"COMPARISON OF POST OPERATIVE ASTIGMATISM AFTER MANUAL SMALL INCISION CATARACT SURGERY USING SUPERIOR, SUPERO TEMPORAL AND TEMPORAL INCISIONS"

By

DR. DILDAR SINGH

Dissertation Submitted to

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In partial fulfillment
Of the requirements for the degree of

MASTER OF SURGERY
IN
OPHTHALMOLOGY

Under the Guidance of
DR. K. KANTHAMANI, M.S.

DEPARTMENT OF OPHTHALMOLOGY
SRI DEVARAJ URS MEDICAL COLLEGE
TAMAKA, KOLAR (APRIL - 2017)

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"Thou thy has given so much to me;

Give one thing more – a grateful heart;

Not thankful when it pleaseth me;

As if thy blessings had spare days;

But such a heart; whose pulse may be

Thy praise"

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LIST OF ABBREVIATIONS USED

+VE	-	PRESENT
<	-	LESS
>	-	MORE
ATR	-	AGAINST THE RULE
BSS	-	BALANCED SALT SOLUTION
CF -CF	–	COUNTING FINGER CLOSE TO FACE
CVK	–	COMPUTERIZED VIDEO KERATOGRAPHY
D	–	DIOPTER
ECCE	–	EXTRA CAPSULAR CATARACT EXTRACTION
GP	–	GROUP
GPE	–	GENERAL PHYSICAL EXAMINATION
HOPI	–	HISTORY OF PRESENTING ILLNESS
ICCE	–	INTRA CAPSULAR CATARACT EXTRACTION
I &A	-	IRRIGATION AND ASPIRATION
IOL	–	INTRA OCULAR LENS
IOP	–	INTRA OCULAR PRESSURE
SDUMC	–	SRI DEVARAJ URS MEDICAL COLLEGE
MM	-	MILLIMETRE
MSICS	–	MANUAL SMALL INCISION CATARACT SURGERY
MTRS	–	METERS
NO	–	NUMBER

OD	–	RIGHT EYE
OS	-	LEFT EYE
P	-	PROBABILITY
PCIOL	–	POSTERIOR CHAMBER INTRA OCULAR LENS
PL	–	PRECEPTION OF LIGHT
PMMA	-	POLYMETHYL METHACRYLATE
POST-OP	–	POSTOPERATIVE
PRE-OP	–	PREOPERATIVE
SD	–	STANDARD DEVIATION
SI	–	SUPERIOR INCISION
SIA	–	SURGICALLY INDUCED ASTIGMATISM
SLE	–	SLIT LAMP EXAMINATION
T	-	STUDENT ‘T’ TEST
STI	–	SUPEROTEMPORAL INCISION
WTR	–	WITH THE RULE
X^2	-	CHI SQUARE TEST

ABSTRACT

TITLE OF THE TOPIC:

COMPARISON OF POST OPERATIVE ASTIGMATISM AFTER MANUAL SMALL INCISION CATARACT SURGERY USING SUPERIOR, SUPEROTEMPORAL AND TEMPORAL INCISIONS.

NEED FOR THE STUDY:

Cataract is the leading cause of avoidable blindness. Of the 39 million people who are blind worldwide, approximately 47.8% are blind due to cataract. Manual small incision cataract surgery is a simple and versatile technique which unlike phacoemulsification can be universally applied nearly in all types of cataract. The site and size of incision will determine the amount of surgically induced astigmatism in manual small incision cataract surgery. Hence we are conducting this study to evaluate and compare post-operative astigmatism in manual small incision cataract surgery through superior, supero-temporal and temporal approach.

OBJECTIVES OF THE STUDY:

1. To evaluate the amount, type of post-operative astigmatism and compare the same in patients undergoing manual small incision cataract surgery with superior, supero-temporal and temporal incisions.
2. To study visual outcome in these incisions.

MATERIAL AND METHODS:

Source of Data:

102 senile cataract patients, source being routine ophthalmology out patients presenting to the R.L.JALAPPA HOSPITAL AND RESEARCH CENTRE, TAMAKA, KOLAR attached to SRI DEVARAJ URS MEDICAL COLLEGE between December 2014 and December 2015. Informed and written consent was taken from all the patients. After all necessary ocular and systemic examinations patients were divided into three groups of 34 each to undergo superior, superotemporal and temporal scleral incision followed by manual small incision cataract surgery with PCIOL implantation. Postoperative visual acuity and postoperative astigmatism was compared between three groups .Statistical analysis was done by Chi square tests.

RESULTS:

1. In subjects with WTR astigmatism preoperatively at 12 week postoperatively mean astigmatism was 0.38 ± 0.31 in superior group, 1.17 ± 0.49 in supero temporal group and 1.52 ± 0.39 in temporal group. In subjects with ATR astigmatism preoperatively at 12 weeks post operatively mean astigmatism was 1.30 ± 0.53 in superior group, 0.66 ± 0.32 in supero temporal group and 0.44 ± 0.23 in temporal group.
2. Post operatively after 12 weeks in superior incision group 76.5% of

the patients had ATR astigmatism, supero temporal group 64.7% and temporal group 88.2% had WTR Astigmatism, even though majority of the patients preoperatively had ATR astigmatism.

3. After 12 week 16(47.1%) of the patients in SI group and 20(58.8%) of the patients in supero-temporal group had visual acuity ranging 6/6-6/9 where as in temporal incision group 25 (73.5%) patients had visual acuity ranging 6/6-6/9 (x^2 – 4.981, $p<0.01$).

CONCLUSION:

Visual rehabilitation is better in temporal incision than superior incision. By considering the preoperative astigmatism, when selecting the incision type and location, postoperative astigmatism can be minimized greatly.

KEYWORDS

MSICS, Superior scleral incision, Superotemporal scleral incision, Temporal scleral incision, WTR, ATR.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF GRAPHS

LIST OF PHOTOGRAPHS

INTRODUCTION

INTRODUCTION

Cataract comes from the latin word which means waterfall. It is the loss of transparency in the crystalline lens. Cataract is the leading cause of avoidable blindness. Of the 39 million people who are blind worldwide, approximately 47.8% are blind due to cataract.[1] In the developing countries it accounts for about three quarters of the blindness. The mainstay of the management of cataract is surgery. Cataract surgery has undergone great refinement in recent years. Recent progress in cataract surgical technique have high-lighted patient's expectations of visual outcome, good post-operative vision without spectacles is considered normal.

Extra capsular cataract extraction (ECCE) was modified in the1970s when the use of posterior chamber intraocular lenses was shown to be a safe and effective way of correcting aphakia. In 1980, it was shown that patients who had undergone ECCE had a lower incidence of retinal detachments compared with those who had undergone intracapsular surgery. It was also shown that the incidence of cystoid macular oedema was less in ECCE. These and other facts transformed cataract surgery in the mid-1970s, with a subsequent transition to a smaller wound size, enlarged if necessary to extract the dismantled cataract and introduce the intraocular lens (IOL).[2]

The surgical options available in India are intracapsular cataract extraction (ICCE), conventional extra capsular cataract extraction (ECCE), manual small incision cataract extraction (MSICS) and phacoemulsification.[3] Manual small incision cataract surgery is a fast, economical and effective way to deliver high quality cataract surgery. Its results are proven better than conventional ECCE and nearly comparable with phacoemulsification.[4] Because of rising population in India and rapidly growing backlog of cataract, the developing countries like India cannot afford expensive modern technologies to treat those cases. A cost effective, fast, machine independent procedure is necessary. Thus, the developing countries have developed a cost effective alternate to phacoemulsification with a very good clinical outcome.

Cataract extraction by nature is refractive surgery, as surgically induced refractive changes are a result of cataract extraction, intraocular lens (IOL) implantation, and incisional corneal astigmatic changes.[5]The emerging standard in cataract surgery today goes beyond safe cataract removal and proper IOL power calculation to include surgical control of preoperative and induced astigmatism.

Astigmatism occurs when toricity of any of the refractive surfaces of the optical system produces two principal foci delimiting an area of intermediate focus called the

conoid of Sturm. Thomas Young in 1801 was the first to describe ocular astigmatism, discovering that his own astigmatism was predominantly lenticular. However, later Airy (1827) corrected astigmatism with a cylindrical lens. Corneal astigmatism was observed by Knapp and also Donders in 1862 after the invention of the ophthalmometer by Helmholtz. In the same year Donders also described the astigmatism due to cataract surgery and soon after Snellen (1869) suggested that placing the incision on the steep axis would reduce the corneal astigmatism. Surgery to specifically treat astigmatism was suggested by Bates who described corneal wedge resection in 1894, but it was the work of Lans that provided most of the early theoretical basis for refractive corneal surgery.[6]

Surgically induced astigmatism (SIA) is one of the important factors that hampers post-operative visual outcome. Thus control of post-operative astigmatism is a key factor in meeting patient's expectations.[7]The site, size and configuration of incision will determine the amount of surgically induced astigmatism in manual small incision cataract surgery. All though superior incision is chosen as standard because of its easy approach with less foreign body sensation as the upper eye lid covers the wound but some recent studies have shown supero-temporal and temporal incisions to be associated with reduced post-operative astigmatism due to early wound stabilization.

Hence we intend to conduct this study to evaluate and compare postoperative astigmatism in manual small incision cataract surgery through superior, supero-temporal and temporal approach.

AIMS AND OBJECTIVES

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1. To evaluate the amount and type of postoperative astigmatism and compare the same in patients undergoing manual small incision cataract surgery with superior, supero-temporal and temporal incisions.

2. To study visual outcome in these incisions.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

HISTORY

The management of cataract has been the removal of cataractous lens since ancient times. Cataract surgery was practiced by **Sushruta** in as early as 800 BC, and he was considered to be the father of cataract surgery. He used a blunt needle passing through the conjunctiva and sclera behind the iris in a blind approach to displace the lens posteriorly. This was called couching.[8]

FIGURE 1: COUCHING

Jacques Daviel in 1745 attempted first cataract extraction using an inferior limbal incision with a triangular knife.[8]The corneal flap was lifted, the capsule was incised and the lens impaled with the knife and lifted out of the eye. He was faced with the dreaded complications of postoperative infection. He published the first account of extra capsular cataract extraction in 1753. It was only after the invention of asepsis after 1870 the cataract surgery became popular. In 1773, **Samuel Sharp** performed intracapsular extraction using thumb pressure after the incision.[8]

The German Ophthalmologist **Von Graefe** (1865) made a number of technical improvements which form a basis for ECCE even today. He designed the cataract knife, made section in the upper half of the eye and advocated iridectomy.[8]In 1877, **Pagenstecher** tried to deliver the lens by pressure at the limbus with a fixation forceps and depression at the scleral edge and by passing a spatula beneath the lens. In 1880, **Antonio Placido** developed first Keratoscope.[9]

In 1902, **Stoever**presented a technique of removing the lens by creating vacuum through a cupping device joined to a rubber bulb called erisophake. In 1910, **Smith** advocated ICCE through cornea incision and pressing the lower limbus with the end of strabismus hook. **Knapp** (1914) and **Elsching** (1924) developed ICCE using

different designs of capsule forceps. **Barraquer** (1917) advocated pneumatic suction of the cataractous lens using a suction apparatus and cup.[10]

Despite these techniques, most ophthalmologist performed extracapsular technique. Intracapsular technique had many complications due to non- availability of anaesthesia. It was only 1919 that **Willard** first time described akinesia of the orbicularis, later **Tochat**in 1920 published his work, **Von Lint's** (1920) and O Brien's (1929) facial block popular and are being practiced still worldwide. In 1930, **Elsching** and **Arruga** advocated the retrobulbar anaesthesia.[11]

A shift from ICCE TO ECCE evolved in an effort to reduce the incision size and decrease the rate of complications like aphakic bullous keratopathy, retinal detachment and cystoid macular oedema.

In 1984, **Dr. Thrasher and Dr. Broener et al** published their study on the lesser incidence of induced astigmatism with posterior limbal incision. Based on this study, **Dr. Richard Kratz** developed the scleral pocket incision consisted of a posteriorly placed incision with a scleral tunnel and a corneal wedge. However these incisions had to be closed with sutures.[12]

Michael McFarland in 1990 demonstrated the first suture less closure of scleral tunnel wound. Paul Ernest recognised that long scleral tunnel incision terminated in a corneal entrance and that the posterior lip acted as a one way valve imparting the self-sealing characteristics. Ultimately these techniques of a small incision with scleral tunnel and self sealing corneal valve combined with manual removal of a cataractous lens have come up.[12]

Cassamata was first to attempt an IOL implantation in 1795, he inserted a glass lens through a wound in cornea only to see it falls back of the eye.[13]In 1949, **Harold Ridley** developed fist IOL and in 1951 he published his memorable pioneering work on placing on PMMA lens behind the pupil of an aphakic eye.[14]**Strampelli** in 1954 inserted an acrylic lens into anterior chamber.[15]

The intracapsular method remained unchallenged until 1967 when **Charles Kelman** developed the phacoemulsification using ultrasound to emulsify the nucleus.[16]

After the development of operating microscope, the last 25 years have produced a rapid advancement in cataract surgery wound architecture. As the technology for removing the cataract has advanced, there has been a gradual trend towards the

smaller incisions moving from superior scleral to the temporal scleral incision in an attempt to reduce the intraoperative complications and postoperative astigmatism.[17]

Louis J Girard, George Rodriguez and Mary L M (1984) demonstrated postoperative astigmatism.[18]In 1989; Shepard introduced the single horizontal suture, for closing the 4 mm scleral tunnel in phacoemulsification.[19]

Cravy TV in 1991, proposed routine use of lateral approach to cataract extraction to achieve rapid and sustained stabilization of post-operative astigmatism.[20]

Blumenthal (1992) described hydro expression of nucleus with glide and popularized the MSICS technique.[21]

Donder, showed an unwelcomed consequence of cataract surgery is an alteration in corneal curvature and noted astigmatism in 1864 and first measured by **Von Rease**and **Winow** in 1969.[22]

DEVELOPMENT OF THE LENS

The rudimentary lens is first seen as a thickening of the surface ectoderm, the lens placode at 22days gestation; it overlies the optic vesicle. The lens placode forms the lens vesicle which consists of a single layer of cells. The cells forming the posterior wall of the lens rapidly elongate and become filled with proteins called crystallins. These densely packed elongated cells are known as the primary lens fibres. Additional fibres are formed by the mitotic division of the anterior epithelial cells at the equator known as secondary lens fibres. New secondary lens fibres are formed throughout life and persist throughout life.

The ends of the fibres come into apposition at sites referred to as sutures. In the foetus, the lens grows rapidly, because it is supplied by the hyaloid artery, which forms a plexus on the posterior surface of the lens. The vascular lens capsule is formed from the mesenchyme. The true lens capsule is formed from the thickened basal lamina.[23]

ANATOMIC AND HISTOLOGIC FEATURES-TOPOGRAPHY:

In the pupillary zone, the lens forms part of the posterior boundary of the anterior chamber. The posterior surface of the lens rests in the patellar fossa of the anterior

vitreous surface. Thezonule forms the suspensory ligament, which holds the lens inplace.[24]

GROSS STRUCTURE AND DIMENSIONS:

The lens is soft, elastic, avascular, transparent, highly refractile, biconvex structure. During early foetal development it is almost spheric, but, as more and more cortical cells develop, it assumes an elliptic shape and increases slightly in size. The antero-posterior diameter averages 3.5 mm in adults, and the equatorial diameter is about 9.0 mm.

TRANSPARENCY:

The normal lens remains perfectly transparent until maturity. The mechanisms of this remarkable feature are incompletely understood, but they undoubtedly include the absence of blood and lymph vessels, nerves, and intercellular connective tissue, the uniform arrangement of the cells in the axial portion of the lens and the absence of nuclei.

OPACIFICATION:

One theory is that the initial increase in light scatter in the cataractous lens is brought about by conformational changes in protein structure that introduce sufficient disorder

in the cellcytoplasm to interfere with light transmission. These conformational changes concurrently lead to increased susceptibility to proteolysis and hydration with further loss of transparency.[25]

CATARACT TYPES:[25]

The three most common kinds of cataractous opacifications that are noted clinically are nuclear sclerosis, posterior subcapsular cataract (PSC), and cortical cataracts.

1- Nuclear sclerosis:

Metabolic changes within the cells lead to colour changes, most commonly yellow and brown, which further attenuate the passage of light through the lens. Nuclear sclerosis increases the refractive power of the lens. The result is increased myopia.

2- Posterior subcapsular cataract:

As fibre cells migrate posteriorly, they may become dysplastic and enlarged. These dysplastic fibre cells tend to congregate in nests, surrounded by normal fibre cells. The clinical appearance at the slit lamp is a posterior subcapsular cataract. PSC, commonly result in glare from diffraction and scatter of light rays as they pass through the posterior part of the lens. Since the posterior capsule is close to the nodal

point of the eye, central PSC cataracts often result in distortion or blurring of vision, particularly for reading, even when they are small.

3- Cortical cataract:

Injuries to the fibre cell mass in the teenage years will notresult in clinical opacity until middle age. Such opacities are cortical cataracts, which may be either anterior or posterior, depending on the location of the first injured fibre cell.

ANATOMICAL CONSIDERATIONS[26]

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

Anatomy of Bulbar conjunctiva and Tenon's capsule:

Bulbar conjunctiva is a thin, transparent and loosely attached to the underlying Tenon's capsule by connective tissue strands. A 3 mm ridge of bulbar conjunctiva around cornea is call limbal conjunctiva.

In the area of limbus; the conjunctiva, Tenon's capsule and the episcleral tissue are fused into a dense tissue which is strongly adherent to underlying corneoscleral junction.

Anatomy of Cornea

It is a transparent, avascular structure occupies the centre of anterior pole of the globe and forms anterior $1/6^{th}$ of the outer coats of eye ball. It is horizontally oval. With sclera and conjunctiva overlapping it more in the superior and inferior part. In adults, it measures 12 mm horizontally and 11 mm vertically, the central cornea is nearly spherical and measures 4 mm in diameter. The posterior surface of cornea is more curved than anterior surface and circular. The cornea becomes flatter at the periphery more so in the nasal and superior regions. Radius of curvature of central part is 7.8 mm anteriorly and 6.5 mm vertically posteriorly. The central cornea is thinner and measures about 0.58 mm whereas the peripheral cornea are about 0.9 mm in thickness.

Sclera

It forms the posterior $5/6^{th}$ of the globe. It is covered by Tenon's capsule which also covers the recti muscles. Radius of curvature of sclera is about 12 mm. Sclera is thickest at the posterior pole measures about 1 mm. It is thinnest at the insertion of

recti muscles and measures about 0.3 mm at equator it measures about 0.4mm-0.6 mm and is about 0.8 mm at the limbus.

Anatomy of Limbus

Anatomically, the limbus refers to circumcorneal transitional zone of conjunctivo corneal and corneal scleral junction. It is bounded anteriorly by a line drawn between the ends of Bowman's and Descemet'smemebrane peripherally by an opaque sclera, internally trabecular meshwork and Schlemm's canal and externally by conjunctiva and Tenon's capsule.

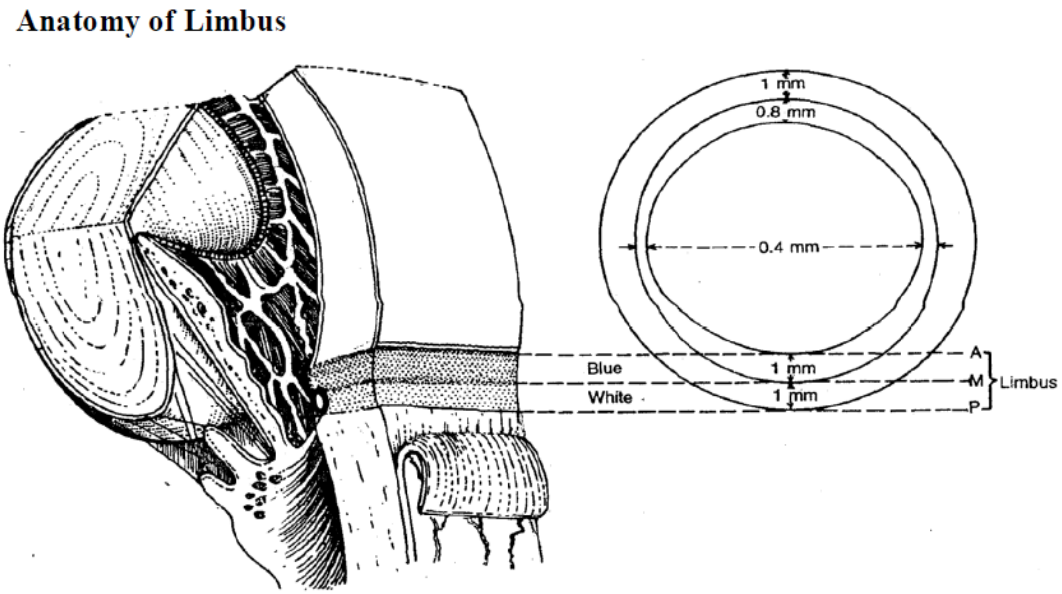


FIGURE 2: ANATOMY OF LIMBUS

Surgical Limbus

Surgical limbus is a 3mm wide transitional zone between clear cornea and sclera. The external landmarks of surgical limbus are:

1) Anterior limbal border
2) Mid limbal border
3) Posterior limbal border (sclera limbal junction)

CATARACT INCISION AND WOUND HEALING[27]

Healing varies according to:

a) Location of incision, corneal, limbal or scleral.
b) Whether conjunctival flap has been used; if so, whether it is fornix based or limbal based.
c) Presence of sutures.

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

Healing of corneal incision

Immediately after completion of incision, the wound edges swell and become somewhat opaque because of imbibition of fluid by the injured corneal lamella

(stromal hydration). Anterior and Posterior triangle results because of retraction of the superficial and deep parts of the wound. Healing of anterior triangle starts within an hour after injury with the sliding of epithelium and mitotic activity of cells.

Mitosis is greater within 24-48 hrs after injury and disappears after 5 days of injury. The new basement membrane is produced by proliferating endothelial cells with gradually thickens after several months. However, the cut edges of Descemet's membrane never re unites and hence Descemet's membrane is absent over incision area. Corneal stroma being avascular, healing occurs by fibrosis. Following injury neutrophils are carried to the site and there is swelling of wound edges, the glycosaminoglycans of corneal matrix disintegrate at the edge of the wound, this activates the stromal fibroblasts which migrate across the wound, laying down the collagen and fibronectin.

Healing of Limbal incision

Classical incision shows similar healing mechanism with some variations. The wound becomes filled by a mass of highly vascularised granulation tissue derived from the episclera. The anterior triangle becomes filled with fibrinous exudates from subconjunctival and episcleral vessels. Remodelling of wound is slow and may take as long as 2 years.

Healing of scleral incision

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

Instead highly vascular tissues on one side or the other, the episclera or uvea actively participates in the repair while the sclera itself plays a more or less passive role. Within 24 hours after incision the region is invaded by leucocytes which originate from the vessel in the neighborhood, their role is mainly phagocytic, to remove injured tissue. After 48 hours, leucocytes disappear and area is dominated by the activity of histiocytes and vascular elements mainly derived from episcleral and conjunctiva. The scleral incisions do not heal as effectively as corneal and limbal incisions.

Healing of sclerocorneal tunnel

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

ASTIGMATISM[28]

Is that condition of refraction wherein unequal refraction is produced in the two principle meridians and hence a point image cannot be formed on the retina thus blurring the image (A-privative; stigma-point).

Aetiology:

Astigmatism may be an error either of curvature, of centering or of refractive index.

1) Curvature astigmatism: Has its seat most frequently in the cornea and is usually congenital. Its occurrence in small degrees is almost invariable. The direct astigmatism, wherein the vertical curvature is greater than the horizontal (about 0.25D), is accepted as physiological. It may be due to constant pressure of the upper lid upon the eye. When the horizontal curvature is greater, the astigmatism is indirect, in other terms with the rule for the former and against the rule for the later. Acquired curvature astigmatism is not infrequently seen. Diseases of the cornea result in its deformity; such as conical cornea, inflammations & ulcerations produce astigmatism. Trauma including surgery, particularly cataract operations, is another cause. Furthermore, corneal astigmatism can be induced by pressure swelling of the eyelid. Curvature astigmatism of the lens also occurs with great frequency. In the great

majority of cases such anomalies are small; but on occasions, as in lenticonus, they may be marked.

2) Decentring: The lens may be placed slightly obliquely or out of line in the optical system, and thus, causing a corresponding astigmatism. Traumatic subluxation of the lens has similar results.

3) Index astigmatism: A small amount of index astigmatism occurs physiologically in the lens, due to small inequalities in the refractive index of the different sectors, but may be accentuated to produce considerable distortion or even polyopia in the grosser change of cataract.

Types of astigmatism:

1) **Regular astigmatism**: Where the two principal meridians are at right angles. In the great majority, the meridians of greater and least curvature are close to or actually vertical and horizontal, or vice versa. Oblique astigmatism occurs when the least and greatest meridians are not at right angles. The optical system in both conditions is still resolvable into sphero-cylindrical combination. Normally corneal vertical meridian is 0.25-0.5 D steeper than horizontal and hence with the rule type of regular

astigmatism. It has been found to reverse in old age giving an against the rule type of regular astigmatism due to pressure effects of lids.

Regular astigmatism can be classified into:

1-1: **Simple astigmatism**: In which one meridian is emmetropic while the other is either myopic or hypermetropic. They are respectively designated simple myopic and simple hypermetropic astigmatism.

1-2: **Compound astigmatism**: Both meridians are ametropic but with the same sign and the state of refraction either compound myopic or compound hypermetropic astigmatism.

1-3: **Mixed astigmatism**: One meridian focuses light in front of and the other behind the retina, so the refraction is myopic in one meridian and hypermetropic in the other.

2) Irregular astigmatism: The refraction in different meridians is quite irregular. A small degree may occur physiologically. A marked degree of irregular astigmatism is seen in corneal deformity due to scarring and opacities results from trauma, inflammation or ulceration of the cornea. It is also seen in lenticonus and keratoconus.

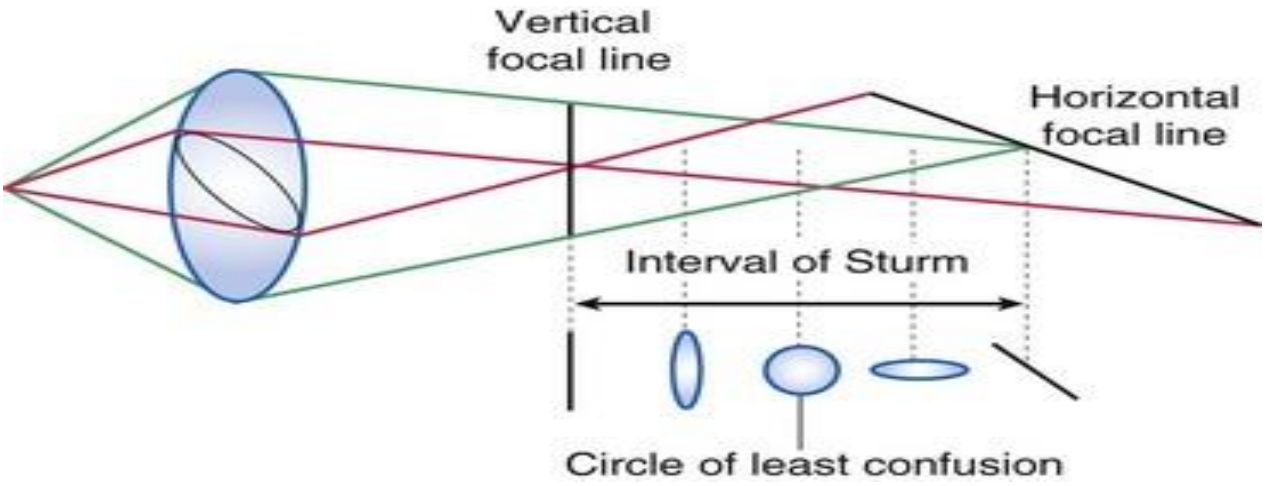


FIGURE 3: STURM'S CONOID

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

SYMPTOMS:

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

FIGURE 4: ASTIGMATIC VIEW

Objective means of determing amount of astigmatism[29]could be either of the following:

Measuring corneal curvature:

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

1. Keratometry (ophthalmometer)[30]: It is an objective method of estimating the corneal astigmatism by measuring the curvature of central cornea.

Principle: Keratometer is based on the fact that the anterior surface of the cornea acts as a convex mirror; so the size of the image formed by the anterior surface of cornea, the radius of curvature of cornea can be calculated. The accurate measurement of the image is obtained by using the principle of visible doubling.

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

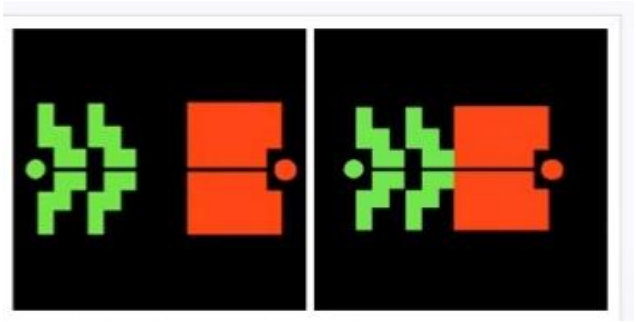


FIGURE 5: MIRES DURING KERATOMETRY WITH JAVAL AND SCHIOTZ MODEL KERATOMETER.

FIGURE 6: BAUSCH AND LOMB KERATOMETER

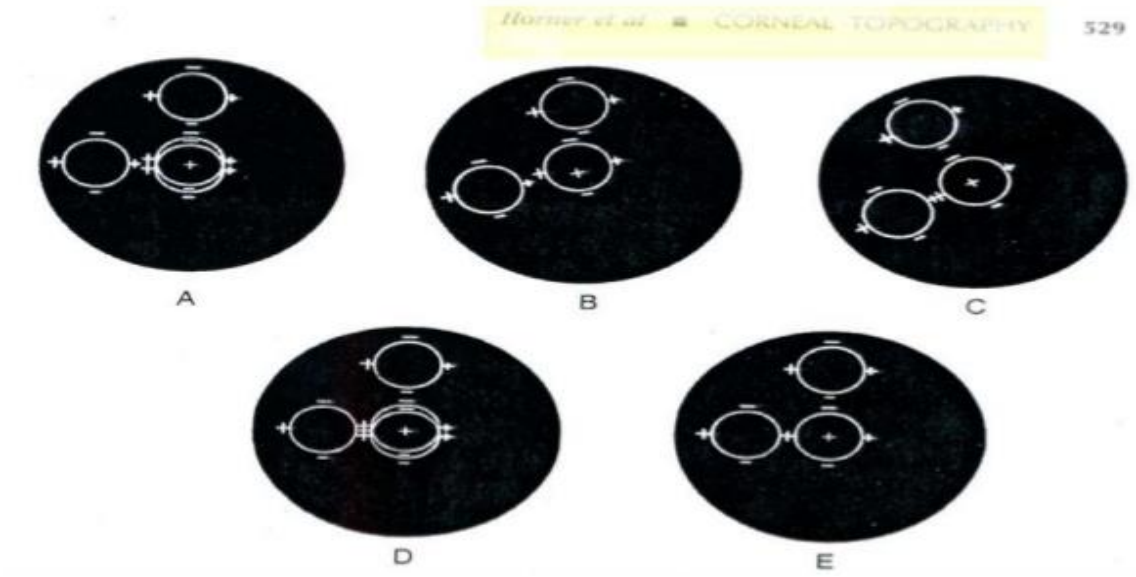


FIGURE 7: MIRES DURING KERATOMETRY WITH BAUSCH AND LOMB KERATOMETER

Keratometry measures corneal curvature into two meridians perpendicular to each other in both dioptres and mm. It measures only central 3mm optic zone and hence changes in peripheral cornea are missed out on such measurements. The two meridians taken would be:

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

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

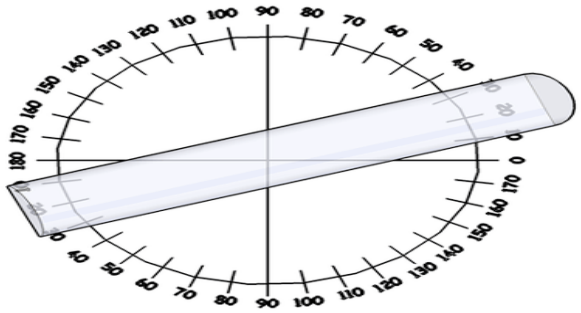


FIGURE 8: AXIS OF ASTIGMATSIM

2. Placido's disc: Simplest and oldest method wherein concentric and equally spaced mires are projected into the cornea from a flat disc and images produced are visualized through a corneal aperture for any distortion.

FIGURE 9: PLACIDO's DISC

3. Corneal topography: With videokeratoscopy provides a colour-coded map of the coneal surface. The dioptric power of the steepest and flattest meridian and their power are also calculated and displayed. The machine is used to quantify irregular astigmatism, diagnose early keratoconus and after refractive surgery, coneal grafting or cataract surgery. The disadvantage, it is rather expensive.

It has two scales:

1- Absolute scale: useful in comparing between different individuals.

2- Relative (normalized) scale: have no fixed end-points, used in comparing different parts of the same cornea.[31]

FIGURE 10: CORNEAL TOPOGRAPHY MACHINE

4. Terry's intraoperative Keratometer: It's very useful on the surgical table and is similar to placido disc with mires which get distorted along astigmatic axis.

Determining total astigmatic error:

1. Automated refractometer: Gives measures of total error with axis of astigmatism as well.

FIGURE 11: COMPUTERIZED REFRACTOMETER

2. Retinoscopy: Gives total error which includes lenticular astigmatism and spherical correction too.
3. Astigmatic fan and jackson's cross cylinder: Both of them have been used to accurately get axis as well as power of the corrective cylinder.

PREOPERATIVE ASTIGMATISM:

Preoperative astigmatism has predictive value for postoperative astigmatism. **Talamo et al** showed that in those patients who have 0-2D of preoperative WTR astigmatism, the average 2-year postoperative astigmatism was 1.18D ATR. Those who have >2D WTR astigmatism before surgery had on average 1.2D WTR astigmatism 2 years postoperatively. Therefore, patients tended to have less postoperative WTR than preoperative WTR astigmatism. Preoperative ATR astigmatism showed the opposite trend. Those who have 0-2D of ATR astigmatism had 1.47D of WTR astigmatism on average, while greater than 2D of preoperative ATR astigmatism was associated with 2.25D ATR astigmatism at 2 years postoperatively. These results imply that the cornea tends toward the original magnitude and direction of the initial astigmatism, except when more than 2D of ATR astigmatism exists preoperatively.[32]

POSTOPERATIVE ASTIGMATISM (P.O.A):

Even with modern microsurgical methods astigmatism has not been eliminated. The factors concerned in the genesis of this astigmatism are multiple and not completely understood.[33]Theamount and stability of corneal flattening is dependent on the incisional design and location, the use of cautery, sutures, and corticosteroids, and the length of time since the surgery. Wound compression by sutures and cautery initially

tends to steepen the cornea in the meridian of the incision, with a gradual relaxation over time.[34]

Appreciation of the physical dynamics of the cornea is a key to understanding surgically induced astigmatism. Jaffe and Clayman's found that the steepness of the corneal meridian was related to suture knot placement; Cravy emphasized that total central corneal power is conserved in cataract surgery, not decreased or increased, as long as tissue is neither added nor removed. These initial observations provided the foundation for better insight into corneal biomechanics. Using a corneoscope (an early form of Placido disc imagery), Rowsey established the principles that govern our ability to understand refractive power changes and coupling in the cornea. The first six of the ten 'caveats' are listed here, as they are most applicable to the dynamics encountered in cataract surgery:

• the normal cornea flattens over any incision.

• radial corneal incisions flatten the adjacent cornea and the cornea 90° away.

• the flattening effect of radial incisions on the cornea increases as incisions approach the visual axis.

• the cornea flattens directly over any sutured incision.

• the cornea flattens adjacent to loose limbal sutures, flattens 180° away, and steepens 90° away.

• the cornea steepens adjacent to tight limbal sutures, steepens 180°away,

and flattens 90° away.[35]

FACTORS AFFECTING POSTOPERATIVE ASTIGMATISM:

Size and site of incision: Small incision cataract surgery and phacoemulsification, lead to more rapid stability of the pseudophakic refraction, though the degree of astigmatism may be only marginally better than after large incision cataract surgery. But studies showed that, these long incisions can induce initial large amounts of with-the-rule (WTR) astigmatism. Mean dioptric initial WTR astigmatism can be 3.4D (range 1.7-4.7) at 1 week, and 2.0D (range, 1.0-3.0) at 12 weeks, which does not differ from preoperative astigmatism.[36]

CONTROL OF ASTIGMATISM:[37]

It is possible prophylactically by recognizing and avoiding causative factors; intraoperative keratometery (Terry keratometer) is helpful in some cases.[38]Certain methods can be used to correct preoperative and avoiding postoperative astigmatism:

1- **Incision construction and location:** A small, straight or frown, scleral tunnel incision is astigmatically more neutral than other type of scleral incisions. The cornea flattens along the meridian of the tunnel incision, so it can be made in the steeper meridian.

2- **Astigmatic keratotomy:** Can be considered intra-operatively in patients with 1.5 –4.0 D pre-existing astigmatism. Incisions are made in paracentral zone in the steeper meridian. Size, site and number of cuts are predetermined according to degree and type of astigmatism.

3-

4- **Limbal relaxing incision (LRI):** Effective method for reducing 0.5 –3.0 D. Advantages of LRI over AK are:

   a) Less postoperative glare.

   b) Preserving optical quality of the cornea.

   c) Minimizing discomfort.

   d) Quicker recovery of vision.

IMPORTANCE OF POST OPERATIVE VISUAL ACUITY:

Cataract is a highly treatable condition due to dramatic advances in cataract surgery procedures and intraocular lens design. Visual impairment from cataract is associated with difficulties with activities of daily living and reduces quality of life. Quality of life related to health involves different problems for validation. One is the objective part, which is the functional status of the individual, and the other is the subjective feeling of health and welfare which includes physical, social and psychological

functionality. The goal of cataract surgery is to improve visual acuity and therefore the visual function, considering that it entails improvement in quality of life.

MATERIALS AND METHODS

MATERIALS AND METHODS

TITLE OF THE STUDY:

"COMPARISON OF POST OPERATIVE ASTIGMATISM AFTER MANUAL SMALL INCISION CATARACT SURGERY USING SUPERIOR, SUPERO TEMPORAL AND TEMPORAL INCISIONS"

SOURCE OF DATA:

102 patients attending to outpatient department of ophthalmology, R.L.JALAPPA HOSPITAL AND RESEARCH CENTRE attached to SRI DEVARAJ URS MEDICAL COLLEGE, TAMAKA, KOLAR with senile cataract fulfilling the inclusion criteria framed were selected for manual small incision cataract surgery under peribulbar anaesthesia between December 2014 to December 2015.

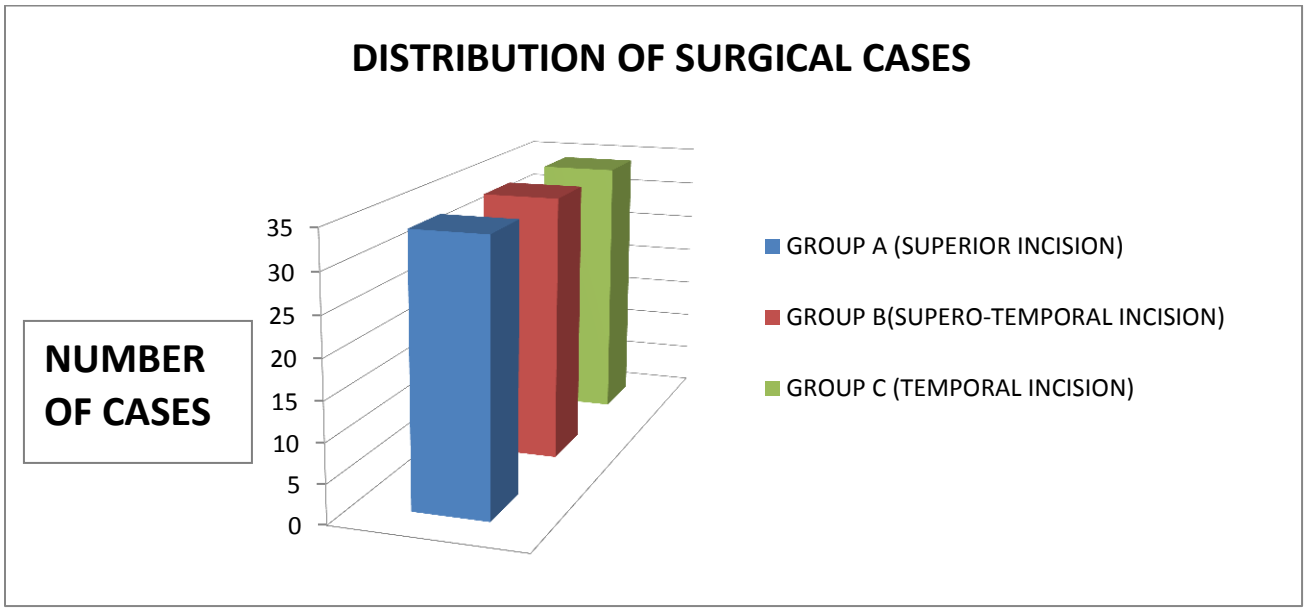
SAMPLE SIZE:

A total number of 102 patients with senile cataract were evaluated for astigmatism ($\leq$1.5D) & were randomly distributed to three groups with age and gender matching.

Group A: Manual small incision cataract surgery with superior scleral incision-34 patients

Group B: Manual small incision cataract surgery with superotemporal scleral incision- 34 patients

Group C: Manual small incision cataract surgery with temporal scleral incision-34 patients



INCLUSION CRITERIA:

Patients with senile cataract

EXCLUSION CRITERIA:

Senile cataract patients with:

1. Preoperative astigmatism >1.5 D
2. Patients with pterygium, corneal opacity anddegeneration
3. Posterior segment pathology
4. Previous intra ocular surgery (trabeculectomy, refractive or retinal detachment surgery)
5. Glaucoma
6. Previous ocular trauma and inflammatory diseases
7. Intraoperative complications like PC rent, zonular dialysis.

The indications for surgery were, defective vision enough to interfere with daily activities, fundus view obscured enough to warrant surgery, and non-improvement of vision with glasses or pin-hole.

PREOPERATIVE EVALUATION:

- Full history of any previous ocular disease or surgery.
- Visual acuity recording by Snellen's or Kannada charts.
- Detailed slit-lamp examination.
- Intraocular pressure recording by Applanation tonometry.
- Fundus examination by both direct and indirect ophthalmoscopy.
- Lacrimal sac syringing ,
- Ultrasound B scan was done on patients with hazy media to evaluate posterior segment.
- Keratometry by Baush and Lomb manual keratometer.
- A Scan (using DGH Jed med instrument) with IOL power calculation by SRK-2 formula.
- General examination and systemic examination including cardiovascular system and respiratory examination.
- BP recording and blood sugar estimation was done.
- Sensitivity to local anaesthetics tested.
- Written informed consent was taken from all the patients for surgery.

PREOPERATIVE PREPARATION:

All patients were given systemic antibiotics (tablet ciprofloxacin 500 mg b.d) on the preoperative day and three hours before surgery one drop of Ciprofloxacin 0.3% hourly was instilled in the eye. On the day of surgery pupils were dilated adequately using instillation of 0.8% tropicamide and 5%/10% phenylephrine eye drops every 10 minutes, one hour before surgery. To sustain the pupil dilatation the anti-prostaglandin eye drops such as flubiprofen was instilled three times one day before surgery and half hourly for two hours immediately before surgery.

PROCEDURE:

All surgeries were performed by a single surgeon under local anaesthesia by using peri bulbar block. Anaesthesia and akinesia of the eye ball was obtained with a peribulbar block using 2% Xylocaine with adrenaline mixed 1500 units of hyaluronidase and 0.5% Bupivacaine. A good massage was given to the eye ball for ten minutes to achieve adequate hypotony. Just before the start of the surgery, the skin around the eye was painted with 5% povidone iodine and the same drops was instilled topically.

All surgeries were performed, using a ZEISS 150 operating microscope. The eye was stabilized with a bridle suture of the superior rectus muscle.

<u>SURGICAL TECHNIQUE:</u> SMALL INCISION CATARACT SURGERY WITH PC IOL IMPLANTATION

A 6mm long scleral incision with sclera-corneal tunnel and self-sealing corneal valve was fashioned after making a fornix-based conjunctival flap. The frown shape external incision was about 2mm from the limbus with No.15 blade. A tunnel was created with crescent blade upto 1.5mm into clear cornea. Entry into AC was made with 3.2 mm Keratome and later extended. A continous curvilinear capsulorhexis was performed with a 26 G needle cystitome depending on cataract type and pupillary mydriasis. The nucleus was prolapsed into AC using hydro dissection and hydraulic expression and then was removed with sandwich technique. All the manipulation was carried out under cover of visco-elastics. Cortex was aspirated with Simcoe cannula. Single piece PMMA 6mm Optic IOL was inserted through the tunnel into capsular bag and properly centered. Anterior chamber was formed and the wound allowed self-sealing by hydrating the side port entry. Surgery was concluded with a sub-conjunctival injection of Dexamethasone 1mg and Gentamycin 20 mg after repositing conjunctiva over the wound.

Postoperatively all patients received a course of topical antibiotic and steroid eye drops second hourly for a week, followed by a tapering dose for 6 weeks along with

flurbiprofen eye drops 0.03%, 3 times a day for 4 weeks. Systemic antibiotic Tab Ciprofloxacin 500 mg was given for 1 day before and continued for 4 days postoperatively.

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

STATISTICAL ANALYSIS

STATISTICAL ANALYSIS

Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square was used as test of significance. Continuous data was represented as mean and SD. Paired t test is the test of significance for paired data such as before and after surgery and ANOVA (Analysis of Variance) was the test of significance to identify the mean difference between more than two groups. P value <0.05 was considered as statistically significant.

OBSERVATION AND RESULTS

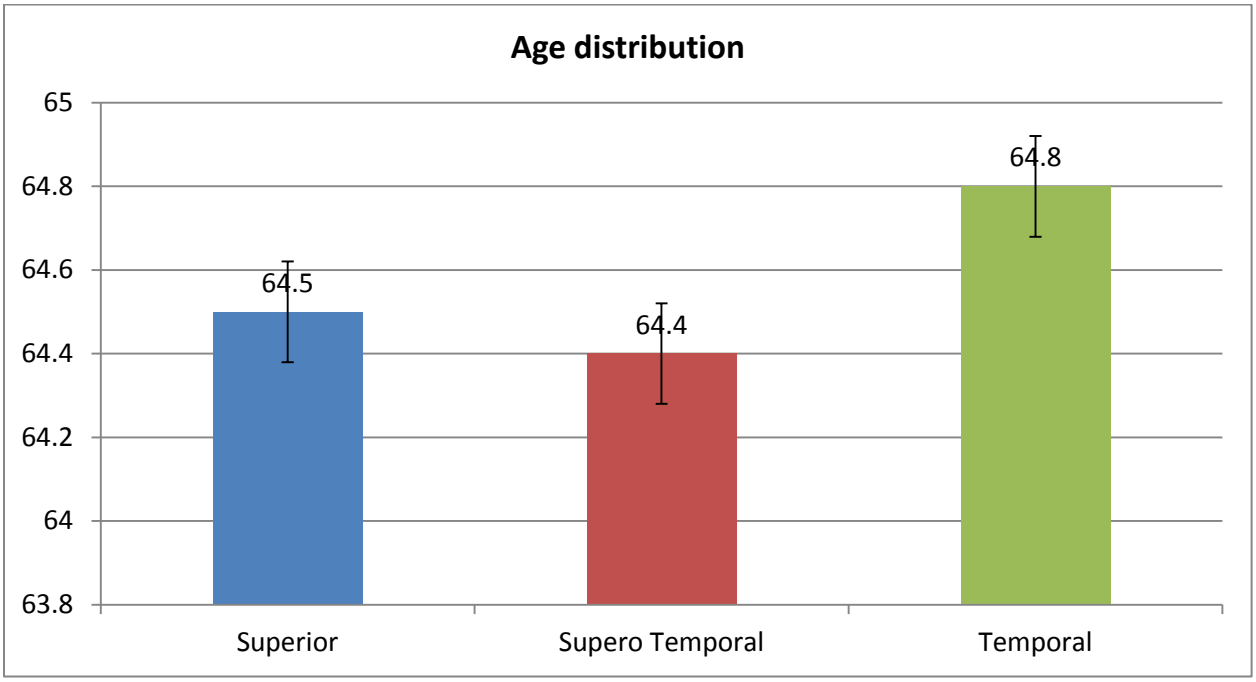
OBSERVATION AND RESULTS

A prospective, comparative study of post-operative astigmatism after manual small incision cataract surgery using superior, supero temporal and temporal incisions was conducted at Department of Ophthalmology, R.L. JALAPPA HOSPITAL AND RESEARCH CENTRE, TAMAKA, KOLAR attached to SRI DEVARAJ URS MEDICAL COLLEGE.

TABLE 1: MEAN AGE DISTRIBUTION OF SUBJECTS IN THREE GROUPS

	Group						P value
	Superior		Supero Temporal		Temporal		
	Mean	SD	Mean	SD	Mean	SD	
Age	64.5	6.7	64.4	7.3	64.8	7.1	0.971

Mean age of subjects in Group 1 was 64.5 ± 6.7 years, in group 2 was 64.4 ± 7.3 and in group 3 was 64.8 ± 7.1 years. There was no significant difference in mean age between two groups.



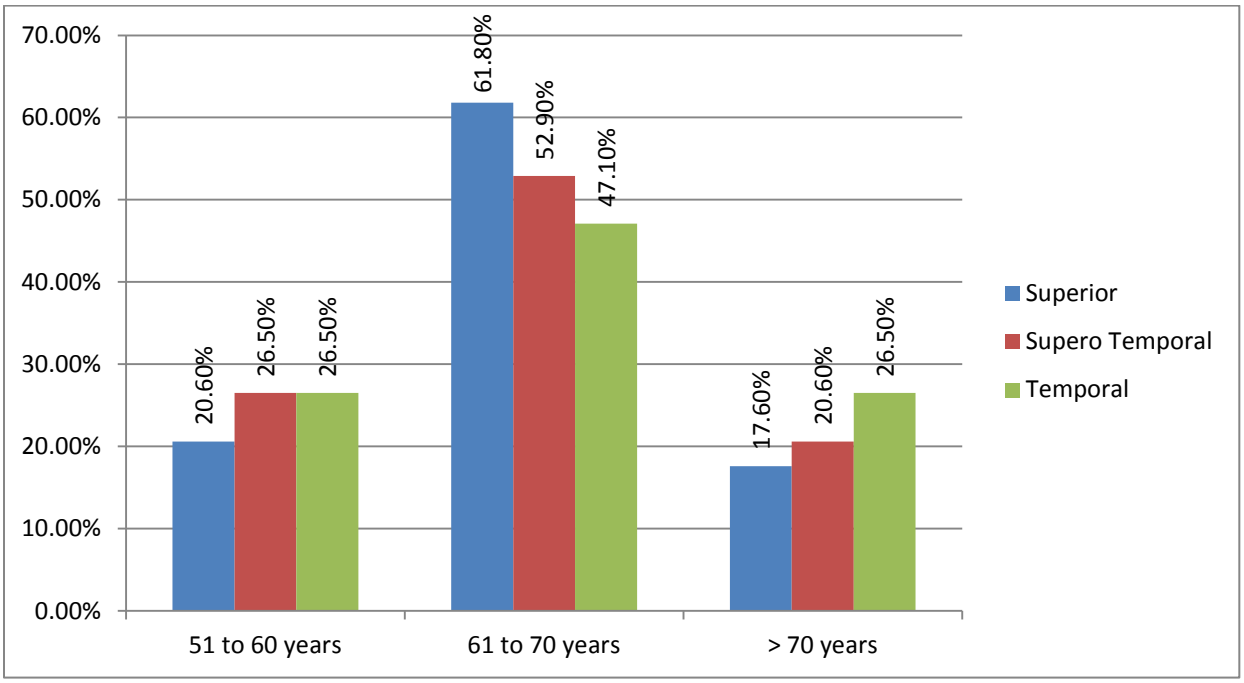
GRAPH 1: MEAN AGE DISTRIBUTION OF SUBJECTS IN THREE GROUPS

TABLE 2: AGE DISTRIBUTION OF SUBJECTS IN THREE GROUPS

		Group					
		Superior		Supero Temporal		Temporal	
		Count	%	Count	%	Count	%
Age	51 to 60 years	7	20.6%	9	26.5%	9	26.5%
	61 to 70 years	21	61.8%	18	52.9%	16	47.1%
	> 70 years	6	17.6%	7	20.6%	9	26.5%

$\chi 2 = 1.647$, df = 4, p = 0.800

Majority of subjects in Group 1 (61.8%), group 2 (52.9%) and group 3 (47.1%) were in the age group between 61 to 70 years. There was no significant difference in age distribution between two groups.



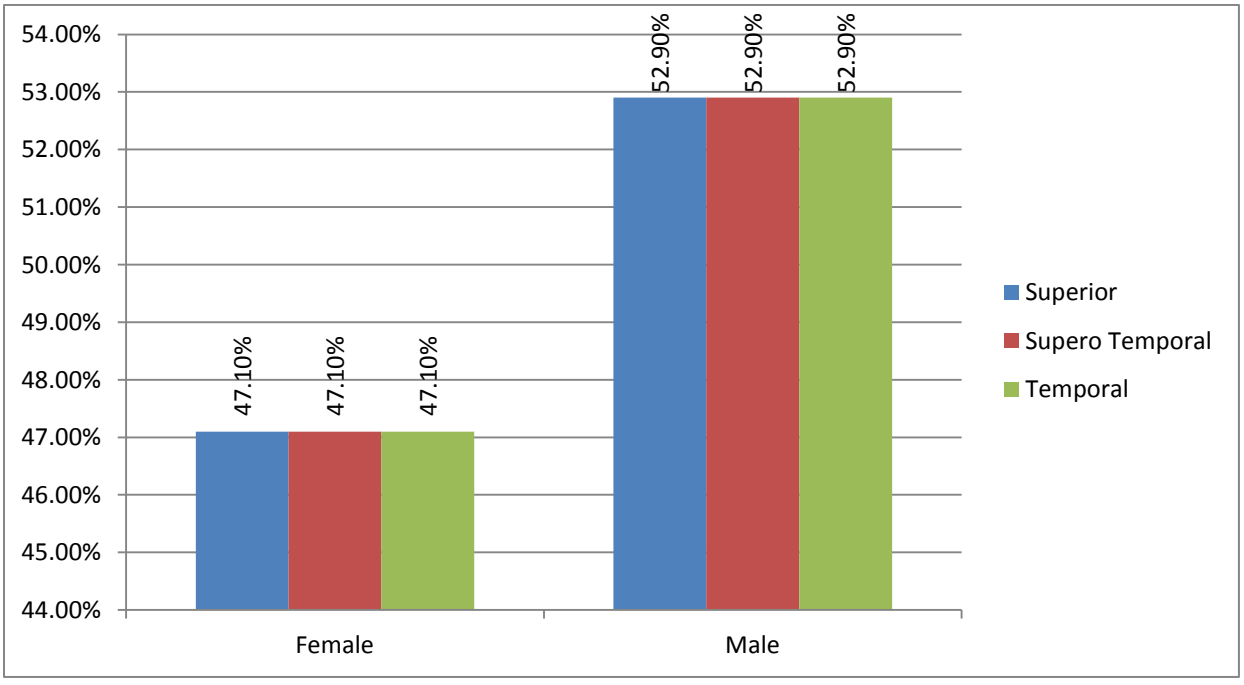
GRAPH 2: AGE DISTRIBUTION OF SUBJECTS IN THREE GROUPS

TABLE 3: GENDER DISTRIBUTION OF SUBJECTS IN THREE GROUPS

		Group					
		Superior		Supero Temporal		Temporal	
		Count	%	Count	%	Count	%
Gender	Female	16	47.1%	16	47.1%	17	50.0%
	Male	18	52.9%	18	52.9%	17	50.0%

χ 2 = 0.079, df = 2, p = 0.961

Majority of subjects in all the three groups was males and there was equal distribution of both males and females in three groups.

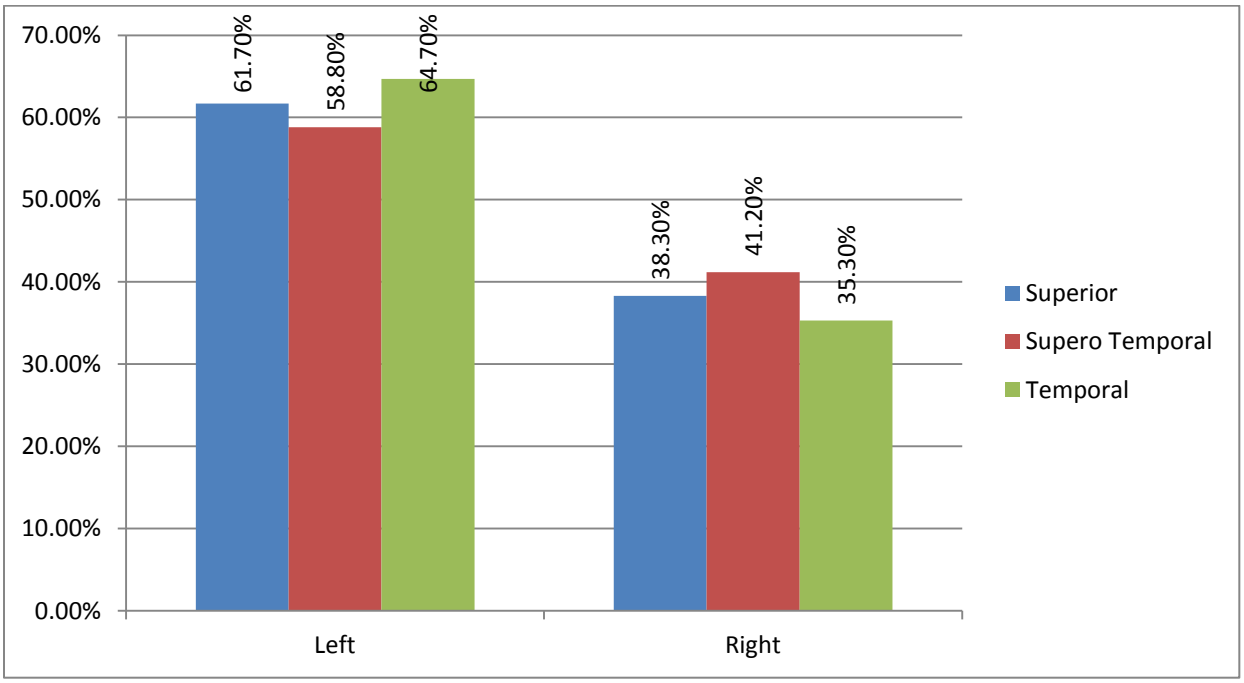


GRAPH 3: GENDER DISTRIBUTION OF SUBJECTS IN THREE GROUPS

TABLE 4: SIDE OF EYE OPERATED IN THREE GROUPS

		Group					
		Superior		Supero Temporal		Temporal	
		Count	%	Count	%	Count	%
Side	Left	21	61.7%	20	58.8%	22	64.7%
	Right	13	38.3%	14	41.2%	12	35.3%

χ 2 = 0.000, df = 2, p = 1.000



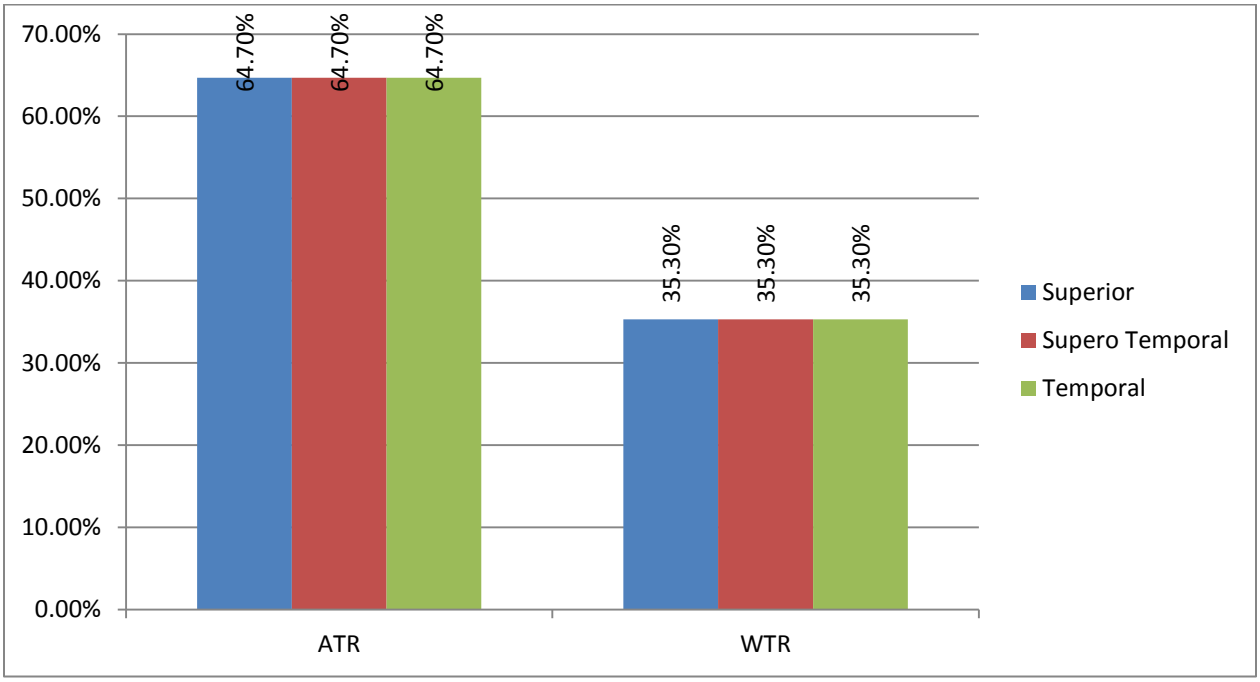
GRAPH 4: SIDE OF EYE OPERATED IN THREE GROUPS

TABLE 5: PRE-OPERATIVE ASTIGMATISM COMPARISON BETWEEN THREE GROUPS

		Group					
		Superior		Supero Temporal		Temporal	
		Count	%	Count	%	Count	%
Type	ATR	22	64.7%	22	64.7%	22	64.7%
	WTR	12	35.3%	12	35.3%	12	35.3%
	Total	34	100.0%	34	100.0%	34	100.0%

χ 2 = 0.000, df = 2, p = 1.000

At pre-operative period in all the three groups 64.7% of them against the rule astigmatism and 35.3% had with the rule astigmatism. Hence at baseline there was equal percentage of ATR and WTR.



GRAPH 5: ASTIGMATISM TYPE AT PRE OPERATIVE PERIOD COMPARISON BETWEEN THREE GROUPS

TABLE 6: ASTIGMATISM AMOUNT COMPARISON BETWEEN THREE GROUPS IN ATR SUBJECTS

	Group						P value
	Superior		Supero Temporal		Temporal		
	Mean	SD	Mean	SD	Mean	SD	
Pre-operative	1.11	0.31	1.11	0.31	1.11	0.31	1.000
1 Week post-op	1.14	0.37	1.11	0.31	0.85	0.34	0.012*
6 Weeks post-op	1.25	0.52	0.64	0.31	0.45	0.25	<0.001*
12 Weeks post-op	1.30	0.53	0.66	0.32	0.44	0.23	<0.001*

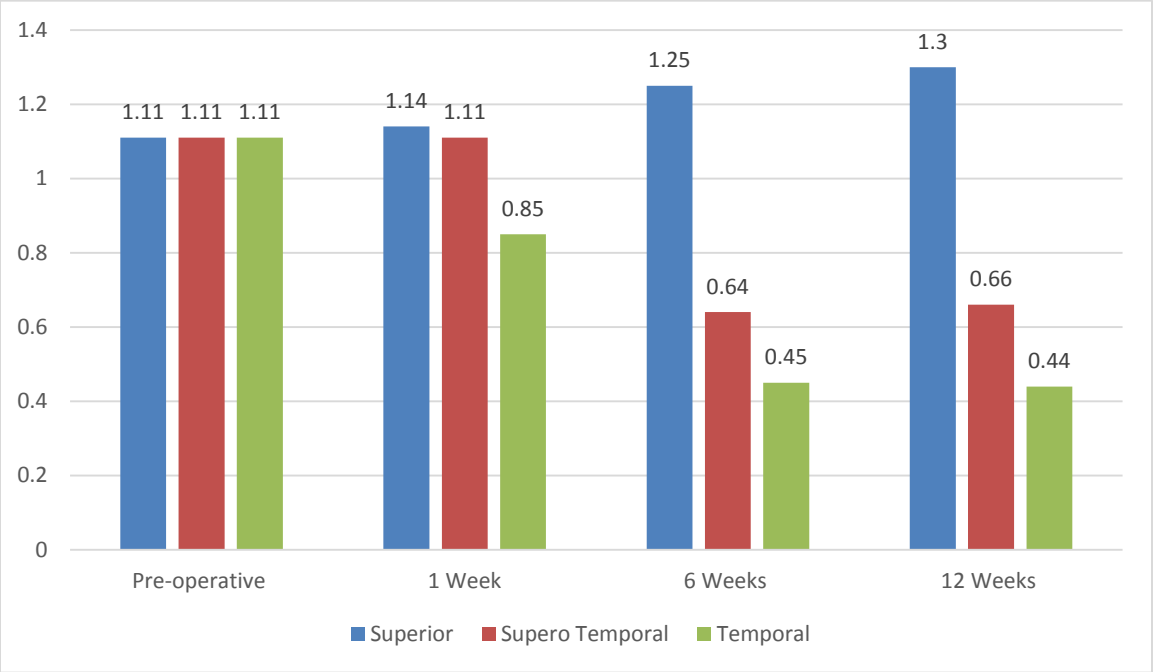
In subjects with ATR astigmatism Pre operatively, mean Astigmatism in all the three groups was 1.1 ± 0.3.

At 1 week mean astigmatism was 1.14 ± 0.37 in superior group, 1.11 ± 0.31 in supero temporal group and 0.85 ± 0.34 in temporal group.

At 6 week mean astigmatism was 1.25 ± 0.52 in superior group, 0.64 ± 0.31 in supero temporal group and 0.45 ± 0.25 in temporal group.

At 12 week mean astigmatism was 1.30 ± 0.53 in superior group, 0.66 ± 0.32 in supero temporal group and 0.44 ± 0.23 in temporal group.

There was significant difference in mean Astigmatism between three groups from 1st Week till 12 weeks of post-operative period. Superior group had higher astigmatism at all the intervals and temporal group had lower astigmatism from 1 week till 12 weeks. Hence temporal incision was better in ATR astigmatism.



GRAPH 6: ASTIGMATISM AMOUNT COMPARISON BETWEEN THREE GROUPS AMONG ATR SUBJECTS PREOPERATIVELY

TABLE 6A: ASTIGMATISM AMOUNT COMPARISON BETWEEN THREE GROUPS IN WTR SUBJECTS

	Group						P value
	Superior		Supero Temporal		Temporal		
	Mean	SD	Mean	SD	Mean	SD	
Pre-operative	1.06	0.30	1.06	0.30	1.06	0.30	1.000
1 Week post-op	0.92	0.33	1.06	0.30	1.10	0.45	0.425
6 Weeks post-op	0.42	0.33	1.15	0.41	1.50	0.40	<0.001*
12 Weeks post-op	0.38	0.31	1.17	0.49	1.52	0.39	<0.001*

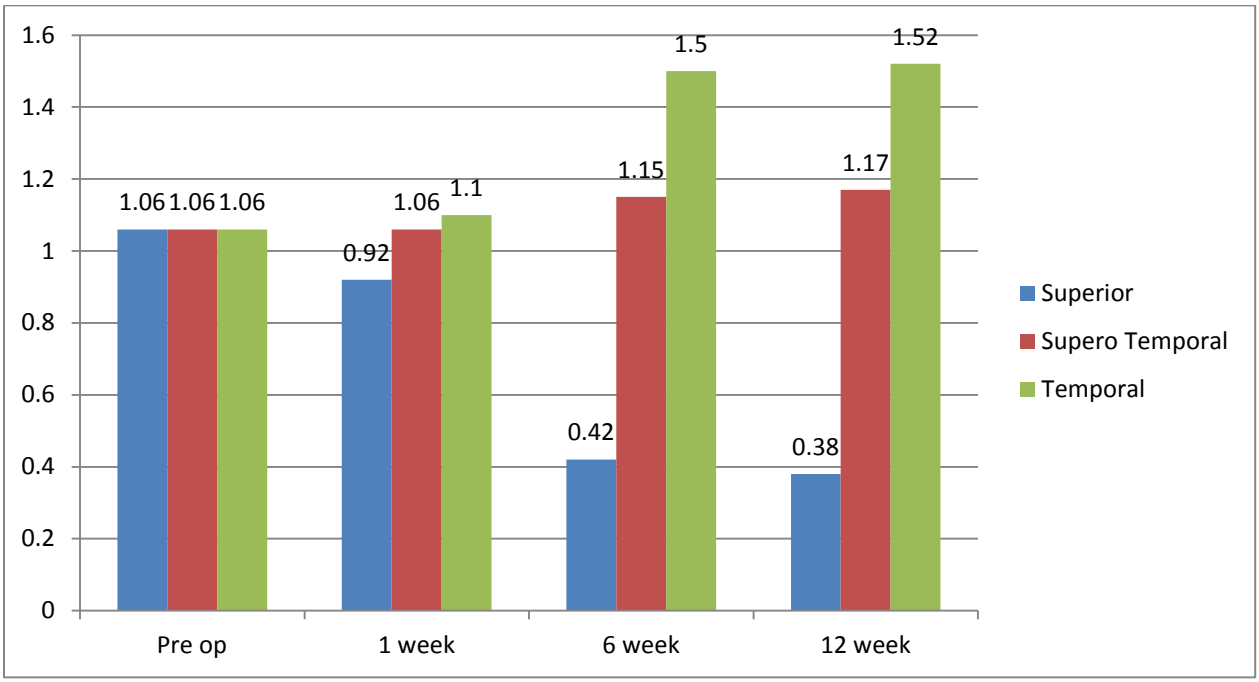
In subjects with WTR astigmatism Pre operatively, mean Astigmatism in all the three groups was 1.1 ± 0.3.

At 1 week mean astigmatism was 0.92 ± 0.33 in superior group, 1.06 ± 0.30 in supero temporal group and 1.10 ± 0.45 in temporal group.

At 6 week mean astigmatism was 0.42 ± 0.33 in superior group, 1.15 ± 0.41 in supero temporal group and 1.52 ± 0.40 in temporal group.

At 12 week mean astigmatism was 0.38 ± 0.31 in superior group, 1.17 ± 0.49 in supero temporal group and 1.52 ± 0.39 in temporal group.

There was no significant difference in mean Astigmatism between three groups at 6 weeks and 12 weeks of post-operative period. Superior group had lower astigmatism at all the intervals and temporal group had higher astigmatism from 1 week till 12 weeks. Hence superior incision was better in WTR astigmatism.



GRAPH 6A: ASTIGMATISM AMOUNT COMPARISON BETWEEN THREE GROUPS AMONG WTR SUBJECTS PREOPERATIVELY

TABLE 7: COMPARISON OF POST-OPERATIVE CHANGE IN ASTIGMATISM FROM PRE-OPERATIVE LEVELS IN THREE GROUPS

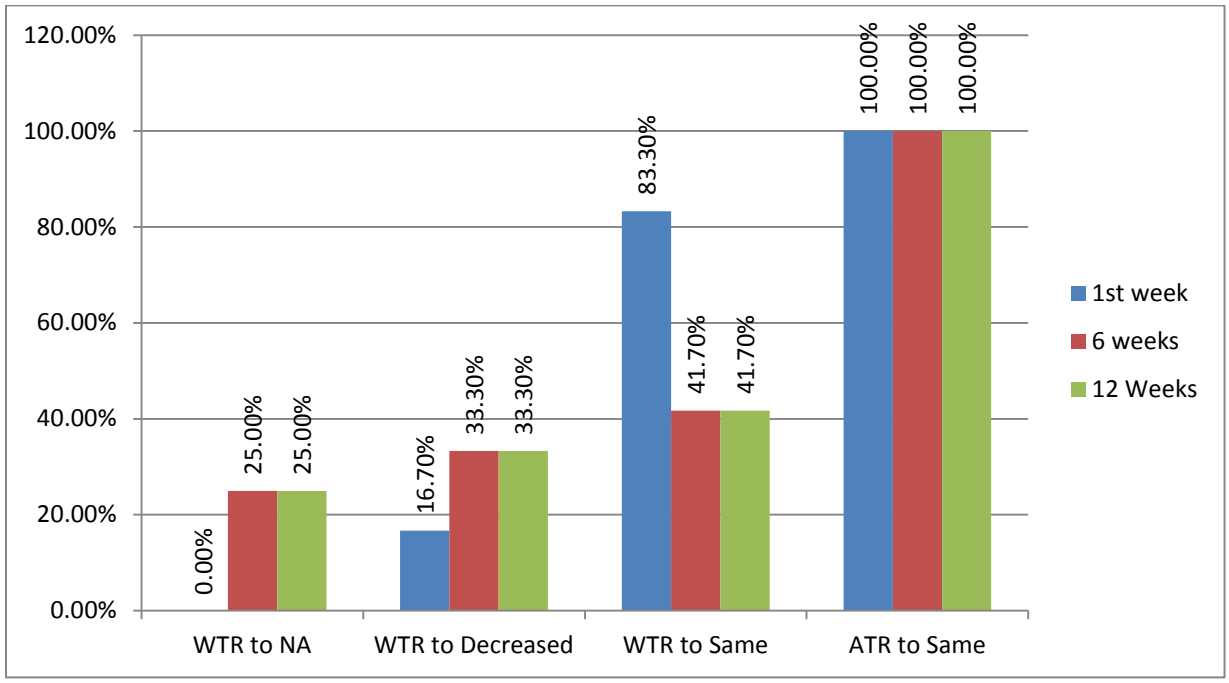
	Pre-operative Astigmatism	Post-operative Change in Astigmatism	Post-operative period						P value
			1st week		6 weeks		12 Weeks		
			Count	%	Count	%	Count	%	
SI	WTR (12)	NA	0	0.0%	3	25.0%	3	25.0%	0.177
		Decreased	2	16.7%	4	33.3%	4	33.3%	
		Same	10	83.3%	5	41.7%	5	41.7%	
	ATR (22)	Same	22	100.0%	22	100.0%	22	100.0%	-
STI	WTR (12)	Increased	8	66.7%	6	50.0%	6	50.0%	0.637
		Same	4	33.3%	6	50.0%	6	50.0%	
	ATR (22)	NA	0	0.0%	1	4.5%	1	4.5%	0.543
		Decreased	13	59.1%	16	72.7%	16	72.7%	
		Same	9	40.9%	5	22.7%	5	22.7%	
TI	WTR (12)	Same	12	100.0%	12	100.0%	12	100.0%	-
	ATR (22)	NA	1	4.5%	1	4.5%	1	4.5%	-
		Decreased	18	81.8%	18	81.8%	18	81.8%	
		Same	3	13.6%	3	13.6%	3	13.6%	

In superior group, out of 12 subjects with WTR astigmatism, 16.7%, 33.3% and 33.3% had decreased levels (changed to ATR astigmatism) at 1st week, 6 weeks and 12 weeks. 83.3%, 41.7% and 41.7% remained with same astigmatism at 1st week, 6 weeks and 12 weeks respectively. There was no significant difference at different time intervals in superior group with respect to astigmatism. In 22 subjects with ATR, all the subjects had same astigmatism at 1st, 6th and 12 weeks.

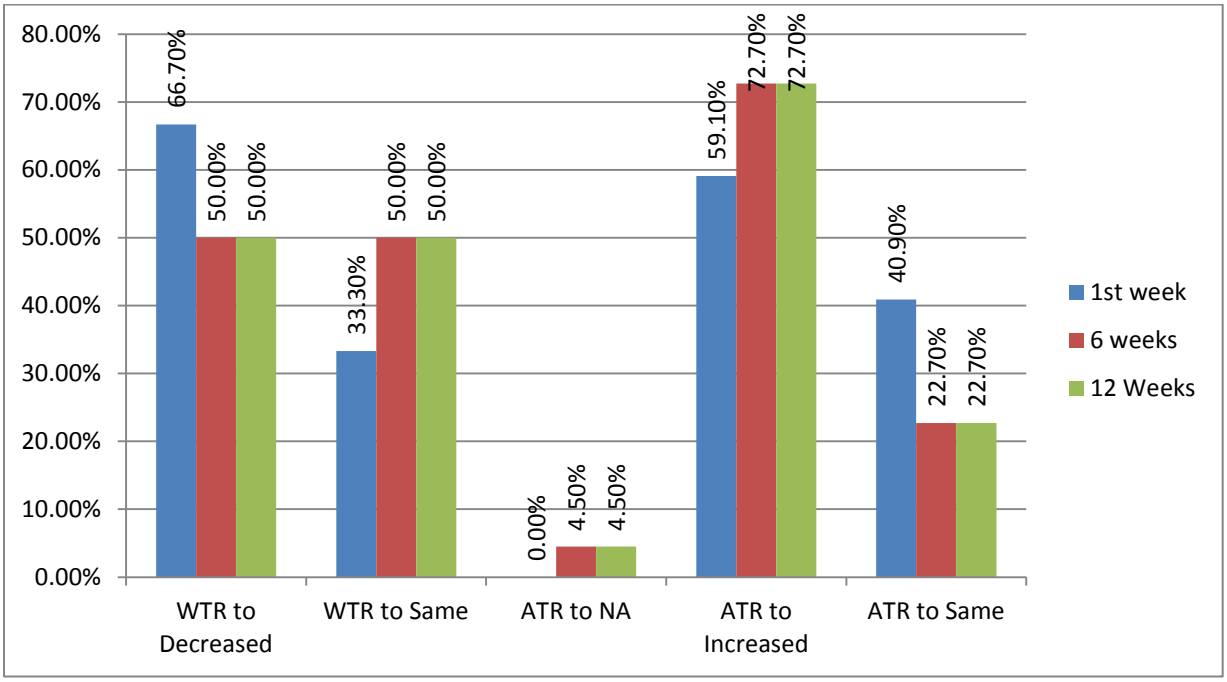
In supero temporal group, out of 12 subjects with WTR astigmatism, 66.7% , 50% and 50% had increased levels (changed to ATR astigmatism) at 1st week, 6 weeks and 12 weeks respectively. 33.3%, 50% and 50% remained with same astigmatism at 1st week, 6 weeks and 12 weeks respectively. There was no significant difference at different time intervals in supero temporal group with respect to astigmatism. In 22 subjects with ATR astigmatism, 59.1% , 72.7% and 72.7% had decreased levels (changed to WTR astigmatism) at 1st week, 6 weeks and 12 weeks respectively. 40.9%, 22.7% and 22.7% remained with same astigmatism at 1st week, 6 weeks and 12 weeks respectively.

In temporal group, out of 12 subjects with WTR astigmatism all the subjects remained with same astigmatism at 1st, 6th and 12th Week post operatively. In 22 subjects with ATR astigmatism, 81.8% had decreased levels (changed to WTR

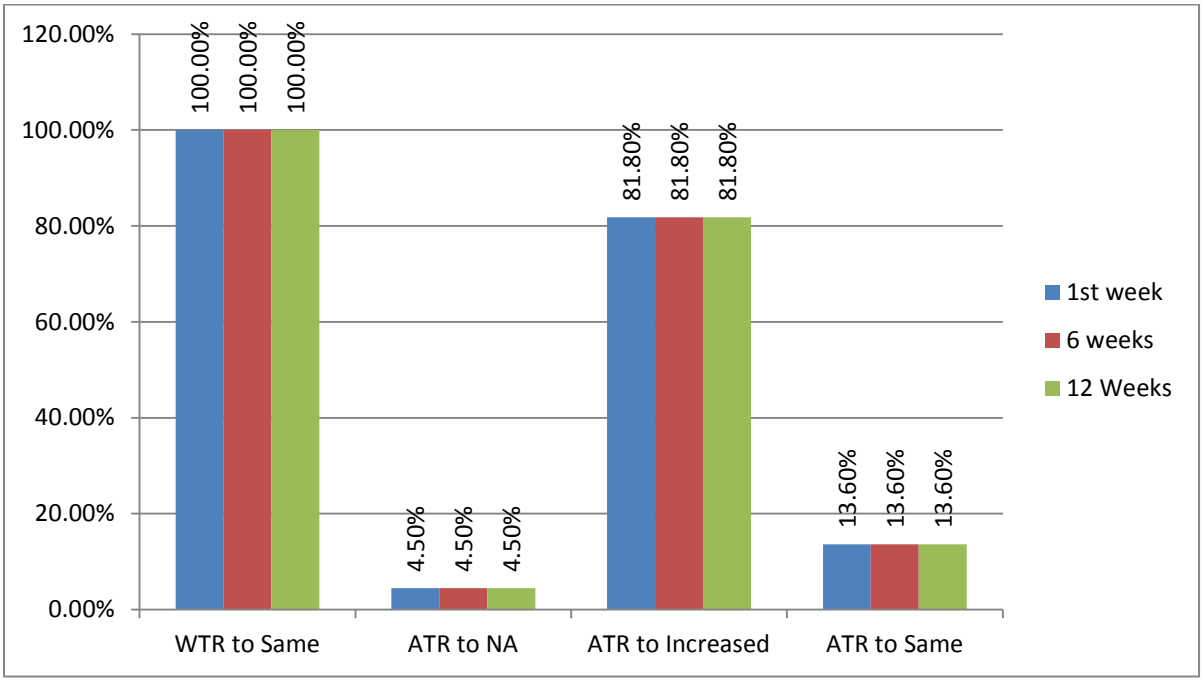
astigmatism) at 1st week, 6 weeks and 12 weeks respectively. 13.6% remained with same astigmatism at 1st week, 6 weeks and 12 weeks respectively.



GRAPH 7: COMPARISON OF POSTOPERATIVE CHANGE IN ASTIGMATISM FROM PREOPERATIVE LEVELS IN SUPERIOR INCISION GROUP



GRAPH 7A: COMPARISON OF POST OPERATIVE CHANGE IN ASTIGMATISM FROM PRE OPERATIVE LEVELS IN SUPERO TEMPORAL INCISION GROUP



GRAPH 7B: COMPARISON OF POSTOPERATIVE CHANGE IN ASTIGMATISM FROM PREOPERATIVE LEVELS IN TEMPORAL INCISION GROUP

TABLE 8: ASTIGMATISM TYPE COMPARISON BETWEEN THREE GROUPS

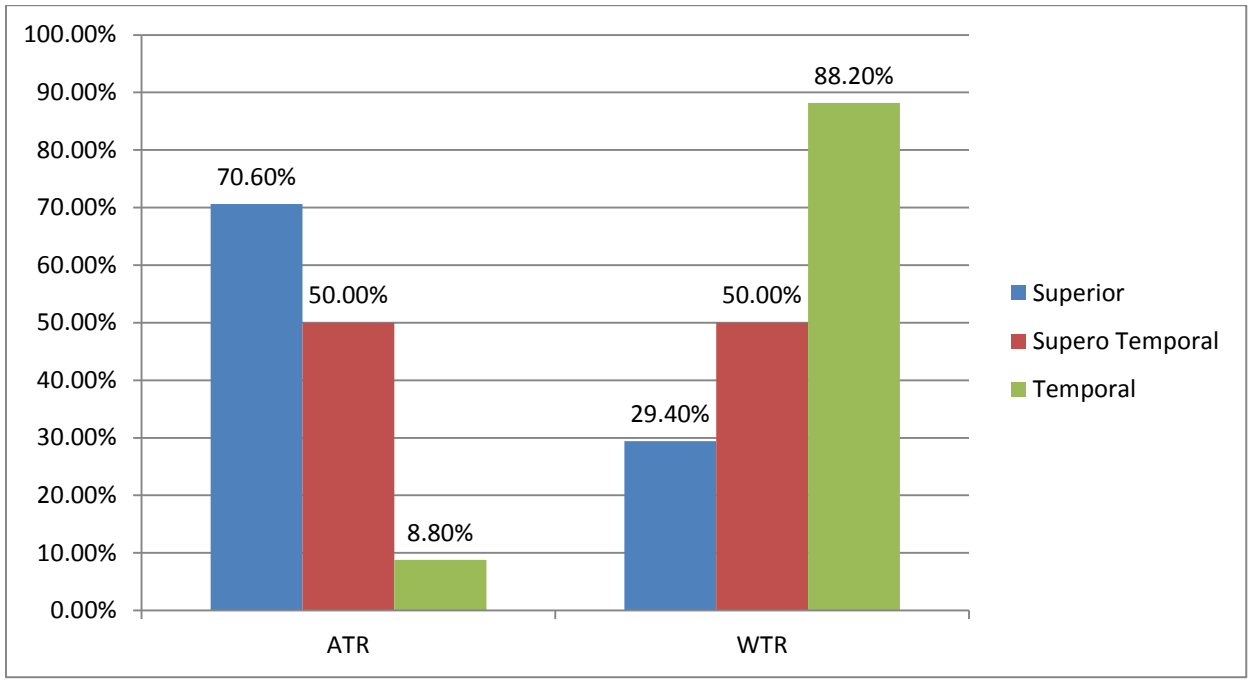
		Group						P value
		Superior		Supero Temporal		Temporal		
		Count	%	Count	%	Count	%	
1 week	NA	0	0.0%	0	0.0%	1	2.9%	<0.001*
	ATR	24	70.6%	17	50.0%	3	8.8%	
	WTR	10	29.4%	17	50.0%	30	88.2%	
6 week	NA	3	8.8%	1	2.9%	1	2.9%	<0.001*
	ATR	26	76.5%	11	32.4%	3	8.8%	
	WTR	5	14.7%	22	64.7%	30	88.2%	
12 week	NA	3	8.8%	1	2.9%	1	2.9%	<0.001*
	ATR	26	76.5%	11	32.4%	3	8.8%	
	WTR	5	14.7%	22	64.7%	30	88.2%	

At 1st week in superior group 29.4% had WTR astigmatism, 50% in supero temporal group had WTR astigmatism and 88.2% in temporal group had WTR rule

astigmatism. This difference in astigmatism pattern was statistically significant at 1st week.

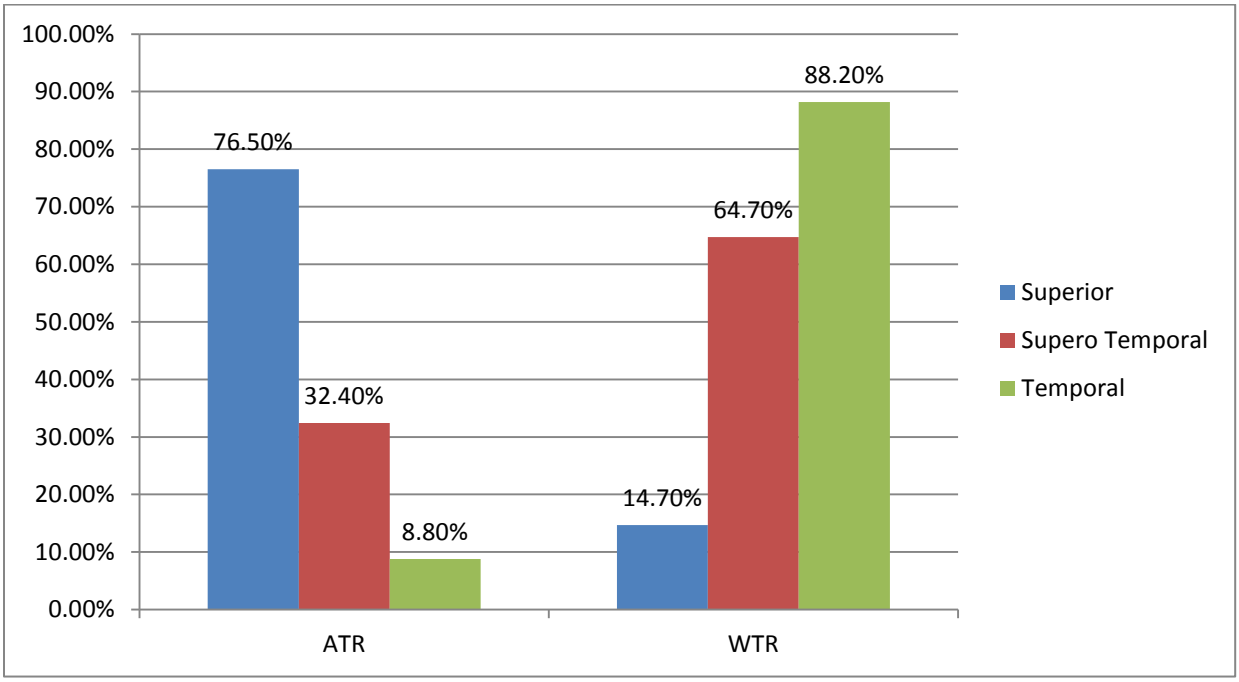
At 6th week in superior group 14.7% had WTR astigmatism, 64.7% in supero temporal group had WTR astigmatism and 88.2% in temporal group had WTR rule astigmatism. This difference in astigmatism pattern was statistically significant at 6th week.

At 12th week in superior group 14.7% had WTR astigmatism, 64.7% in supero temporal group had WTR astigmatism and 88.2% in temporal group had WTR rule astigmatism. This difference in astigmatism pattern was statistically significant at 12th week.



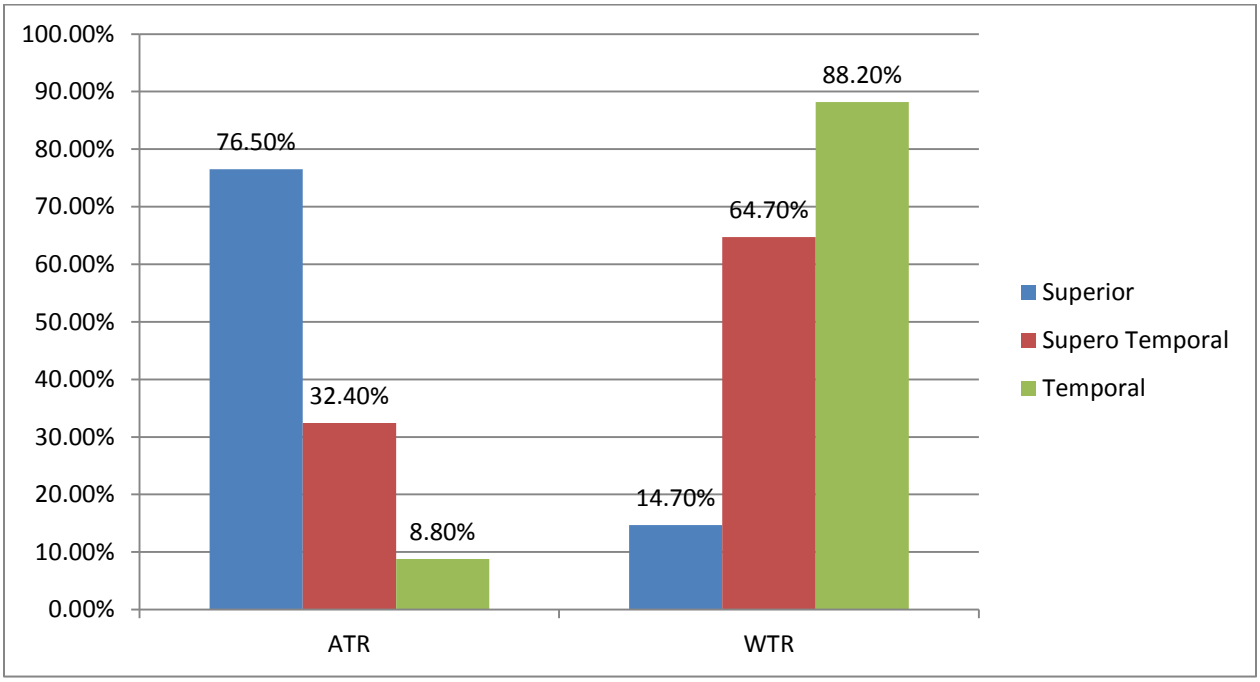
GRAPH 8: ASTIGMATISM TYPE AT 1 WEEK POST OPERATIVE PERIOD

COMPARISON BETWEEN THREE GROUPS



GRAPH 8A: ASTIGMATISM TYPE AT 6 WEEK POST OPERATIVE PERIOD

COMPARISON BETWEEN THREE GROUPS



GRAPH 8B: ASTIGMATISM TYPE AT 12 WEEK POST OPERATIVE PERIOD

COMPARISON BETWEEN THREE GROUPS

TABLE 9: VISUAL ACUITY AT PRE-OPERATIVE PERIOD BETWEEN THREE GROUPS

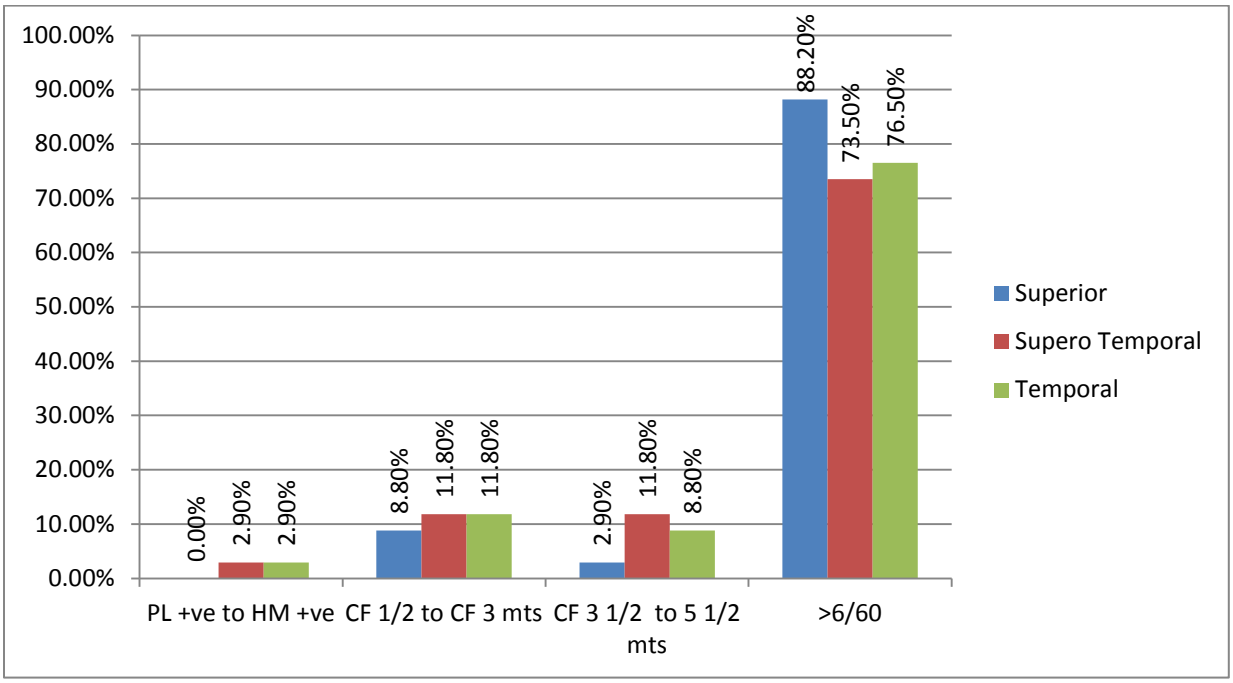
		Group					
		Superior		Supero Temporal		Temporal	
		Count	%	Count	%	Count	%
Preop VA	PL +ve to HM +ve	0	0.0%	1	2.9%	1	2.9%
	CF 1/2 to CF 3 mts	3	8.8%	4	11.8%	4	11.8%
	CF 3½ to 5½ mts	1	2.9%	4	11.8%	3	8.8%
	>6/60	30	88.2%	25	73.5%	26	76.5%
	Total	34	100.0%	34	100.0%	34	100.0%

$\chi 2 = 3.45$, df = 6, p = 0.751

In the superior group majority of subjects (88.2%) had Visual acuity of >6/60, 2.9% had Visual acuity of CF of 3 ½ to 5 ½ mts and 8.8% had CF of ½ to 3 ½ mts and none of them had PL +ve to HM +ve.

In the supero temporal group majority of subjects (73.5%) had Visual acuity of >6/60, 11.8% had Visual acuity of CF of 3 ½ to 5 ½ mtsand CF of ½ to 3 ½ mts respectively and 2.9% of them had PL +ve to HM +ve.

In the temporal group majority of subjects (76.5%) had Visual acuity of >6/60, 8.8% had Visual acuity of CF of 3 ½ to 5 ½ mts and 11.8% had CF of ½ to 3 ½ mts and 2.9% of them had PL +ve to HM +ve. There was no significant difference in Visual acuity between three groups.



GRAPH 9: VISUAL ACUITY AT PREOPERATIVE PERIOD BETWEEN THREE GROUPS

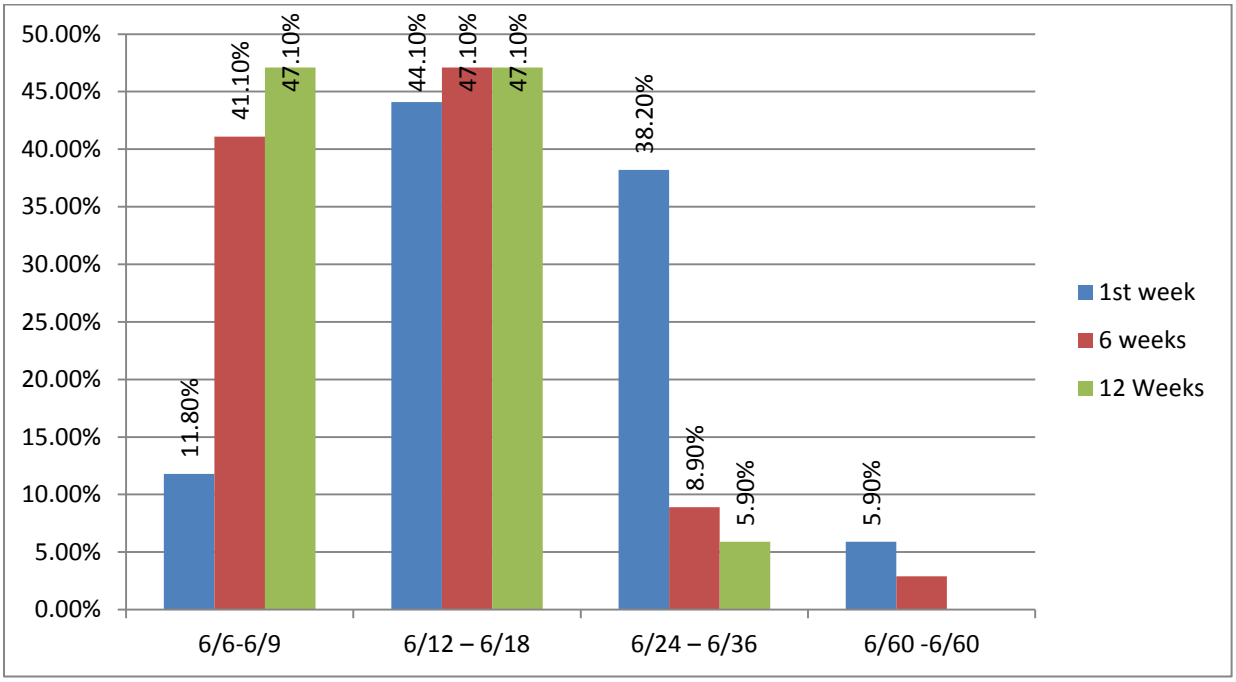
TABLE 10: COMPARISON OF POSTOPERATIVE VISUAL ACUITY IN SI, STI AND TI GROUPS

	Visual acuity	1st week		6 weeks		12 Weeks	
		Count	%	Count	%	Count	%
Superior	6/6-6/9	4	11.8%	14	41.1%	16	47.1%
	6/12 – 6/18	15	44.1%	16	47.1%	16	47.1%
	6/24 – 6/36	13	38.2%	3	8.9%	2	5.9%
	6/60	2	5.9%	1	2.9%	0	0.0%
Supero temporal	6/6-6/9	4	11.8%	19	55.9%	20	58.8%
	6/12 – 6/18	15	44.1%	11	32.3%	12	35.3%
	6/24 – 6/36	13	38.2%	4	11.8%	2	5.9%
	6/60	2	5.9%	0	0.0%	0	0.0%
Temporal	6/6-6/9	18	52.9%	23	67.6%	25	73.5%
	6/12 – 6/18	4	11.8%	8	23.5%	9	26.5%
	6/24 – 6/36	12	35.3%	3	8.9%	0	0.0%
Chi-square test		2.428		3.109		4.981	
P value		0.876		0.795		0.546	

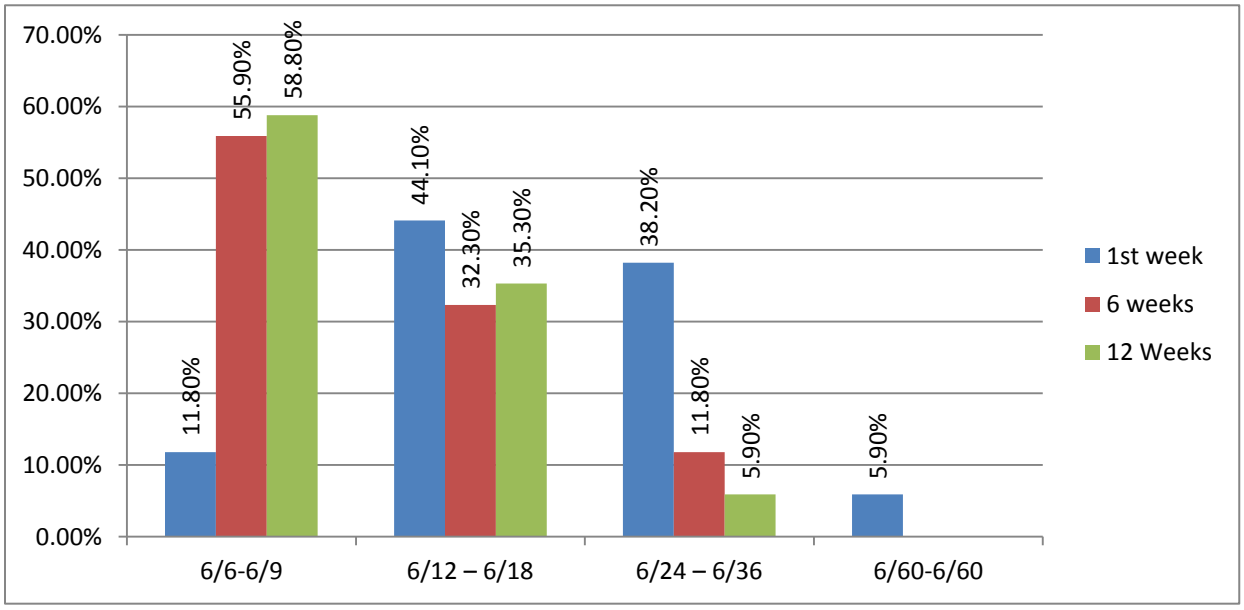
In the superior group at 1st week, 11.8% had 6/6 to 6/9 VA, 44.1% had 6/12 to 6/18 VA, 38.2% had 6/24 to 6/36 VA and 5.9% had 6/60 VA. At 6 weeks 41.1 % had 6/6 to 6/9 VA, 47.1% had 6/12 to 6/18 VA and 8.9% had 6/24 to 6/36 VA, 2.9% had 6/60 VA. At 12 weeks 47.1 % had 6/6 to 6/9 VA, 47.1% had 6/12 to 6/18 VA and 5.9% had 6/24 to 6/36 VA.

In the supero temporal group at 1st week, 11.8% had 6/6 to 6/9 VA, 44.1% had 6/12 to 6/18 VA, 38.2% had 6/24 to 6/36 VA and 5.9% had 6/60 VA. At 6 weeks 55.9 % had 6/6 to 6/9 VA, 32.3% had 6/12 to 6/18 VA and 11.8% had 6/24 to 6/36 VA. At 12 weeks 58.8 % had 6/6 to 6/9 VA, 35.3% had 6/12 to 6/18 VA and 5.9% had 6/24 to 6/36 VA.

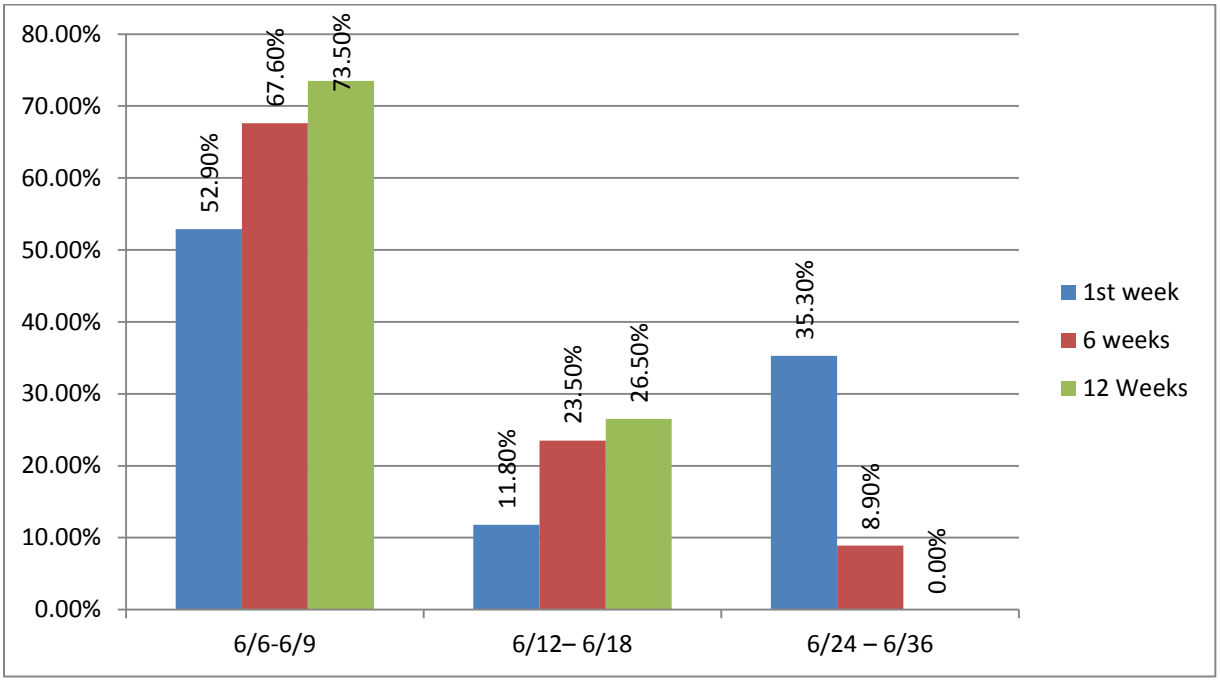
In the temporal group at 1st week, 52.9% had 6/6 to 6/9 VA, 11.8% had 6/12 to 6/18 VA and 35.3% had 6/24 to 6/36 VA. At 6 weeks 67.6 % had 6/6 to 6/9 VA, 23.5% had 6/12 to 6/18 VA, and % had 6/24 to 6/36 VA. At 12 weeks 73.5 % had 6/6 to 6/9 VA and 26.5% had 6/12 to 6/18 VA.



GRAPH 10: COMPARISON OF POST OPERATIVE VISUAL ACUITY IN SI AT DIFFERENT POST OPERATIVE PERIOD



GRAPH 10A: COMPARISON OF POST OPERATIVE VISUAL ACUITY IN STI AT DIFFERENT POST OPERATIVE PERIOD



GRAPH 10B: COMPARISON OF POST OPERATIVE VISUAL ACUITY IN TI AT DIFFERENT POST OPERATIVE PERIOD

DISCUSSION

DISCUSSION

This study was done to compare the postoperative astigmatism after manual small incision cataract surgery using superior, supero temporal and temporal incisions.

102 patients attending to outpatient department of ophthalmology, R.L.JALAPPAHOSPITAL AND RESEARCH CENTRE, attached to SRI DEVARAJ URS MEDICALCOLLEGE, TAMAKA, KOLAR with senile cataracts fulfilling the inclusion criteria framed were selected for manual small incision cataract surgery under peribulbar anaesthesia between December2014 to December 2015.The patients were divided into three groups of 34 patients each (group A- superior scleral incision, group B-superotemporal scleral incision& group C- temporal scleral incision). Detailed preoperative evaluation of ocular and systemic examination was done.

Of the total (Table 2) 102 patients selected for the study majority of the patients in both the groups were in the age range of 61-70 yrs and majority were male patients. Preoperative Snellen‟s chart visual acuity recording was done. Bausch and Lomb keratometry was done to detect the keratometric value in both horizontal and vertical

meridian. Preoperative astigmatism was calculated by scalar analysis. All patients with preoperative astigmatism <1.5D were included in the study.

The SI (Group A) consisted of 34 patients, all patients had senile immature cataract. Among 34 SI patients 12 (35.3%) had preoperative WTR astigmatism, 22(64.7%) had preoperative ATR astigmatism.

The STI (group B) consisted of 34 patients, 4(11.8%) patients among them had senile mature cataract and 30(88.2%) patients had senile immature cataract. Among 34 STI patients, 12 (35.3%) patients had preoperative WTR astigmatism, 22(64.7%) patients had preoperative ATR astigmatism.

The TI (group C) consisted of 34 patients, 3(8.9%) patients among them had senile mature cataract and 31(91.1%) patients had senile immature cataract. Among 34 STI patients, 12 (35.3%) patients had preoperative WTR astigmatism, 22(64.7%) patients had preoperative ATR astigmatism.

In the present study, preoperative astigmatism was present in 100% of patients with average astigmatism of 0.85 D in all three groups, incidence wise 35.3% shows with the rule astigmatism, 64.7% against the rule astigmatism. Average preoperative

astigmatism reported by other authors was 0.5D to 0.75 D "Duke elder (1970), 0.98 D by Kapoor (1965) and 0.64 D by Cravy (1975).[39]

After all necessary preoperative investigations patients were posted for manual small incision cataract surgery. In group A superior scleral incision was made, in group B superotemporal and in group C temporal scleral incision was made followed by manual small incision cataract surgery with PCIOL implantation.

Postoperative astigmatism was recorded by manual Baush and Lomb keratometry at postoperative 1 week, 6 weeks and 12 weeks.

In the present study, one week post-operative there was a significant difference in the amount of astigmatism between all the groups. It was observed there was significant difference in mean Astigmatism between three groups at 1 week and 12 weeks of post-operative period.

Patients with pre-existing WTR astigmatism with Superior incision had lower astigmatism at all the intervals and temporal group had higher astigmatism from 1 week till 12 weeks. Hence superior incision was better in WTR astigmatism.

Patients with pre-existing ATR astigmatism with Superior incision had higher astigmatism at all the intervals and temporal group had lower astigmatism from 1 week till 12 weeks. Hence temporal incision was better in ATR astigmatism.

One week post operatively, the patients with pre-existing ATR astigmatism in the superior group had higher mean astigmatism (1.14 ± 0.37) than the supero-temporal(1.11 ± 0.31) and temporal group (0.85 ± 0.34), the difference was statistically significant (p=0.012).

One week post operatively, the patients with pre-existing WTR astigmatism in the superior group had lower mean astigmatism (0.92 ± 0.33) than the supero-temporal(1.06 ± 0.30) and temporal group (1.10 ± 0.45), the difference was statistically significant (p=0.012).

Even after 6 weeks postoperatively, the patients with pre-existing ATR in the superior group had higher mean astigmatism (1.25 ± 0.52) than the supero-temporal (0.64 ± 0.31) and temporal group (0.45± 0.22). The difference was statistically significant (p<0.001). But in the patients with pre-existing WTR astigmatism in the superior group had lower mean astigmatism (0.42 ± 0.33) than the supero-temporal (1.15 ± 0.41) and temporal group (1.52 ± 0.40), the difference was statistically

significant (p=0.012).

However, after 12 week post operatively not much reduction was noted in any group as compared to 6th week post operatively mean astigmatism data.

In patients with pre-existing ATR astigmatism 12 week post operatively in the superior group, supero-temporal and temporal had mean astigmatism of 1.30 ± 0.53, 0.66 ± 0.32 and 0.44 ± 0.23 respectively.

In patients with pre-existing WTR astigmatism 12 week post operatively in the superior group, supero-temporal and temporal had mean astigmatism of 0.38 ± 0.31, 1.17 ± 0.49, 1.52 ± 0.39 respectively. This shows that most of astigmatic stabilization occurred by 12th week.

Post operatively, at the end of 12 week in a SI group majority of the patients 26(76.5%) had ATR astigmatism and only 8(14.7%) of the patients had WTR astigmatism, this is because incision on the vertical meridian causes flattening of the vertical meridian and steepening of the horizontal meridian leading to ATR shift. In STI and TI group majority of the patients had WTR astigmatism as the incision on the horizontal meridian causes flattening in that meridian and steepening along the

vertical meridian leading to WTR shift. The temporal incision has a neutralizing effect on preoperative ATR astigmatism which is advantageous because most elderly cataract patients have preoperative ATR astigmatism.

In a study done by **Gade SP, Khaire BS** concluded that Temporal and superotemporal incision leads to significantly less amount of mean post-operative astigmatism as compared to superior incision.[40] In our study we also observed that mean postoperative astigmatism is more in superior incision as compared to Superotemporal and temporal incision.

In a study done by **Pawar VS, Sindal DK** showed that mean postoperative astigmatism (vector analysis, keratometry) was 1.572 ± 0.651,0.532± 0.317and 0.435 ±0.338 in the superior, superotemporal and temporal scleral incision, respectively. They concluded that SICS with the superior-temporal and the temporal approaches provides a better quality of vision due to the significantly less SIA than the superior approach.[41]This is comparable with present study.

A study performed by **Magdum RM, Gahlot A, Maheshgauri A, Patel K** observed that superior incision causes more ATR shift than the WTR, as the

incision on the superior meridian causes flattening of the vertical meridian and steepening of the horizontal meridian leading to more ATR shift post operatively, where as in temporal incision the shift of astigmatism was more towards WTR (56%) though pre operatively only 34% has WTR and flattening of horizontal meridian and steepening of the vertical meridian leading to more WTR shift. This is advantageous as most of the patients in older age will have ATR.[42]In our study also we found that superior incision causes more ATR shift than the WTR.

In a study done by **Vinay KV, Sudheendra AN, Vishal K, Beena DN** evaluated the incidence of post-operative against the rule (ATR) astigmatism increased from 48.9 % to 72 % i.e., by 24 % in superior incision group. In the super temporal incision it increased from 30.2 % to 45 % i.e., by 14.8 %. The incidence of post-operative with the rule (WTR) astigmatism decreased in superior incision group by 21.8 %, whereas in super temporal incision group it decreased by 13.1 %.[43]

In a study done by **Bhavani MV, Naidu KL, Satish AV** showed that the decay of astigmatism from third to sixth week in temporal scleral incision was negligible (0.068 D) implying early wound stabilization. Temporal scleral incision is more advantageous than superior scleral incision in astigmatically neutral patients, patients with 'Against the rule' astigmatism, patients with 'with the rule' astigmatism up to or

< 1D and superior scleral incision is preferred only if ‘with the rule’ astigmatism is> 1D.[44]But in our study we found complete stabilization of wound by 6thweek.

In a study done by **Kavitha KNS, Kishore AK, Reddy GS, Jehan K** showed that ATR is more common type of astigmatism than WTR and astigmatically neutral cases in older age group and placement of incision on steep axis reduces pre-existing astigmatism.[45]

In a study done by **Rashid MA, Hossain KA, Islam AKMR, Uddin Z** observed that "against the rule drift" is present more markedly in SICS patients with superior tunnel approach than that of temporal tunnel due to eyelid pressure emphasizes the "against the rule shift" with a 12 o' clock incision in the elderly population.[46]

Postoperative uncorrected visual acuity was recorded using Snellen's chart at 1 week, 6 weeks and 12 weeks.

In the present study, visual acuity after 1 week was almost similar in all the three groups, this could be attributed to corneal oedema or anterior segment reaction.

After 6 weeks, the SI group had visual acuity in the range of 6/6 to 6/9 in 14 (41.1%) patients, where as in STI group 19 (55.9%) patients and TI group 23 (67.6%) patients had visual acuity in the range of 6/6 to 6/9.

After 12 week 16(47.1%) of the patients in SI group and 20(58.8%) of the patients in supero-temporal group had visual acuity in the range of 6/6 to 6/9, where as in temporal incision group 25 (73.5%) patients had visual acuity 6/6 to 6/9 (x^2 – 4.981, $p<0.01$). The results of this study are consistent with previous reports that, temporal incision induces small amount of WTR astigmatism and gives early visual rehabilitation to the patients.

In a study done by **Gade SP, Khaire BS** showed that uncorrected visual acuity was better in the temporal incision group as compared to the superior

incision group.[4]This study is in comparable with our study as we also recorded uncorrected visual acuity better in the temporal incision group as compared to other superior or Superotemporal group.

In temporal incision, minimal WTR astigmatism and early rehabilitation of visual recovery could be due to the fact that temporal allocation is farther from the visual axis than superior location and any flattering due to wound is less likely to affect the corneal curvature at the visual axis. When the incision is located superiorly, both gravity and eyelid blink tend to create a drag on the incision. These factors are neutralized well with temporally placed incision because the incision is parallel to the vector of forces.

CONCLUSION

CONCLUSION

Post-operative astigmatism is a very common sequel of cataract surgery. In suture less small incision cataract surgeries, superior scleral incision causes against the rule (ATR) astigmatism and in supero-temporal and temporal scleral incision cause with the rule astigmatism(WTR).

Our results clearly suggest that suture less temporal scleral incision produce less post-operative astigmatism ($p<0.5$). The degree of change induced by supero-temporal and temporal incision compares favourably with published data.

Our results support the claim that a superior incision induces higher magnitude ATR astigmatism, while the temporal incision induces lower magnitude WTR astigmatism. This surgically induced astigmatic change might be compounded over time by ATR change that may people develop with older age.

In sutureless small incision cataract surgeries, incisions can be placed either superiorly or super-temporally or temporally depending upon pre-operative keratometric astigmatism to lessen the surgically induced astigmatism.

Due to change in the functional angle, temporal approach may require little practice, if one considers the preoperative astigmatism when selecting the incision type and location for MSICS, one can minimize post-operative keratometric surgically induced astigmatism. This is the incision of choice in all cases that have undergone previous surgery from 12 o' clock position.

A simple modification in incision placement produces comparable results to other sophisticated procedures and hence offers a way to attain better surgical outcome with limited resources available in most of the setups.

Our study supports that visual rehabilitation is early and better uncorrected visual acuity in the temporal scleral incision. No Significant statistical difference was found in postoperative astigmatism and visual acuity after a 6 weeks follow up period in between the three groups.

SUMMARY

SUMMARY

This study was done to compare the postoperative astigmatism in superior, supero temporal and temporal scleral incision in MSICS.

One hundred two patients attending to outpatient department of ophthalmology, R.L. JALAPPA HOSPITAL AND RESEARCH CENTRE attached to SRI DEVARAJ URS MEDICAL COLLEGE, TAMAKA, KOLAR with senile cataract fulfilling the inclusion criteria framed were selected for manual small incision cataract surgery with PCIOL under peribulbar anaesthesia between December 2014 to December 2015.

The patients were divided in to three groups of 34 patients each (group A-superior incision, group B-superotemporal and group C-temporal incision). After detailed preoperative evaluation, manual small incision cataract surgery with PCIOL was performed.

Visual acuity unaided and Keratometer readings were recorded in each patient postoperatively on first week, six week and twelve week.

Pre and postoperative astigmatism was evaluated by manual Bausch and Lomb Keratometer readings. Statistical analysis was applied to compare the effects of visual recovery and postoperative astigmatism.

In the present study, 76.5% of the patients in SI Group had ATR astigmatism and 14.7% of the patients had WTR astigmatism, STI group 64.7% of the patients had WTR astigmatism and 32.4% had ATR astigmatism, whereas in TI group 88.2% of the patients had WTR astigmatism and 8.8% had ATR astigmatism, post operatively after 12 weeks.

In the present study at the end of 12 weeks, among SI group 16(47.1%) of the patients had visual acuity 6/6 to 6/9, where as in STI group 20(58.8%) and TI group 25(73.5%) of the patients had visual acuity 6/6 to 6/9 (x^2 =11.37, $p<0.01$).

A temporal incision is advantageous because it can be made easily in deep sockets and small eyes. The "against the rule drift" is present more markedly in SICS patients with superior tunnel approach than that of temporal tunnel due to eyelid pressure emphasizes the "against the rule shift" with a 12 o' clock incision in the elderly population.

We found that visual rehabilitation is early and better uncorrected visual acuity in the temporal scleral incision.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Avachat SS, Phalke V, Kambale S. Epidemiological correlates of cataract cases in Tertiary care centre in rural area of Maharashtra. J Family Med Prim Care 2014;3:45-7.
2. Chalarton J F, Weinstein G W. Cataract Surgery, Duane's Ophthalmology. Philadelphia, Pennsylvania: Lippincott-Raven Publishers;1997.
3. Shamanna R, Kumar P, Sarwanan S. Role and responsibilities in the secondary level eye model. Community Eye Helth J 2005; 18:118–20.
4. Gogate PM, Kulkarni SR, Krishnaiah S, Deshpande RD, Joshi SA, Palimkar A, et al. Safety and efficacy of phacoemulsification compared with manual small incision cataract surgery by a randomized controlled clinical trial: Six weeks results. Ophthalmology 2005;112:869–74.
5. Kohnen T, Koch DD. Methods to control astigmatism in cataract surgery. Curr Opin Ophthalmol 1996;7(1):75–80.
6. Morlet N, Minassian D, Dart J. Astigmatism and the analysis of its surgical correction. Br J Ophthalmol 2001;85:1127–1138.

7. Rashid MA, Hossain KA, Islam AKMR, Uddin Z. Comparative study of post-operative astigmatism following small incision cataract surgery-Sics in superior, supero-temporal and temporal Incision. Medicine Today 2013;25:72-4.
8. Ascaso FJ, Huerva V. The history of cataract surgery. Cataract surgery 2009;9:75-90
9. Levene JR. The true inventors of the Keratoscope and Photo-Keratoscope. British journal for the history of science 2009;2:324-42.
10. Barraquer J, Bobergans J. Cataract surgery. Brit. J Ophthal1959;43:69-77.
11. Arruga's Ocular surgery: Mcgraw Hill Book Co.1962:4:109-15.
12. Haldipurkar SS, Shikari HT, Gokhale V. Wound construction in manual small incision cataract surgery. Indian J Ophthalmol 2009;57(1):9-13.
13. Zegans ME, Kidd CMT, Gilmore MS. Bacterial endophthalmitis following cataract surgery.2008:193-94.
14. Jaffe NS, Jaffe MS, Jaffe GF. Intraocular lens in cataract surgery and its complications. 6th Edition. St Louis Missouri: Mosby 1997:147-99.
15. Ridley HA. Implantation of PMMA intraocular lens in human cataract therapy. In OphthSurg, Speath and Kratz 135.
16. Kelman CD. Phacoemulsification and Aspiration, A new technique of cataract removal: A preliminary report. Am J Ophthalmol 1967;64:23-35.

17. Colvard DM, Kratz RP, Mazzocco TR, Davidson B. Clinical evaluation of the Terry surgical keratometer. *J Am Intraocul Implant Soc.* 1980;6(3):249–251.

18. Girard LJ, Jorge R, Mary LM. Reducing surgically induced astigmatism by using scleral tunnel. Am J Ophthalmol1984;97:450-6.

19. Shepard JR. Induced astigmatism in cataract surgery. J Cataract Refract Surg 1989;15:85-8.

20. Cravy TV. Routine use of lateral approach to the cataract extraction to achieve rapid and sustained stabilization of postoperative astigmatism. J Cataract Refract Surg 1991;17(4):415-23.

21. Blumenthal M, Ashkenazi I, Fogel R, Assia EL. The gliding nucleus. J Cataract Refract Surg 1993; 19:435-7.

22. Merriam JC, Zheng L, Urbanowicz J, Zaider M. Change on the horizontal and vertical meridians of the cornea after cataract surgery. Tr Am Ophth Soc 2001;99:187-197.

23. Snell R S, Lemp M A. Clinical anatomy of the eye. 2nd ed. Boston: Blackwell Science Inc.;1998;P.197-204.

24. Bron AJ, Tripathi RC, Tripathi BJ. London: Wolff‟s Chapman and Hall; 1997:P. 411-442.

25. Albert DM, Henkind P. Men of Vision. Lives of Notable Figures in Ophthalmology. WB Saunders; 1993.
26. Bron A J and Triphati, Cornea and sclera, In: Wolff's Anatomy of the Eye and Orbit. 8th Edition. London: Chapman and Hall; 1997.233-78.
27. Jaffe NS, Jaffe MS, Jaffe F. Anaesthesia, wound healing, sutures and needles in cataract surgery and its complications. 6th Edition. St Louis Missouri: Mosby;1997:18-47.
28. Abrama D.Duke-Elder's Practice of Refraction.10th ed. Elsevier Science;2002.p.65-70.
29. Maltzman BA, Cinotti DJ, Horan CA, Rengel AM. Posterior chamber implants and postoperative refractive astigmatism. CLAO J 1983;9:229-31.
30. Elkington AR. Clinical Optics. Measurement of corneal curvature.3rd ed. Blackwell Science Ltd;1999.p.187-94.
31. Kaul S, Billore OP, Goel S, Damania K. Pattern of topography and length of incision. All India Ophth Conf;2005.
32. Talamo JH, Stark WJ, Gottsch JD. Natural history of corneal astigmatism after cataract surgery. J Cataract Refractive Surg 1991;17:313-18.

33. Abrams D. Astigmatism, Duke-Elder's: Practice of Refraction.10th Edition. Delhi: Churchill Livingstone; reprinted 1998.p.65-70.
34. Yanoff M, Duker J. The Lens; Basic science of the lens, Ophthalmology. London: Mosby; 1998.
35. Yanoff M, Duker J. The Lens; Lens surgery, Ophthalmology. London: Mosby; 1998.
36. Watson A, Sunderraj P. Comparison of small-incision phacoemulsification with standard extracapsular cataract extraction surgery: postoperative astigmatism and visual recovery. Eye 1992;6.
37. American Academy of Ophth, Basic and clinical science course, Section 11, Lens and cataract .San Francisco: American Academy of Ophthalmology; 2005:89-162.
38. Masket S. Correlation between intraoperative and early postoperative keratometry. J Cataract Refractive Surg 2008;13:277-80.
39. Holladay JT, Cravy TV, Koch D. Calculating the surgically induced refractive changes following ocular surgery. J Cataract Refract Surg 1992;18:429-43.
40. Gade SP, Khaire BS. Comparison of surgically induced astigmatism (SIA) and postoperative astigmatism with superior, superotemporal and temporal incisions in phacoemulsification surgery. International Journal of Recent Trends in Science And Technology 2014;12(3):517-521.

41. Pawar VS, Sindal DK. Comparative Study on the Superior, Supero-Temporal and the Temporal Incisions in Small Incision Cataract Surgeries for PostOperative Astigmatism. JCDR 2012;6:1229-32.

42. Magdum RM, Gahlot A, Maheshgauri A, Patel K. A comparative study of surgically induced astigmatism in superior and temporal scleral incision in manual small incision cataract surgery.National journal of medical research 2012;2:497-500.

43. Vinay KV, Sudheendra AN, Vishal K, Beena DN. A study on surgically induced astigmatism following small incision cataract surgery. Ind J Fund Appl Life Sci.2012;2:147-52.

44. Bhavani MV, Naidu KL, Satish AV. Comparative study on corneal astigmatism induced by superior versus temporal incision in small incision cataract surgery. IJSRM 2015;3(3):2401-04.

45. Kavitha KNS, Kishore AK, Reddy GS, Jehan K. Comparative study of surgically induced astigmatism in superior versus temporal incision in small incision cataract surgery cases. Int J Res Med Sci 2015;3(11):3027-31.

46. Rashid MA, Hossain KA, Islam AKMR, Uddin Z. Comparative study of postoperative astigmatism following small incision cataract surgery-SICS in superior, supero-temporal and temporal incision. Med today 2013;25:72-74.

ANNEXURE

ANNEXURE: I

PROFORMA

"COMPARISON OF POST OPERATIVE ASTIGMATISM AFTER MANUAL SMALL INCISION CATARACT SURGERY USING SUPERIOR, SUPERO TEMPORAL AND TEMPORAL INCISIONS"

NAME: I.P. NO.:

AGE: O.P. NO.

SEX: DATE OF ADMISSION:

ADDRESS: DATE OF SURGERY:

DATE OF DISCHARGE:

FINAL DIAGNOSIS:

PRESENTING COMPLAINTS:

HISTORY OF PRESENTING COMPLAINTS:

PAST HISTORY:

FAMILY HISTORY:

PERSONAL HISTORY:

GENERAL PHYSICAL EXAMINATION:

SYSTEMIC EXAMINATION:

OCULAR EXAMINATION:

HEAD POSTURE

OCULAR POSTURE

FACIAL SYMMETRY

OD: OS:

- VISION

  UNCORRECTED

  PINHOLE

  CORRECTED

- EXTRA OCULAR MOVEMENTS:
- LIDS AND ADNEXA:

- CONJUNCTIVA:
- CORNEA:
- ANTERIOR CHAMBER:
- IRIS:
- PUPIL:

    SIZE

    SHAPE

    REACTION

- LENS:
- INTRA OCULAR PRESSURE (APPLANATION TONOMETRY):
- DIRECT OPHTHALMOSCOPY:
- INDIRECT OPHTHALMOSCOPY:
- KERATOMETRY(MANUAL BAUSCH AND LOMB)

    K1:

    K2:

- AXIAL LENGTH
- INTRA OCULAR LENS POWER:
- PREOPERATIVE ASTIGMATISM:

- LACRIMAL SYRINGING:
- LAB INVESTIGATIONS-URINE: ALBUMIN, SUGAR AND MICROSCOPY.
- TYPE OF ANAESTHESIA:
- SITE OF INCISION(SUPERIOR,SUPEROTEMPORAL,TEMPORAL):

INTRAOPERATIVE COMPLICATIONS:

FOLLOW UP:

POST-OPERATIVE	VA	K1	K2	ASTIGMATISM
IST WEEK				
6th WEEK				
12th WEEK				

ANNEXURE: II

INFORMED CONSENT FORM

"COMPARISON OF POST OPERATIVE ASTIGMATISM AFTERMANUAL SMALL INCISION CATARACT SURGERY USINGSUPERIOR, SUPERO TEMPORAL AND TEMPORAL INCISIONS"

Surgically induced astigmatism (SIA) is one of the important factors that hampers post-operative visual outcome. Thus control of post-operative astigmatism is a key factor in meeting patient's expectations. Recent progress in cataract surgical technique has high lightened patient's expectation of visual outcome, good post-operative vision without spectacles considered normal. Manual small incision cataract surgery is a simple and versatile technique which unlike phacoemulsification can be universally applied nearly in all types of cataract. The location and width of incision will determine the amount of surgically induced astigmatism in manual small incision cataract surgery.

To prevent these complications we can use below methods:

1. Superior incision
2. Supero temporal incision
3. Temporal incision

If you agree to participate in the study we will examine you for anterior segment and fundal changes .we will collect the treatment and relevant details about you from your hospital record. The information collected will be used only for research. This study will be reviewed by local ethical review board and will be started only after their formal approval. The care you will get will not change if you don't wish to participate. You are required to sign/provide thumb impression only if you voluntarily agree to participate in this study. Participation in this study does not involve any cost for you. If any complication happens during above technique it will be treated free of cost. This also does not affect the care that you receive in the hospital.

I have read or have been read to me and understand the purpose of the study, the procedure that will be used, the risk and benefits associated with my involvement in the study and the nature of information that will be collected and disclosed during the study. I have had the opportunity to ask my questions regarding various aspects of the study and my questions are answered to my satisfaction. I the undersigned agree to participate in this study and authorize the collection and disclosure of my personal information for my research

Subject's name and signature /thumb impression Date:

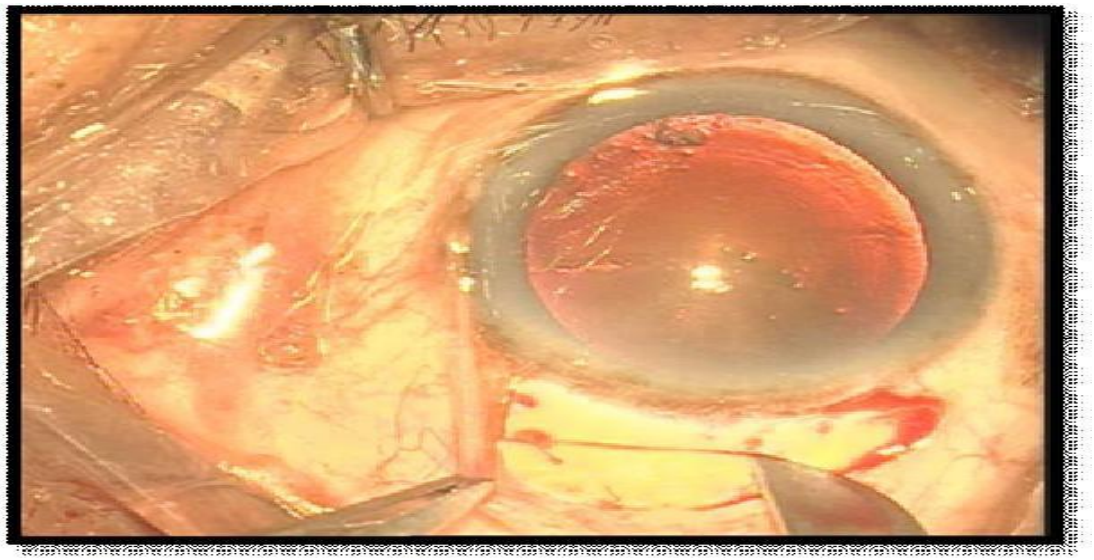
Name and signature of witness/thumb impression Date:

Name and signature of person obtaining consent Date:

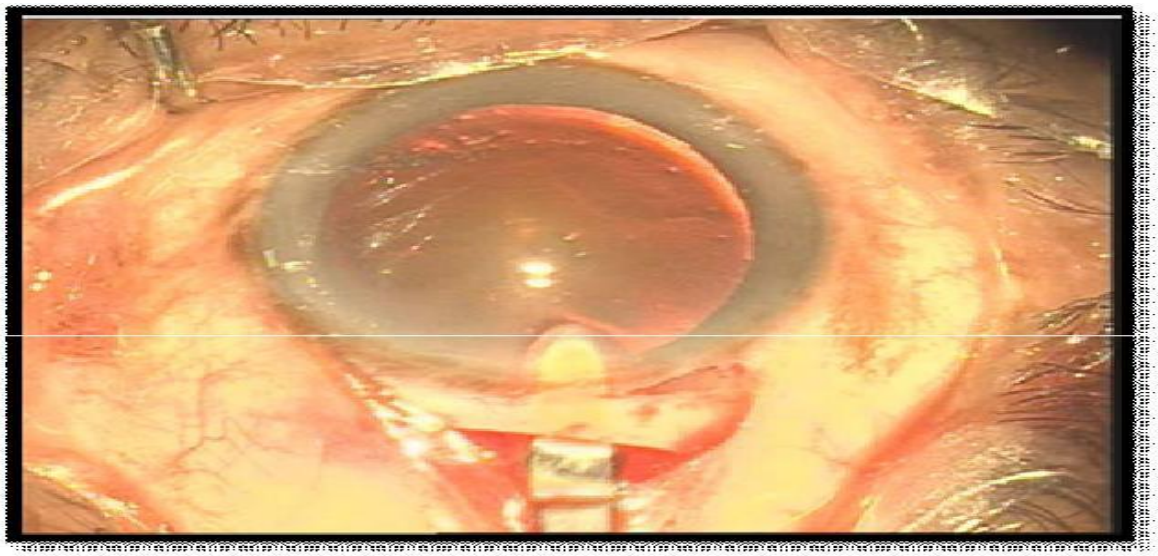
ANNEXURE III

PHOTOGRAPHS

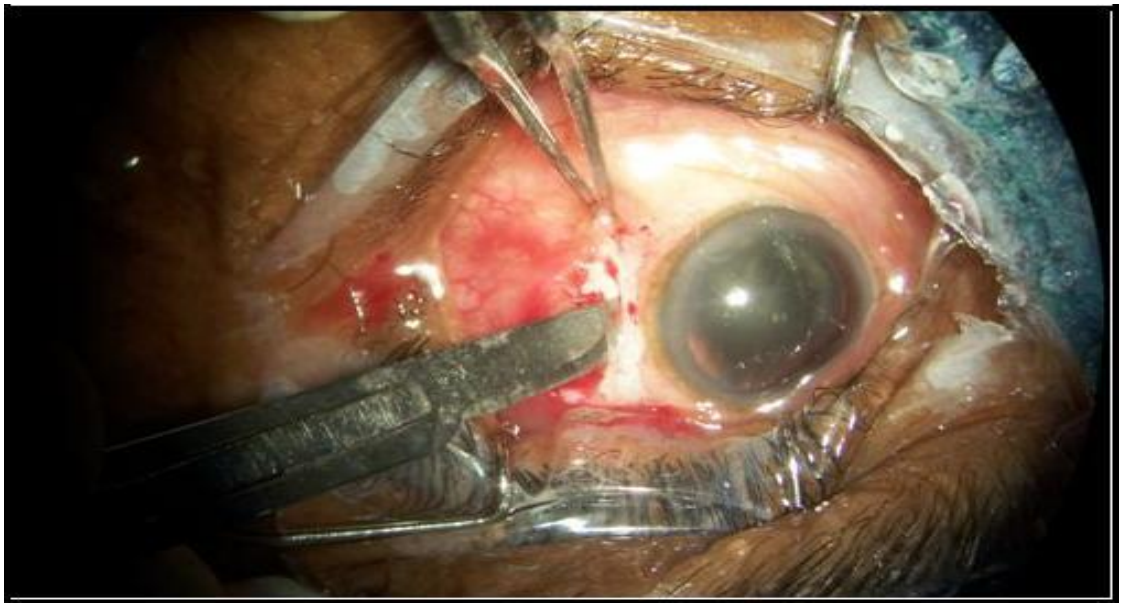
PHOTOGRAPH 1: SLIT LAMP EXAMINATION



PHOTOGRAPH 2: SUPERIOR SCLERAL INCISION

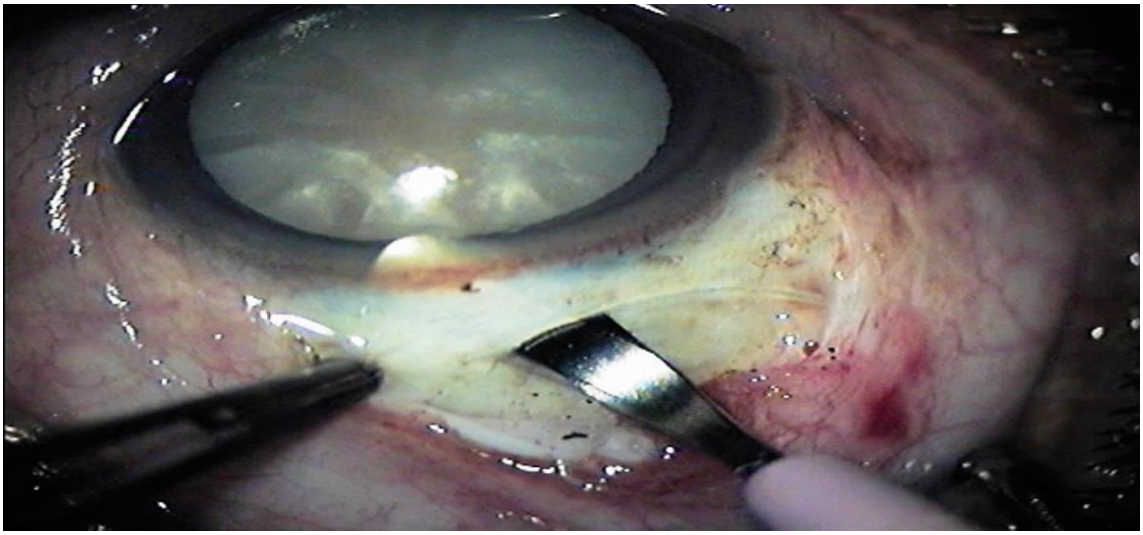


PHOTOGRAPH 3: SCLERO CORNEAL TUNNEL



PHOTOGRAPH 4: TEMPORAL INCISION

PHOTOGRAPH 5: SUPEROTEMPORAL INCISION



ANNEXURE IV

KEY TO MASTER CHART

Sl. No.: Serial number

IP.No.: Hospital number

RE : Right eye

LE : Left eye

SIMC = SENILE IMMATUR CATARACT

SMC= SENILE MATURE CATARACT

VA= VISUAL ACUITY

K1 = KERATOMETRY READING IN VERTICAL MERIDIAN

K2 = KERATOMETRY READING IN HORIZONTAL MERIDIAN

ATR = AGAINST THE RULE ASTIGMATISM (WHEN HORIZONTAL MERIDIAN IS MORE STEEPER THAN VERTICAL MERIDIAN)

WTR = WITH THE RULE ASTIGMATISM (WHEN VERTICAL MERIDIAN IS MORE STEEPER THAN HORIZONTAL MERIDIAN)

NA= NO ASTIGMATISM

GROUP 1= SUPERIOR INCISION

GROUP 2= SUPERO-TEMPORAL INCISION

GROUP 3= TEMPORAL INCISION

CF= COUNTING FINTERS

HM= HAND MOVEMENT

PL= PRECEPTION OF LIGHT

M=METRES

WK=WEEKS

MASTER CHART

S.No.	HOS.NO.	AGE	SEX	DIAGNOSIS	SURGERY	PRE OP DATA					POST OP VISUAL ACUITY			POST OP DATA										GROUP
						PRE OP VA	K1	K2	ASTIGMATISM		1WK	6WK	12WK	1 WK			6 WK			12 WK				
									AMOUNT	TYPE				K1	K2	ASTIGMATISM	K1	K2	ASTIGMATISM	K1	K2	ASTIGMATISM	
1	810553	61	M	SIMC(RE)	MSICS(RE)	6/60	43	42	1	WTR	6/36	6/24	6/12	43	42	1 WTR	42.5	42	0.5 WTR	42.25	42	0.25 WTR		1
2	821169	71	M	SIMC(LE)	MSICS(LE)	6/18	43.75	43	0.75	WTR	6/18	6/18	6/12	43	44.75	1 ATR	43	44	1 ATR	43	44	1 ATR		1
3	828818	63	F	SIMC(LE)	MSICS(LE)	6/18	44	45	1	ATR	6/12	6/12	6/9	44	45.5	1.5 ATR	44	45	1 ATR	44	45	1 ATR		1
4	828814	67	M	SIMC(RE)	MSICS(RE)	6/18	43	44.5	1.5	ATR	6/18	6/9	6/9	43	44.5	1.5 ATR	42.25	43.25	1 ATR	42.25	43.25	1 ATR		1
5	838012	68	M	SIMC(LE)	MSICS(LE)	6/24	42.75	44	1.25	ATR	6/18	6/18	6/12	42.75	44.25	1.5 ATR	44.25	46	1.75 ATR	44.25	46	1.75 ATR		1
6	838829	65	F	SIMC(LE)	MSICS(LE)	6/24	41.5	40.5	1	WTR	6/24	6/18	6/12	41.5	41	0.5 WTR	41	41	0 NA	41	41	0 NA		1
7	850551	52	M	SIMC(RE)	MSICS(RE)	6/60	40.5	42	1.5	ATR	6/18	6/18	6/9	40.5	42.25	1.75 ATR	40	42	2 ATR	40	42	2 ATR		1
8	851600	72	F	SIMC(LE)	MSICS(LE)	6/60	44.5	45	0.5	ATR	6/60	6/36	6/18	44.5	45	0.5 ATR	42.5	43	0.5 ATR	42.5	43	0.5 ATR		1
9	854686	69	M	SIMC(RE)	MSICS(RE)	6/36	44	42.5	1.5	WTR	6/12	6/12	6/12	44	42.75	1.25 WTR	42	42.5	0.5 ATR	42	42.5	0.5 ATR		1
10	868228	66	M	SIMC(LE)	MSICS(LE)	6/60	44.75	43.5	0.75	WTR	6/18	6/12	6/9	44.75	43.5	0.75 WTR	44.75	44	0.75 WTR	44.75	44.25	0.5 WTR		1
11	916954	53	F	SIMC(RE)	MSICS(RE)	6/24	44	45	1	ATR	6/24	6/24	6/12	44	45	1 ATR	42.5	43.75	1.25 ATR	42.25	43.75	1.5 ATR		1
12	920213	70	F	SIMC(LE)	MSICS(LE)	6/60	43	44.5	1.5	ATR	6/36	6/36	6/18	43	44.5	1.5 ATR	43	45	2 ATR	43	45	2 ATR		1
13	926166	64	F	SIMC(LE)	MSICS(LE)	6/24	42.75	44	1.25	ATR	6/18	6/18	6/18	42.75	44	1.25 ATR	42.75	43	0.25 ATR	42.75	43	0.25 ATR		1
14	928229	54	M	SIMC(LE)	MSICS(LE)	CF AT 5m	43.25	42	1.25	WTR	6/24	6/24	6/9	43.25	44.5	1.25 WTR	44.5	44	0.5 WTR	44.5	44	0.5 WTR		1
15	782740	73	F	SIMC(RE)	MSICS(RE)	6/60	45.5	46	0.5	ATR	6/36	6/24	6/24	45.5	46	0.5 ATR	44	45.5	1.5 ATR	44	45.5	1.5 ATR		1
16	782741	70	M	SIMC(LE)	MSICS(LE)	6/24	45	43.5	1.5	WTR	6/18	6/9	6/9	45	46.5	1.5 ATR	45	45.5	0.5 ATR	45	45.5	0.5 ATR		1
17	782742	74	F	SIMC(LE)	MSICS(LE)	CF AT 3m	41	42	1	ATR	6/24	6/18	6/9	41	42	1 ATR	42	42.5	0.5 ATR	42	42.5	0.5 ATR		1
18	782745	70	F	SIMC(LE)	MSICS(LE)	CF AT 3m	42.75	42	0.75	WTR	6/18	6/18	6/18	42.75	42	0.75 WTR	44	44.25	0.25 ATR	44	44.25	0.25 ATR		1
19	782746	62	F	SIMC(RE)	MSICS(RE)	6/24	42.25	43	0.75	ATR	6/9	6/9	6/9	42.25	43	0.75 ATR	42.25	43	0.75 ATR	42.25	43	0.75 ATR		1
20	782752	55	M	SIMC(LE)	MSICS(LE)	6/24	44	45	1	ATR	6/24	6/24	6/12	44	45	1 ATR	41.5	43	1.5 ATR	41.5	43	1.5 ATR		1
21	31591	61	M	SMC(RE)	MSICS(RE)	CFAT 1M	43	44.5	1.5	ATR	6/60	6/18	6/9	43	44.5	1.5 ATR	43	45	2 ATR	42.75	45	2.25 ATR		1
22	31586	71	M	SIMC(LE)	MSICS(LE)	6/60	42.75	44	1.25	ATR	6/24	6/24	6/24	42.75	44	1.25 ATR	42	43	1 ATR	42	43	1 ATR		1
23	31588	63	F	SIMC(LE)	MSICS(LE)	6/18	41.5	40.75	0.75	WTR	6/18	6/18	6/9	41.5	41	0.5 WTR	42.75	42.75	0 NA	42.75	42.75	0 NA		1
24	31596	67	M	SIMC(RE)	MSICS(RE)	6/18	44	45	1	ATR	6/18	6/18	6/12	44	45	1 ATR	42.5	44	1.5 ATR	42.5	44	1.5 ATR		1
25	31584	68	M	SIMC(LE)	MSICS(LE)	6/18	41	42.25	1.25	ATR	6/9	6/9	6/9	41	42.25	1.25 ATR	42.25	43	0.75 ATR	42.25	43.25	1 ATR		1
26	53826	65	F	SIMC(LE)	MSICS(LE)	6/24	42	42.75	0.75	ATR	6/9	6/9	6/9	42	42.75	0.75 ATR	41.75	42.75	1 ATR	41.75	42.75	1 ATR		1
27	53804	52	M	SIMC(RE)	MSICS(RE)	6/24	42.25	41.25	1	WTR	6/24	6/24	6/9	42.25	41.75	0.5 WTR	42	42	0 NA	42	42	0 NA		1
28	53824	72	F	SIMC(RE)	MSICS(RE)	6/60	45	44	1	WTR	6/24	6/9	6/9	45	44	1 WTR	41.75	41.5	0.25 WTR	41.75	41.5	0.25 WTR		1
29	53805	69	M	SIMC(RE)	MSICS(RE)	6/60	44	45	1	ATR	6/18	6/18	6/12	44	44.5	0.5 ATR	41.25	43	1.75 ATR	41.25	43	1.75 ATR		1
30	53799	66	M	SIMC(LE)	MSICS(LE)	6/36	43	44.5	1.5	ATR	6/36	6/36	6/18	43	44.5	1.5 ATR	41.25	43	1.75 ATR	41.25	43	1.75 ATR		1
31	58825	53	F	SIMC(RE)	MSICS(RE)	6/60	42.75	44	1.25	ATR	6/36	6/9	6/9	42.75	44	1.25 ATR	42.75	44.5	1.5 ATR	42.75	44.5	1.5 ATR		1
32	53811	70	F	SIMC(LE)	MSICS(LE)	6/24	43.5	42	1.5	WTR	6/18	6/18	6/12	43.5	42.5	1 WTR	43	42.75	0.75 WTR	43	42.75	0.75 WTR		1
33	53820	64	F	SIMC(RE)	MSICS(RE)	6/60	42.5	43.5	1	ATR	6/18	6/18	6/12	42.5	43.5	1 ATR	42.75	44	1.25 ATR	42.75	44.25	1.5 ATR		1
34	53817	54	M	SIMC(LE)	MSICS(LE)	6/24	41	42.25	1.25	ATR	6/9	6/9	6/9	41	42.25	1.25 ATR	41	42	1 ATR	41	42	1 ATR		1
35	53818	73	F	SIMC(RE)	MSICS(RE)	CF AT 5m	43	42	1	WTR	6/36	6/18	6/12	42	43	1 ATR	43	41.5	1.5 WTR	43	41.5	1.5 WTR		2
36	53812	70	M	SIMC(LE)	MSICS(LE)	6/60	43.75	43	0.75	WTR	6/18	6/9	6/9	43.75	43	0.75 WTR	42	41.75	0.75 WTR	42	41.75	0.75 WTR		2
37	53816	74	F	SIMC(LE)	MSICS(LE)	6/24	44	45	1	ATR	6/12	6/12	6/6	44	45	1 ATR	42	42.5	0.5 ATR	42	42.5	0.5 ATR		2
38	53810	70	F	SIMC(RE)	MSICS(RE)	CF AT 3m	43	44.5	1.5	ATR	6/18	6/9	6/9	43	41.5	1.5 WTR	43	42.25	0.75 WTR	43	42.25	0.75 WTR		2
39	53815	62	F	SIMC(LE)	MSICS(LE)	CF AT 3m	42.75	44	1.25	ATR	6/18	6/18	6/9	42.75	41.5	1.25 WTR	43	42.25	0.75 WTR	43	42.25	0.75 WTR		2
40	53823	55	M	SIMC(LE)	MSICS(LE)	6/24	41.5	40.5	1	WTR	6/24	6/18	6/12	41.5	40.5	1 WTR	45	43.75	1.25 WTR	44.25	43.75	1.5 WTR		2
41	53819	70	F	SIMC(RE)	MSICS(RE)	6/24	40.5	42	1.5	ATR	6/18	6/9	6/9	40.5	42	1.5 ATR	45	45.75	0.75 ATR	45	45.75	0.75 ATR		2
42	52874	69	F	SMC(LE)	MSICS(LE)	CFAT 1M	44.5	45	0.5	ATR	6/60	6/60	6/24	44.5	45	0.5 ATR	42.25	42.25	0 NA	42.25	42.25	0 NA		2
43	53807	61	M	SIMC(RE)	MSICS(RE)	6/24	44	42.5	1.5	WTR	6/12	6/12	6/12	44	42.5	1.5 WTR	43.25	41.5	1.75 WTR	43.25	41.25	2 WTR		2
44	53798	51	M	SIMC(LE)	MSICS(LE)	6/18	44.75	43.5	0.75	WTR	6/18	6/18	6/9	44.75	45.5	0.75 ATR	44.5	45.25	0.75 ATR	44.5	45.25	0.75 ATR		2
45	55674	54	M	SIMC(RE)	MSICS(RE)	6/24	44	45	1	ATR	6/24	6/24	6/12	45	44	1 WTR	41.25	41	0.25 WTR	41.25	41	0.25 WTR		2
46	55670	61	F	SIMC(LE)	MSICS(LE)	CF AT 2m	43	44.5	1.5	ATR	6/36	6/36	6/18	43	41.5	1.5 WTR	41.25	40.5	0.75 WTR	41.25	40.5	0.75 WTR		2
47	55669	71	M	SIMC(LE)	MSICS(LE)	6/36	42.75	44	1.25	ATR	6/18	6/18	6/9	42.75	41.5	1.25 WTR	43	42.5	0.5 WTR	43	42.5	0.5 WTR		2
48	55668	74	F	SIMC(LE)	MSICS(LE)	6/60	43.25	42	1.25	WTR	6/24	6/24	6/12	43.25	44.5	1.25 ATR	43	44.5	1.5 ATR	43	44.5	1.5 ATR		2
49	55666	64	F	SIMC(RE)	MSICS(RE)	CF AT 4m	45.5	46	0.5	ATR	6/36	6/36	6/9	45.5	46	0.5 ATR	45	44.5	0.5 WTR	45	44.5	0.5 WTR		2
50	55676	65	M	SIMC(LE)	MSICS(LE)	6/60	45	43.5	1.5	WTR	6/18	6/18	6/9	45	46.5	1.5 ATR	41	42.75	1.75 ATR	43	44.75	1.75 ATR		2
51	55675	66	F	SMC(LE)	MSICS(LE)	6/60	41	42	1	ATR	6/24	6/24	6/12	41	40	1 WTR	42.25	41.75	0.5 WTR	42.25	41.75	0.5 WTR		2
52	55671	52	F	SMC(LE)	MSICS(LE)	PL+ve	42.75	42	0.75	WTR	6/18	6/18	6/9	42.75	43.5	0.75 ATR	44.25	45.25	1 ATR	44.25	45.25	1 ATR		2
53	55679	55	M	SIMC(RE)	MSICS(RE)	6/60	42.25	43	0.75	ATR	6/9	6/9	6/9	42.25	41.5	0.75 WTR	41	40.5	0.5 WTR	41	40.5	0.5 WTR		2
54	55673	68	M	SIMC(LE)	MSICS(LE)	6/60	44	45	1	ATR	6/24	6/24	6/9	44	45	1 ATR	42	41.75	0.75 WTR	42	41.75	0.75 WTR		2
55	55664	69	M	SMC(RE)	MSICS(RE)	6/60	43	44.5	1.5	ATR	6/60	6/36	6/12	43	41.5	1.5 WTR	43.75	42.75	1 WTR	44	42.75	1.25 WTR		2
56	55665	67	M	SIMC(LE)	MSICS(LE)	6/36	42.75	44	1.25	ATR	6/24	6/24	6/24	42.75	44	1.25 ATR	42.25	44	1.75 ATR	42.25	44	1.75 ATR		2
57	55681	53	F	SIMC(LE)	MSICS(LE)	6/24	41.5	40.75	0.75	WTR	6/18	6/9	6/9	41.5	40.75	0.75 WTR	43	42	1 WTR	43	42	1 WTR		2
58	58188	56	M	SIMC(RE)	MSICS(RE)	6/18	44	45	1	ATR	6/18	6/18	6/18	44	45	1 ATR	44	45.25	1.25 ATR	44	45.25	1.25 ATR		2
59	58203	72	F	SIMC(LE)	MSICS(LE)	6/60	41	42.25	1.25	ATR	6/9	6/9	6/6	42.25	40	1.25 WTR	43.75	42.5	1.25 WTR	43.75	42.5	1.25 WTR		2
60	58215	73	F	SIMC(LE)	MSICS(LE)	6/36	42	42.75	0.75	ATR	6/9	6/9	6/9	42	41.25	0.75 WTR	42	41	1 WTR	43	42	1 WTR		2
61	58217	69	M	SIMC(RE)	MSICS(RE)	6/24	42.25	41.25	1	WTR	6/24	6/9	6/9	42.25	43.25	1 ATR	42	43	1 ATR	42	43	1 ATR		2
62	58914	68	M	SIMC(RE)	MSICS(RE)	6/18	45	44	1	WTR	6/24	6/24	6/12	45	46	1 ATR	43	42	1 WTR	44	43	1 WTR		2
63	758909	63	M	SIMC(RE)	MSICS(RE)	6/24	44	45	1	ATR	6/18	6/18	6/9	44	43	1 WTR	43	42	1 WTR	43	42	1 WTR		2
64	760861	62	F	SIMC(LE)	MSICS(LE)	CF AT 5m	43	44.5	1.5	ATR	6/36	6/36	6/9	43	44.5	1.5 ATR	43.75	43.5	0.25 WTR	43.75	43.5	0.25 WTR		2
65	762809	57	M	SIMC(RE)	MSICS(RE)	6/36	42.75	44	1.25	ATR	6/36	6/18	6/12	42.75	41.5	1.25 WTR	42.75	42.25	0.5 WTR	42.75	42	0.75 WTR		2
66	789599	56	M	SIMC(LE)	MSICS(LE)	CF AT 5m	43.5	42	1.5	WTR	6/18	6/18	6/9	43.5	45	1.5 ATR	45	45.5	0.5 ATR	45	45.25	0.25 ATR		2
67	894884	77	F	SIMC(RE)	MSICS(RE)	6/18	42.5	43.5	1	ATR	6/18	6/18	6/12	44.5	43.5	1 WTR	42.75	42.5	0.25 WTR	42.75	42.5	0.25 WTR		2
68	796072	62	M	SIMC(LE)	MSICS(LE)	6/24	41	42.25	1.25	ATR	6/9	6/9	6/9	41	42.25	1.25 ATR	44	45	1 ATR	44	45	1 ATR		2
69	796109	63	F	SIMC(RE)	MSICS(RE)	6/36	43	42	1	WTR	6/36	6/24	6/12	43	41.5	1.5 WTR	43	41.5	1.5 WTR	43	41.5	1.5 WTR		3
70	798026	64	F	SIMC(LE)	MSICS(LE)	CF AT 3m	43.75	43	0.75	WTR	6/18	6/18	6/9	43.75	43	0.75 WTR	44.25	42.25	1 WTR	44.25	42.25	1 WTR		3
71	798037	57	M	SIMC(LE)	MSICS(LE)	CF AT 5m	44	45	1	ATR	6/12	6/12	6/9	44	43	1 WTR	43.75	42.25	1.25 WTR	43.75	42.25	1.25 WTR		3
72	813520	72	M	SIMC(RE)	MSICS(RE)	6/60	43	44.5	1.5	ATR	6/18	6/18	6/9	43	41.5	1.5 WTR	41.5	40	1.5 WTR	41.75	40	1.75 WTR		3
73	813525	58	M	SIMC(LE)	MSICS(LE)	6/60	42.75	44	1.25	ATR	6/18	6/18	6/6	42.75	43.75	1 ATR	41.75	42	0.25 ATR	41.75	42	0.25 ATR		3
74	834081	65	F	SIMC(LE)	MSICS(LE)	6/24	41.5	40.5	1	WTR	6/24	6/24	6/12	41.5	40.5	1 WTR	43	41.75	1.25 WTR	43	41.75	1.25 WTR		3
75	850561	59	M	SIMC(RE)	MSICS(RE)	6/18	40.5	42	1.5	ATR	6/18	6/18	6/12	40.5	40	0.5 WTR	42.25	42	0.25 WTR	42.25	42	0.25 WTR		3
76	913368	71	F	SIMC(LE)	MSICS(LE)	6/24	44.5	45	0.5	ATR	6/12	6/12	6/6	44.5	44	0.5 WTR	42.25	42	0.25 WTR	42.25	42	0.25 WTR		3
77	913369	66	F	SIMC(RE)	MSICS(RE)	CF AT 2m	44	42.5	1.5	WTR	6/12	6/12	6/12	44	42	2 WTR	43	41	2 WTR	43	41	2 WTR		3
78	914386	75	M	SIMC(LE)	MSICS(LE)	6/36	44.75	43.5	0.75	WTR	6/18	6/18	6/9	44.75	43	1.75 WTR	44.75	42.75	2 WTR	44.75	42.75	2 WTR		3
79	915477	67	F	SIMC(RE)	MSICS(RE)	6/60	44	45	1	ATR	6/24	6/24	6/9	44	43	1 WTR	43	42.75	0.25 WTR	43	42.75	0.25 WTR		3
80	816893	71	M	SIMC(LE)	MSICS(LE)	CF AT 4m	43	44.5	1.5	ATR	6/36	6/36	6/12	43	43.5	0.5 ATR	44.75	45	0.25 ATR	44.75	45	0.25 ATR		3
81	817555	76	F	SIMC(LE)	MSICS(LE)	6/60	42.75	44	1.25	ATR	6/18	6/18	6/9	42.75	42	0.75 WTR	44	43.75	0.75 WTR	44	43.5	0.5 WTR		3
82	826720	68	M	SIMC(LE)	MSICS(LE)	6/60	43.25	42	1.25	WTR	6/24	6/24	6/9	43.25	42	1.25 WTR	45.5	44	1.5 WTR	45.5	44	1.5 WTR		3
83	829555	70	F	SMC(RE)	MSICS(RE)	HM+ve	45.5	46	0.5	ATR	6/36	6/24	6/12	45.5	45	0.5 WTR	44.5	43.5	1 WTR	44.75	43.5	1.25 WTR		3
84	929683	69	F	SIMC(LE)	MSICS(LE)	6/60	45	43.5	1.5	WTR	6/18	6/18	6/9	45	44.5	0.5 WTR	41	40	1 WTR	41	40	1 WTR		3
85	930838	61	M	SIMC(LE)	MSICS(LE)	6/60	41	42	1	ATR	6/24	6/24	6/12	43	42	1 WTR	41	40.75	0.25 WTR	41	40.75	0.25 WTR		3
86	876792	51	M	SIMC(LE)	MSICS(LE)	6/60	42.75	42	0.75	WTR	6/18	6/12	6/9	42.75	42	0.75 WTR	41.75	40.75	1 WTR	41.75	40.75	1 WTR		3
87	876794	54	M	SIMC(RE)	MSICS(RE)	6/36	42.25	43	0.75	ATR	6/9	6/9	6/9	43.75	43	0.75 WTR	42	41.75	0.5 WTR	42	41.75	0.5 WTR		3
88	831148	61	F	SIMC(LE)	MSICS(LE)	6/24	44	45	1	ATR	6/24	6/24	6/12	44	44	0 NA	41.25	41.25	0 NA	41.25	41.25	0 NA		3
89	89146	71	M	SMC(RE)	MSICS(RE)	6/18	43	44.5	1.5	ATR	6/18	6/12	6/9	43	42	1 WTR	45.5	45	0.5 WTR	45.5	45	0.5 WTR		3
90	895111	74	F	SMC(LE)	MSICS(LE)	CF AT 1m	42.75	44	1.25	ATR	6/24	6/24	6/12	42.75	41.75	1 WTR	46	45.5	0.5 WTR	46	45.25	0.25 WTR		3
91	898392	64	F	SIMC(LE)	MSICS(LE)	6/36	41.5	40.75	0.75	WTR	6/18	6/18	6/9	41.5	40.75	0.75 WTR	45	43.25	1.75 WTR	45	43.25	1.75 WTR		3
92	898997	65	M	SIMC(RE)	MSICS(RE)	6/24	44	45	1	ATR	6/18	6/9	6/6	44	43	1 WTR	44	43.5	0.5 WTR	44	43.5	0.5 WTR		3
93	899242	66	F	SIMC(LE)	MSICS(LE)	6/18	41	42.25	1.25	ATR	6/9	6/9	6/9	41	40	1 WTR	41	40	1 WTR	41	40	1 WTR		3
94	579281	52	F	SIMC(LE)	MSICS(LE)	6/36	42	42.75	0.75	ATR	6/9	6/9	6/9	42	42.75	0.75 ATR	42	42.25	0.25 ATR	42	42.25	0.25 ATR		3
95	791576	55	M	SIMC(RE)	MSICS(RE)	6/24	42.25	41.25	1	WTR	6/24	6/12	6/9	42.25	41.25	1 WTR	44	42.75	1.25 WTR	44	42.5	1.5 WTR		3
96	891461	68	M	SIMC(RE)	MSICS(RE)	CF AT 3m	45	44	1	WTR	6/24	6/24	6/9	45	44	1 WTR	42	40.25	1.75 WTR	42	40.25	1.75 WTR		3
97	949606	69	M	SIMC(RE)	MSICS(RE)	6/18	44	45	1	ATR	6/18	6/18	6/6	44	43	1 WTR	43	42.25	0.75 WTR	43	42.25	0.75 WTR		3
98	730628	67	M	SIMC(LE)	MSICS(LE)	6/36	43	44.5	1.5	ATR	6/36	6/12	6/9	43	42.5	0.5 WTR	45	44.5	0.5 WTR	45.25	44.5	0.75 WTR		3
99	725327	53	F	SIMC(RE)	MSICS(RE)	6/24	42.75	44	1.25	ATR	6/12	6/12	6/6	42.75	41.75	1 WTR	41	40.5	0.5 WTR	41	40.5	0.5 WTR		3
100	733234	56	M	SIMC(LE)	MSICS(LE)	CF AT 5m	43.5	42	1.5	WTR	6/18	6/18	6/9	43.5	44.5	1 WTR	43.5	41.5	2 WTR	43.5	41.5	2 WTR		3
101	739673	72	F	SIMC(RE)	MSICS(RE)	6/18	42.5	43.5	1	ATR	6/18	6/9	6/9	42.5	41.5	1 WTR	40.5	40.25	0.25 WTR	40.5	40	0.5 WTR		3
102	739669	73	F	SIMC(LE)	MSICS(LE)	6/36	41	42.25	1.25	ATR	6/9	6/9	6/9	43.75	42.25	1.5 WTR	45	44.25	0.75 WTR	45.25	44.25	1 WTR		3