50	180	ATR	0.25	180	ATR
83	Pandit	75	M	213472	R	CF--1MT	43.25	43.25	20.5	Rt-smc	0.00	-		6|9	6|6	43.50	42.50	-	-0.50	90	6|6	3.00	0.25	180	ATR	0.25	180	ATR
84	JANaba.P.	60	M	225440	R	6\60-6\24	44.00	44.75	21.0	Rt simc	0.75	90	WTR	6\12	6\9	44.00	44.50	-	0.50	90	6\9	2.50	0.50	90	WTR	0.25	180	ATR
85	Basavva.K.	62	F	225439	R	6\60-6\24	43.75	43.00	21.0	Rt simc	0.75	180	ATR	6\12	6\9	44.00	42.75	-	-1.25	90	6\9	2.50	1.25	180	ATR	0.50	180	ATR
86	Devaki	62	F	229246	L	CF1MT	43.00	41.00	21.0	Lt-smc	2.00	180	ATR	6\12	6\9	42.75	40.50	-0.50	-1.50	90	6\9	2.50	2.25	180	ATR	0.25	180	ATR
87	Manjula	50	F	215198	R	6\36-6\18	43.50	44.00	21.0	Rt simc	0.50	90	WTR	6\12	6\6	43.50	43.75	-	0.25	90	6\6	2.00	0.25	90	WTR	0.75	180	ATR
88	Drupadi.K.	70	F	215199	R	CF6mts-6|36	44.50	43.50	21.0	Rt simc	1.00	180	ATR	6\24	6\9	44.50	43.00	-	1.50	90	6\9	3.00	1.50	180	ATR	0.50	180	ATR
89	Dattatreya.J	65	M	250804	L	HMCF	46.50	44.25	23.0	Lt-simc	2.25	180	ATR	6\12	6\6P	46.50	44.00	-	-2.00	90	6\6P	2.50	2.50	180	ATR	0.25	180	ATR
90	Shivling	70	M	215063	L	6\60-6\24	44.00	43.50	22.0	Lt-simc	0.50	180	ATR	6\18	6\9	44.00	43.00	-	-1.00	90	6\9	2.50	1.00	180	ATR	0.50	180	ATR
91	govindgouda	66	M	250567	L	CF-1\2MT	42.00	41.50	18.0	Lt-simc	0.50	180	ATR	6\12	6\6	42.00	41.00	-	-0.50	90	6\6	2.50	1.00	180	ATR	0.50	180	ATR
92	Prakash.K	56	M	250624	L	6\60-6\24	41.75	44.00	22.0	Lt-simc	2.25	90	WTR	6\12	6\6	41.75	43.00	-	1.00	90	6\6	2.50	1.25	90	WTR	1.00	180	ATR
93	Kashavva	55	F	221613	R	cf-4mt	45.00	46.00	22.0	Rt simc	1.00	90	WTR	6\12	6\6	45.00	45.50	-	0.50	90	6\6	2.50	0.50	90	WTR	0.50	180	ATR
94	Sudha.M.	60	F	212316	R	6\60-6\36	43.50	43.00	21.0	Rt simc	0.50	180	ATR	6\12	6\6	43.50	42.50	-	-1.00	90	6\6	2.50	1.00	180	ATR	0.50	180	ATR
95	Yallappa	65	M	225613	R	cf-4mts	43.75	44.75	21.5	Rt simc	1.00	90	WTR	6\12	6\6	44.00	44.25	-	0.25	90	6\6	2.50	0.25	90	WTR	0.75	180	ATR
96	Basappa	70	M	223416	L	CF-3MTS	45.00	46.00	22.0	Lt-simc	1.00	90	WTR	6\12	6\6	45.00	45.50	-	0.50	90	6\6	3.00	0.50	90	WTR	0.50	180	ATR
97	Shivanappa	70	M	223465	R	CF-5MTS-6\60	44.00	43.25	21.0	Rt simc	0.75	180	ATR	6\12	6\6	44.25	43.00	-	-1.50	90	6\6	3.00	1.25	180	ATR	0.50	180	ATR
98	Venu.C.	60	M	222869	R	CF-4MT-6\60	44.00	43.00	21.0	Rt simc	1.00	180	ATR	6\18	6\9	44.00	42.50	-	-1.50	90	6\9	2.50	1.50	180	ATR	0.50	180	ATR
99	Kishan.T.	65	M	223694	L	CF-3MT	43.00	44.00	20.5	Lt-simc	1.00	90	WTR	6\12	6\6	43.00	43.50	-	0.50	90	6\6	2.50	0.50	90	WTR	0.50	180	ATR
100	Shivanand.B.	65	M	223469	R	CF-6MT-6|60	44.50	44.00	21.5	Rt simc	0.50	180	ATR	6\12	6\6	44.00	42.75	-	-1.00	90	6\6	2.50	1.25	180	ATR	0.75	180	ATR
101	Gangavva.K.	70	F	223694	L	6\60-6\36	43.75	43.00	21.0	Lt-simc	0.75	180	ATR	6\12	6\6	43.75	42.75	-	-1.00	90	6\6	2.50	1.00	180	ATR	0.25	180	ATR
102	Yamanappa	70	M	223411	R	6\60-6\24	42.50	42.00	20.5	Rt simc	0.50	180	ATR	6\12	6\6	42.75	41.75	-	-1.00	90	6\6	2.50	1.00	180	ATR	0.50	180	ATR
103	Thayappa	63	M	223695	R	CF-5MTS-6\60	44.00	43.25	20.0	Rt simc	0.75	180	ATR	6\12	6\6	44.25	43.00	-	-1.00	90	6\6	2.50	1.25	180	ATR	0.50	180	ATR
104	Mallappa.T.	60	M	236276	R	CF-6MT-6|60	43.50	42.50	21.0	Rt simc	1.00	180	ATR	6\12	6\6	43.50	42.00	-	-1.50	90	6\6	2.50	1.50	180	ATR	0.50	180	ATR
105	Mallappa	65	M	223419	L	CF-5MTS-6\60	44.00	43.50	21.0	Lt-simc	0.50	180	ATR	6\12	6\6	44.00	43.00	-	-1.00	90	6\6	2.50	1.00	180	ATR	0.50	180	ATR

106	Yallawa	60	F	223612	R	CF-4MT-6\60	43.50	44.50	21.5	Rt simc	1.00	90	WTR	6\12	6\6	43.50	44.00	-	0.50	90	6\6	2.50	0.50	90	WTR	0.50	180	ATR
107	Siddawwa	65	F	266345	L	6\60-6\24	44.50	45.50	21.5	Lt-simc	1.00	90	WTR	6\12	6\6	44.50	45.00	-	0.50	90	6\6	2.50	0.50	90	WTR	0.50	180	ATR
108	Shivappa	75	M	266356	L	CF-3MT	44.00	43.00	20.5	Lt-simc	1.00	180	ATR	6\12	6\6	44.00	42.50	-	-1.50	90	6\6	3.00	1.50	180	ATR	0.50	180	ATR
109	Mallappa	70	M	266371	R	CF-4MT-6\60	44.00	45.00	21.0	Rt simc	1.00	90	WTR	6\9	6\6	44.00	44.50	-	0.50	90	6\6	2.50	0.50	90	WTR	0.50	180	ATR
110	Vittal	65	M	266803	R	CF-5MTS-6\60	43.50	44.00	22.0	Rt simc	0.50	90	WTR	6\12	6\6	43.50	43.00	-	-0.50	90	6\6	2.50	0.50	180	ATR	1.00	180	ATR
111	Shivalingappa	60	M	267079	L	CF6mts-6|36	44.50	45.00	21.5	Lt-simc	0.50	90	WTR	6\12	6\6	44.50	44.75	-	0.25	90	6\6	2.50	0.25	90	WTR	0.25	180	ATR
112	Shankar.	60	M	267851	R	6\60-6\36	43.00	43.50	21.0	Rt simc	0.50	90	WTR	6\12	6\6	43.00	42.50	-	-0.50	90	6\6	2.50	0.50	180	ATR	1.00	180	ATR
113	Ningappa	67	M	267855	R	CF-6MT-6|60	44.50	45.50	21.5	Rt simc	1.00	90	WTR	6\12	6\6	44.75	45.00	-	0.25	90	6\6	2.50	0.25	90	WTR	0.25	180	ATR
114	pandurang	60	M	268309	L	6\60-6\24	43.50	45.00	21.5	Lt-simc	1.50	90	WTR	6\12	6\6	43.50	44.00	-	0.50	90	6\6	2.50	0.50	90	WTR	1.00	180	ATR
115	Basavaneppa	70	M	268329	R	CF-6MT-6|60	43.75	44.75	21.5	Rt simc	1.25	90	WTR	6\12	6\6	43.50	44.00	-	0.50	90	6\6	2.50	0.50	90	WTR	0.75	180	ATR
116	Kamalawwa	60	F	268284	L	CF-5MTS-6\60	44.00	44.50	22.0	Lt-simc	0.50	90	WTR	6\12	6\6	44.00	44.25	-	0.25	90	6\6	2.50	0.25	90	WTR	0.25	180	ATR
117	Jani.p.	68	F	268324	R	CF-6MT-6|60	42.50	42.00	20.5	Rt simc	0.50	180	ATR	6\9	6\6	42.50	41.75	-	-0.75	90	6\6	2.50	0.75	180	ATR	0.25	180	ATR
118	Shakuntala	60	F	269292	R	CF-4MT-6\60	43.50	44.50	21.5	Rt simc	1.00	90	WTR	6\12	6\9	43.50	44.00	-	0.50	90	6\6	2.50	0.50	90	WTR	0.50	180	ATR
119	Bhimappa	65	M	270108	L	CF-5MTS-6\60	43.00	44.00	21.5	Lt-simc	1.00	90	WTR	6\12	6\6	43.50	43.75	-	0.25	90	6\6	2.50	0.25	90	WTR	0.75	90	ATR
120	Satyabhama	60	F	270131	R	6\60-6\36	45.50	45.00	21.0	Rt simc	0.50	180	ATR	6\12	6\6	45.50	44.50	-	-1.00	90	6\6	2.50	1.00	180	ATR	0.50	180	ATR
121	irappa	65	M	270129	R	CF-4MT	44.00	43.75	21.5	Rt simc	0.25	180	ATR	6\12	6\6	44.00	43.00	-	-1.00	90	6\6	2.50	1.00	180	ATR	0.75	180	ATR
122	Bailappa	78	M	270122	L	CF-6MT-6|60	43.50	43.00	20.5	Lt-simc	0.50	180	ATR	6\12	6\6	43.50	42.50	-	-1.00	90	6\6	3.00	1.00	180	ATR	0.50	180	ATR
123	Narmada.K.	70	F	784938	L	CF-6MT-6|60	43.50	43.00	21.0	Lt-simc	0.50	180	ATR	6\12	6\6	43.50	42.50	-	-1.00	90	6\6	2.50	1.00	180	ATR	0.50	180	ATR
124	Gangavva	65	F	772658	R	6\60-6\24	46.50	44.00	22.0	Rt simc	2.50	180	ATR	6\12	6\6	46.00	43.00	-1.00	-1.00	90	6\6	2.50	3.00	180	ATR	0.50	180	ATR
125	Anambi.p.	60	F	236586	R	CF-6MT-6|60	44.00	43.75	22.0	Rt simc	0.25	180	ATR	6\12	6\6	44.00	43.00	-	-1.00	90	6\6	2.50	1.00	180	ATR	0.75	180	ATR
126	Annapurna	45	F	236605	R	CF-5MTS-6\60	45.75	45.25	21.5	Rt simc	0.50	180	ATR	6\12	6\6	45.00	43.50	-	-1.50	90	6\6	2.50	1.50	180	ATR	1.00	180	ATR
127	Revayya.M.	60	M	236279	L	6\60-6\24	45.25	44.50	21.5	Lt-simc	0.75	180	ATR	6\12	6\6	45.25	44.00	-	-1.50	90	6\6	2.50	1.25	180	ATR	0.50	180	ATR
128	Padmavathi	60	F	223413	R	6\60-6\36	44.00	44.50	21.0	Rt simc	0.50	90	ATR	6\12	6\6	44.00	44.25	-	0.50	90	6\6	2.50	0.25	90	WTR	0.25	180	ATR
129	Katharsab	60	M	223094	L	CF-3MT	45.00	46.00	21.5	Lt-smc	1.00	90	WTR	6\12	6\6	45.00	45.50	-	0.50	90	6\6	2.50	0.50	90	WTR	0.50	180	ATR
130	Adiyawwa	72	F	223694	R	CF6mts-6|36	43.50	42.50	20.5	Rt simc	1.00	180	ATR	6\9	6\6	43.50	42.00	-	-1.50	90	6\6	2.50	1.50	180	ATR	0.50	180	ATR
131	Shantabai	65	F	222314	L	CF-6MT-6|60	43.50	42.75	21.0	Lt-simc	0.75	180	ATR	6\12	6\6	43.75	42.50	-	-1.00	90	6\6	2.50	1.25	180	ATR	0.75	180	ATR
132	Durgappa	65	M	225623	R	cf-4mts	43.75	44.75	21.5	Rt simc	1.00	90	WTR	6\12	6\6	44.00	44.25	-	0.25	90	6\6	2.50	0.25	90	WTR	0.75	180	ATR
133	Basaveneppa	70	M	223426	L	CF-3MTS	45.00	46.00	22.0	Lt-simc	1.00	90	WTR	6\12	6\6	45.00	45.50	-	0.50	90	6\6	3.00	0.50	90	WTR	0.50	180	ATR
134	Shivanna	70	M	223455	R	CF-5MTS-6\60	44.00	43.25	21.0	Rt simc	0.75	180	ATR	6\12	6\6	44.25	43.00	-	-1.50	90	6\6	3.00	1.25	180	ATR	0.50	180	ATR
135	Venugopal	65	M	222879	R	CF-4MT-6\60	44.00	43.00	21.0	Rt simc	1.00	180	ATR	6\18	6\9	44.00	42.50	-	-1.50	90	6\9	2.50	1.50	180	ATR	0.50	180	ATR
136	Kishore	65	M	223691	L	CF-3MT	43.00	44.00	20.5	Lt-simc	1.00	90	WTR	6\12	6\6	43.00	43.50	-	0.50	90	6\6	2.50	0.50	90	WTR	0.50	180	ATR
137	Dayanand	65	M	223459	R	CF-6MT-6|60	44.50	44.00	21.5	Rt simc	0.50	180	ATR	6\12	6\6	44.00	42.75	-	-1.00	90	6\6	2.50	1.25	180	ATR	0.75	180	ATR
138	Sumati	70	F	223666	L	6\60-6\36	43.75	43.00	21.0	Lt-simc	0.75	180	ATR	6\12	6\6	43.75	42.75	-	-1.00	90	6\6	2.50	1.00	180	ATR	0.25	180	ATR
139	Vitalsab	70	M	223444	R	6\60-6\24	42.50	42.00	20.5	Rt simc	0.50	180	ATR	6\12	6\6	42.75	41.75	-	-1.00	90	6\6	2.50	1.00	180	ATR	0.50	180	ATR
140	Fakirappa	63	M	223634	R	CF-5MTS-6\60	44.00	43.25	20.0	Rt simc	0.75	180	ATR	6\12	6\6	44.25	43.00	-	-1.00	90	6\6	2.50	1.25	180	ATR	0.50	180	ATR
141	Rajendra	60	M	223624	R	CF-6MT-6|60	43.50	42.50	21.0	Rt simc	1.00	180	ATR	6\12	6\6	43.50	42.00	-	-1.50	90	6\6	2.50	1.50	180	ATR	0.50	180	ATR
142	Singuli	62	F	225448	F	CF-6MT-6|60	44.00	44.50	21.0	Rt simc	0.50	90	WTR	6|12	6|9	44.00	44.75	-	0.25	90	6|9	2.50	0.75	90	WTR	0.25	180	ATR

143	Rameez	62	M	225440	L	CF-4MT-6\60	43.50	43.00	21.5	Lt simc	0.50	180	ATR	6\18	6\9	44.00	43.00	-	-1.00	90	6\9	2.50	1.00	180	ATR	0.50	180	ATR
144	Kamalavva	50	F	225480	R	CF-5MTS-6\60	43.00	43.50	20.5	Rt simc	0.50	90	WTR	6\12	6\9	42.75	42.25	-	0.50	90	6\9	2.00	0.50	90	WTR	0.00	0	
145	Chandravva	60	F	225441	R	CF-5MTS-6\60	44.00	43.00	21.0	Rt simc	1.00	180	ATR	6|18	6|9	44.00	42.50	-	-1.50	90	6|9	2.50	1.50	180	ATR	0.50	180	ATR
146	Savitramma	58	F	225465	R	6\60-6\36	42.75	42.75	20.5	Rt simc	0.00	0	-	6|12	6|9	43.75	42.75	-	-1.50	90	6|9	2.50	1.00	180	ATR	1.00	180	ATR
147	Imamsab	70	M	221391	R	6\60-6\36	41.75	41.25	21.0	Rt simc	0.50	180	ATR	6|12	6|9	42.00	41.00	-	-1.00	90	6|9	3.00	1.00	180	ATR	0.50	180	ATR
148	Dattu	65	M	226377	R	CF-4mts	41.00	42.00	21.5	Rt simc	1.00	90	WTR	6|18	6|12	41.50	42.00	-	0.50	90	6|12	2.50	0.50	90	WTR	0.50	180	ATR
149	Krishna	65	M	213426	L	PLPR+	43.50	43.25	21.5	Lt-smc	0.25	180	ATR	6|12	6|9	44.00	43.25	-	-1.00	90	6|9	2.50	0.75	180	ATR	0.50	180	ATR
150	kantayya	65	M	213477	R	6\60-6\36	43.50	43.25	21.0	Rt-simc	0.25	180	ATR	6|12	6|9	43.75	43.25	-	-0.75	90	6|9	2.50	0.50	180	ATR	0.25	180	ATR