STUDY OF CORNEAL THICKNESS CHANGES DURING DIFFERENT PHASES OF MENSTRUAL CYCLE

BY

DR. POONAM RANA

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SBKS MEDICAL INSTITUTE & RESEARCH CENTRE

SUMANDEEP VIDYAPEETH, PIPARIA, VADODARA

IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

M.S.

IN

OPHTHALMOLOGY

UNDER THE GUIDANCE OF

DR. R.N KOTHARI

PROFESSOR AND HOD,

DEPARTMENT OF OPHTHALMOLOGY

SBKS MEDICAL INSTITUTE & RESEARCH CENTRE,

PIPARIA, VADODARA– 391760

YEAR 2015-2018

Sumandeep Vidyapeeth
Institutional Ethics Committee (SVIEC)

Declerad as deemed to be university u/s 3 of UGC act of 1956
At & Po Pipariya,Ta. Waghodia,
Dist. Vadodara-391760 (Gujarat) India , Phone :+02668-245262/64/66
E-Mail : rd.sumandeep@gmail.com | www.sumandeepuniversity.co.in

Dr. Poonam Rana (1st Yr Resident)
Department of Ophthalmology
SBKS MI&RC, DGH,
Sumandeep Vidyapeeth,
Piparia, Waghodia Road,
Vadodara-391760
Gujarat.

Date: 12th May 2016

SUMANDEEP VIDYAPEETH
INSTITUTIONAL ETHICS COMMITTEE
OUTWARD: SVIEC/dissImee3/BMP915/D16038
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SV Institutional Ethics committee

HRRP
S.B.K.S.M.I.R.C.
Outward No.: 530
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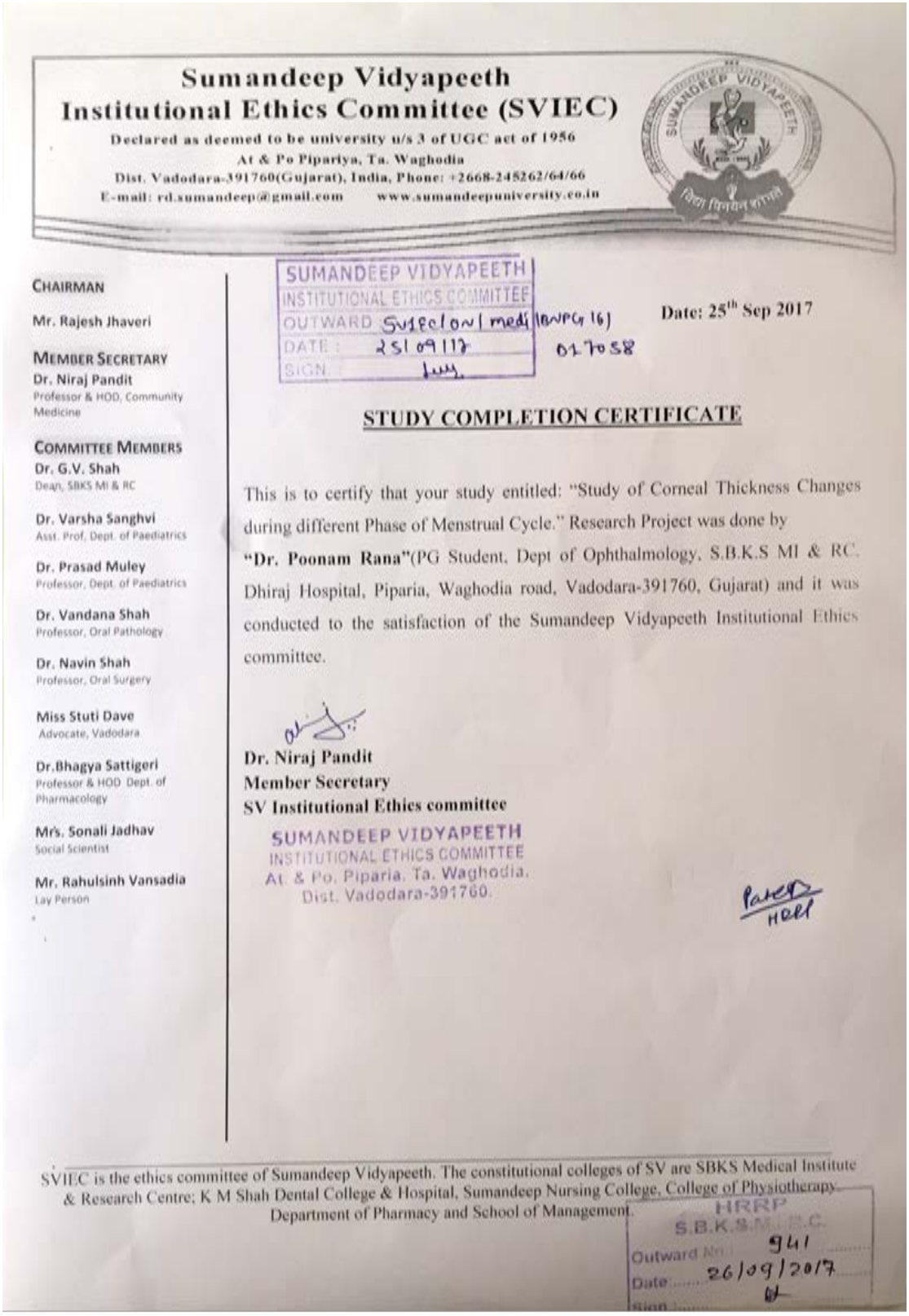

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Institutional Ethics Committee (SVIEC)

Declared as deemed to be university u/s 3 of UGC act of 1956
At & Po Piparіya, Ta. Waghodia
Dist. Vadodara-391760(Gujarat), India, Phone: +2668-248262/64/66
E-mail: rd.sumandeep@gmail.com www.sumandeepuniversity.co.in

SUMANDEEP VIDYAPEETH
INSTITUTIONAL ETHICS COMMITTEE
OUTWARD Surgeon/medi (BNPG 16)
DATE : 25/09/17
SIGN.
017058

Date: 25th Sep 2017

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Member Secretary
SV Institutional Ethics committee

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INSTITUTIONAL ETHICS COMMITTEE
At. & Po. Piparia, Ta. Waghodia,
Dist. Vadodara-391760.

Pateel
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S.B.K.S.M.I. & R.C.
Outward No. 941
Date: 26/09/2017
Sign.

SUMANDEEP VIDYAPEETH

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Date:
Place: PIPARIA

Signature of the Candidate
Dr. POONAM RANA

SUMANDEEP VIDYAPEETH

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Date:
Place:PIPARIA

Signature of the Guide
DR. R.N. KOTHARI
Professor & HOD,
Department of Ophthalmology
SBKS MI&RC, Piparia.

SUMANDEEP VIDYAPEETH

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Seal & Signature of the HOD
DR. R. N. KOTHARI
Professor & HOD,
Department of Ophthalmology.

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ABSTRACT

Introduction

Central corneal thickness is determined by many factors including, age sex, corneal hydration, hormones etc. Many studies have been done to study changes in central corneal thickness during different phases of menstrual cycle, however the results have been very varied. We did this study to find out changes in central corneal thickness during various phases of menstrual cycle. We also studied concurrent changes in IOP associated with various phases of menstrual cycle.

Methods

The study was carried out in the Department of Ophthalmology, Dhiraj Hospital, Piparia, Gujarat from May 2016 to September 2017. 100 participants were enrolled in the study. Thorough ophthalmic examination was done including ultrasonic pachymetry and Goldmann applanation tonometry

Results

Total 100 participants were included in the study. In our study, central corneal thickness was found to be thickest, at ovulation, and thinnest at the beginning of the menstrual cycle, with mean values of 533.24±22.44, 534.40±30.08(right eye, left eye respectively) on days 1-3;547.51±31, 548.25±29.94(right eye, left eye respectively) days13-15 and 537.22±29.62 538.28±29.97 (right eye, left eye respectively) on days 26-28.

The intraocular pressure was found to be increasing from beginning of the menstrual cycle to ovulation with mean values of12.65±2.48,12.86±2.165(right eye, left eye respectively) on days 1-3 and13.15± 2.29,13.25± 2.086(right eye, left eye respectively) on days 26-28, although the increase was trivial.

Conclusion

Many ophthalmic procedures especially refractive surgeries should consider the change in central corneal thickness changes during different phases of menstrual cycle, and thorough evaluation should be done before surgery to yield better results.

Keywords: Central corneal thickness, menstrual cycle, pachymerty.

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INTRODUCTION

The cornea is a transparent, avascular, watch glass like structure. It forms anterior one-sixth of the outer vascular coat. Almost two-thirds of the total refractive power of the eye is provided by cornea. The adult cornea measures around 11–12 mm horizontally and 9–11 mm vertically. The central cornea thickness varies from 0.5mm and increases to around 1 mm near the limbus.[1] The curvature decreases from the center toward the periphery, this makes the periphery more aspheric. Refractive index of the cornea is 1.376. The radius of curvature anteriorly is 7.8 mm and posteriorly 6.5 mm. The refractive power of the cornea is +48D on the anterior surface and −5D on the posterior surface which makes net power to be +43 D. The normal keratometric value for the cornea is within the range of 42–45 D.[2]

Properties of cornea include transparency, avascularity, and immunological privilege. It derives its nutrition from tears, aqueous, and the perilimbal vasculature. Tear film and the perilimbal capillaries provide oxygen from the atmosphere to the cornea. The main source of glucose for all layers of the cornea is aqueous humor, while amino acids required for protein synthesis are acquired by passive diffusion from the aqueous.[3]

Changes in corneal curvature, thickness, and sensitivity during the woman's menstrual cycle have been co related to endocrine influences.[4,5]

Cornea is relatively in dehydrated state, integrity of the hydrophobic epithelium and endothelium is responsible for this state, the endothelial pump and the osmotic gradient are relatively hypertonic because of aqueous and tears**.** Estrogen and progesterone changing levels tends to change the hydration of cornea leading to

changes in corneal curvature and corneal thickness and ultimately changes the refractive power of the eye.

The menstrual cycle can be described by the ovarian or uterine cycle. The ovarian cycle describes changes that occur in the follicles of the ovary whereas the uterine cycle describes changes in the endometrial lining of the uterus.

The first phase, an estrogen dominated phase, lasts up to the time of ovulation, this phase is known as the proliferative phase or the follicular phase. The second phase, the secretory or luteal phase, is due to an increase in progesterone secretion. In the last phase or the menstrual phase, there is a decrease in all the ovarian hormones which, in turn, decreases the production of all anterior pituitary reproductive hormones. Plasma estrogen levels increase on two occasions during the menstrual cycle: ovulation (14 day of menstrual cycle) and the luteal phase(14-18 day of menstrual cycle). Progesterone levels rise shortly before ovulation and rapidly during the luteal phase, until estrogen levels are paralleled. The main action of estrogen is on sodium and chloride balance and on the hydration of tissues; it enhances sodium reabsorption by the tissues leading to water retention and edema.[6] Estrogen and progesterone can readily gain access to the cornea via the aqueous humor or tear film due to their high lipid solubility[7] and exert their direct effect on the corneal tissue. An indirect effect on the cornea can also take place via their action on tear film osmolarity.

Increase in these hormones cause changes in other parts like increase in skin surface lipid secretion and sebum production, increase skin thickness, fat deposition, increase skin hydration, and barrier function ,increase in core body temperature, increase in hair density, supresses cellular immunity, enhances humoral immunity etc. and one of

these is change is increase in hydration of cornea[8] leading to changes in corneal curvature and corneal thickness and thus changing the refractive power of cornea.

Corneal thickness consideration is an important aspect for lasik surgery and any change pre/post lasik will greatly affect the visual outcome of the surgery. As the thickness of cornea changes in the menstrual cycle, it becomes important factor in pre /post lasik surgery. These corneal changes may result in miscorrections and further ectasia. Corneal ectasia is the most dreaded potential side effect in corneal refractive surgery and results from predisposed factors such as irregular corneal thickness, different ablation rates, and ultrasound pachymetry errors. The analysis of a pachymetry map and its relationship to corneal curvature patterns is critical to identify and provide additional data to alert the surgeon of a risk for ectasia.**[9]**

This study emphasises studying changes in central corneal thickness during different phases of menstrual cycle are substantial and that can affect visual profile in post-Lasik cases.

AIMS AND OBJECTIVES

1. To study the changes in corneal thickness occurring during menstrual cycle.

2. To study the changes in intraocular pressure occurring during different phases of menstrual cycle.

REVIEW OF LITERATURE

The cornea is a transparent avascular connective tissue that forms barrier of the eye against primary infections and also provides 2/3 of refractive power of the eye. A proper anterior refractive surface for the eye is formed by cornea and overlying tear film. In the average adult, 11.5 to 12.0 mm is the horizontal diameter of the cornea[10], which is about 1.0 mm larger than the vertical diameter. It is approximately 0.5 mm thick at the center and gradually increases towards the periphery. The shape of the cornea is steeper centrally and prolate flatter in the periphery, creating an aspheric optical system. The intrinsic biomechanical structure is responsible for corneal shape and curvature. The corneal curvature is maintained by anterior corneal stromal rigidity.[11] Traditionally the human cornea consists of 5 recognized layers, 3 cellular (epithelium, stroma, endothelium) and 2 interface (Bowman membrane, Descemet membrane). In 2013, one more was added known as Dua,'s layer.[1] It is hypothetically 15 micrometres (0.59 mils) thick, the fourth caudal layer, and located between the corneal stroma and Descemet's membrane. Despite its thinness, the layer is very strong and impervious to air.[1] It is strong enough to withstand up to 2 bars (200 kPa) of pressure.

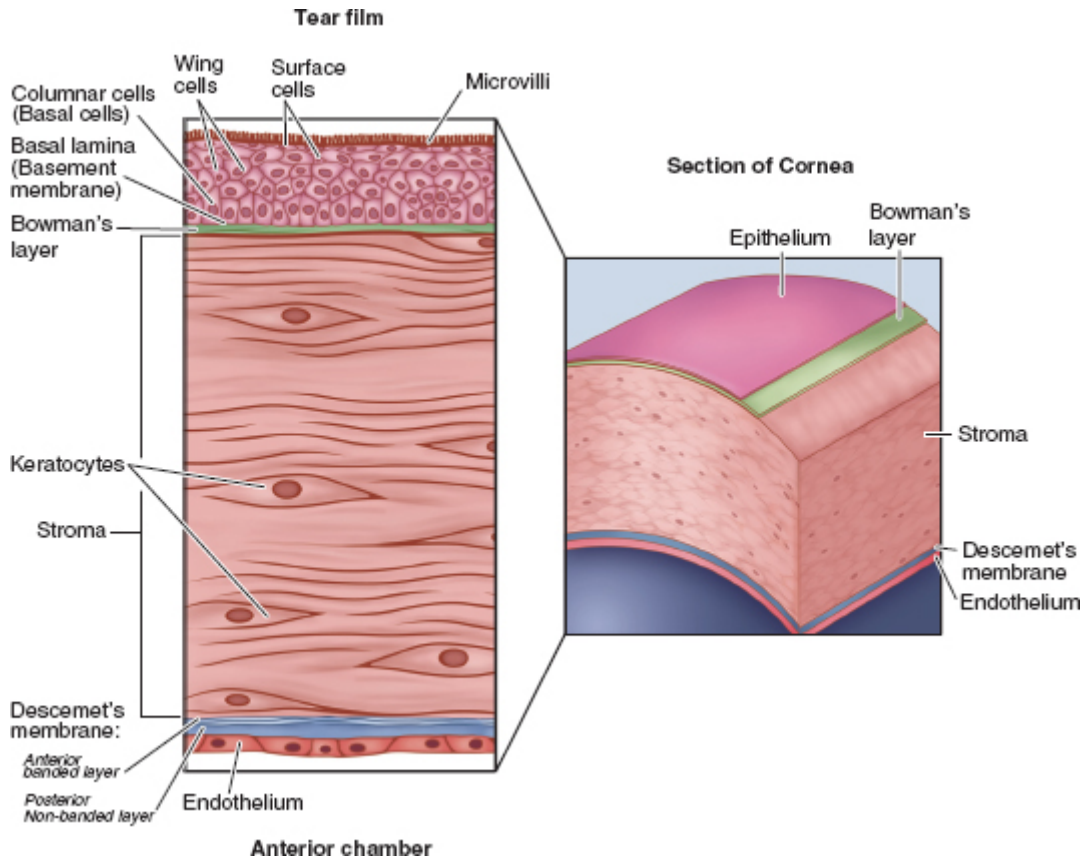


Figure1: Layers of Cornea

EPITHELIUM

The first barrier to the outside environment is formed by the epithelial surface, which is an integral part of the tear film–cornea interface making, it is responsible for the refractive power of the eye. The corneal epithelium is derived from surface ectoderm between 5 and 6 weeks of gestation.

It is formed by nonkeratinized, stratified squamous epithelium that is 4 to 6 cell layers thick (40 mm to 50 mm).[12] Corneal epithelial cells have an average lifespan of 7 to 10 days[13] and routinely undergo orderly involution, apoptosis (programmed cell death), and desquamation.

This process results in formation of the corneal epithelial layer every week, as deeper cells replace the desquamating superficial cells in an orderly manner. 2 to 3 layers of flat polygonal cells forms the most superficial corneal epithelial cells.

Suprabasal or wing cells are just beneath the superficial cell layer, anterior to the deepest basal layer of the epithelium. This layer is 2 to 3 cells deep.

The deepest cellular layer of the corneal epithelium is the basal layer, which composes a single cell layer of columnar epithelium, 20 mm tall. Besides the stem cells and transient amplifying cells, basal cells are the only corneal epithelial cells capable of mitosis.[14] The epithelial basement membrane, approximately 0.05 mm thick, comprises type IV collagen and laminin secreted by the basal cells.

BOWMAN'S LAYER

The Bowman's membrane (Bowman's layer, anterior limiting lamina, anterior elastic lamina) is a smooth, acellular, non-regenerating layer, present between the stroma and superficial epithelium of the cornea of the eye. It is formed of strong, randomly oriented collagen fibrils where the smooth anterior surface faces the epithelial basement membrane and the posterior surface merges with the collagen lamellae of the corneal stroma proper.[15] In adult humans, Bowman's membrane is 8-12 μm thick.[16]

STROMA

The corneal stroma provides the bulk of the structural framework of the cornea and comprises roughly 80% to 85% of its thickness. Embryologically, it is the product of a second wave of neural crest migration that occurs in the seventh week of gestation, after establishment of the primitive endothelium. The stroma differs from other

collagenous structures in its transparency, which is the due to organization of the stromal fibers and extracellular matrix (ECM).[17,18]

The collagen fibers know as fibrils are arranged in parallel bundles, and these fibrils are arranged in parallel layers or lamellae. The stroma of the human eye contains 200 to 250 distinct lamella, each layer arranged at right angles relative to fibers in adjacent lamellae.[18] The peripheral stroma is thicker from the central stroma, and the collagen fibrils usually change direction to run circumferentially as they approach the limbus.[19] Stromal collagen fibrils are composed of type I collagen in a heterodimeric complex with type V collagen to obtain their unique and narrow diameter.[20] Keratocytes are the major cell type of the stroma and are involved in maintaining the ECM environment. Most of these keratocytes reside in the anterior stroma and comprises of corneal "crystallins," forming 25% to 30% of soluble protein in the cells. These crystallins are responsible for decreasing back scatter of light from the keratocytes and maintaining corneal transparency.[21]

DESCEMET MEMBRANE

It lies between the corneal proper substance, also called stroma, and the endothelial layer of the cornea. It is composed of a different kind of collagen (Type VIII)[22] than the stroma. The endothelial layer is present at the posterior of the cornea. Descemet's membrane, is the basement membrane for the endothelial layer, is formed by the single layer of squamous epithelial cells that comprises the endothelial layer of the cornea. Its thickness ranges from 3 μm at birth to 8-10 μm in adults.[23]

ENDOTHELIUM

The endothelial layer of the cornea remains in a relatively deturgesced state leading to clarity of the cornea. The human endothelium is a monolayer, which forms a honeycomb-like mosaic when seen from the posterior side. At birth, the endothelial monolayer is approximately 10 mm thick and comprise of a uniform thickness layer of cells that forms the entire posterior corneal surface and combines with the cells of the trabecular meshwork. Similarly, Descemet membrane becomes continuous and uniform, combining peripherally with the trabecular beams.[24] The individual cells continue to flatten over period time and stops at approximately 4 mm in thickness in adulthood. Adjacent cells have extensive lateral interdigitations and tight junctions along their lateral borders. The lateral membranes contain a high density of Na, K - ATPase pump sites.[25] Endothelial cell density and topography changes throughout the life. From the second to eighth decades of life, the cell density declines from 3000to 4000 cells/mm2 to around 2600cells/mm^2, and the percentage of hexagonal cells declines from approximately 75% to approximately 60%.[26] The central endothelial cell density decreases at an average rate of 0.6% per year in normal corneas.[27]

CENTRAL CORNEAL THICKNESS

Central corneal thickness (CCT) and its measurement are crucial in many ophthalmic procedures, such as tonometry and refractive surgery.[28] Many studies,[29,30] have proved that CCT significantly influences the measured IOP and consequently, the classification and management of glaucoma. Thinner than average corneas may result in underestimation of the true IOP, while thicker than average corneas may result in overestimation of IOP[31]. However, this factor alone is insufficient when explaining the increased susceptibility to glaucoma found in those with thinner corneas. The diagnosis and treatment of contact lens related complications and certain ophthalmic procedures (such as astigmatic keratectomy, LASIK, PRK and Intacs placement) depends on the accurate measurement of CCT.[32] Normal corneal thickness ranges from 480 to 575 microns. Factors thought to affect CCT include race, age, sex, anthropometric parameters, hormonal changes, time of day, blink rate, and type of measuring equipment used. It has also been established that CCT varies according to ethnicity. However, none of these factors alone can predict CCT.

PACHYMETRY

Corneal pachymetry is the measurement of corneal thickness. Central corneal thickness (CCT) is routinely used to monitor corneal edema and endothelial function,[33-36] manage ocular hypertension,[37,38] and plan common keratorefractive surgeries such as LASIK and photorefractive keratectomy (PRK). Few of pachymetry technologies gives only spot measurements, whereas a wide area of the cornea is measured by others. Spot measurement technologies include traditional optical pachymetry,[39] specular and confocal microscopy,[40] ultrasound pachymetry,[41,42] and

optical low-coherence reflectometry.[43,44] Pachymetric mapping technologies include slit scanning optical pachymetry[44] and very high–frequency ultrasound imaging.[46,47]

Pachymetric mapping have numerous advantages over spot measurements. Mapping can show abnormal patterns such as keratoconus and pellucid marginal degeneration. It can also provide preoperative planning for surgeries that do not concern just the center of the cornea, such as astigmatic keratotomy, intracorneal ring segment implantation, phototherapeutic keratectomy, and lamellar keratoplasty.

Portability and easy to use makes a Traditional ultrasound pachymetry (10-20 MHz) better option then others. These dry contact systems are simple, portable, and cost-effective[41]. The accuracy of machine relies on the perpendicular placement of the probe on the cornea.

Ultrasound biomicroscopy (50 MHz) and very-high-frequency ultrasound (70 MHz) requires a water medium but provides corneal sublayer detail and pachymetry.

Some ultrasound pachymeters provides other details with CCT measurement. For example, the Reichert IOPac can calculate glaucoma risk.

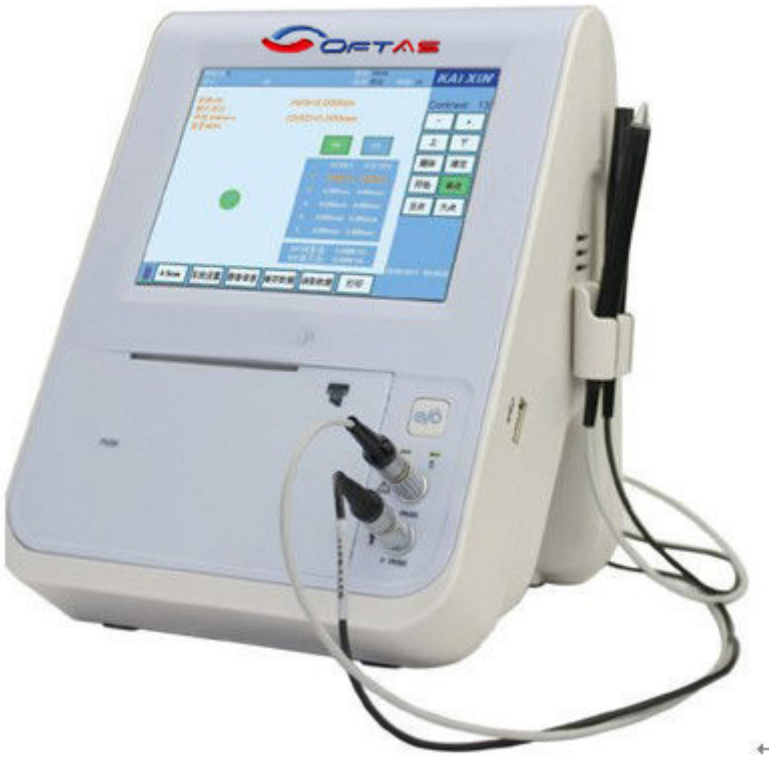


Figure : 2 Ultrasound Pachymetry

Optical slit lamp techniques measure corneal thickness using a device mounted to the slit lamp through which the observer aligns the anterior surface and endothelial surface of the cornea through image doubling.[45] The corneal thickness is measured using an equation using refractive index and anterior radius of curvature of the cornea. These variables, along with examiners technique are major disadvantages of this modality.

Specular microscopy is a contact based pachymetry that records the adjustment required in the focal plane of the instrument.[40] The SP-2000P specular microscope (Topcon Corp.) is a noncontact optical instrument which measures pachymetry as well as do specular microscopy.

Orbscan is a noncontact optical scanning-slit instrument that measures pachymetry in addition to doing topography. Corneal thickness is underestimated in patient undergone refractive surgeries and patients with hazy corneas, when measured with orbscan.

Optical coherence tomography (OCT) and optical low-coherence reflectometry (OLCR) are noncontact techniques that measure pachymetry by optical interferometry. These techniques provide sublayer detail and measure pachymetry. OCLR is advantageous in that it provides continuous measurement and is useful in obtaining pachymetry measurements during corneal ablation procedures.[43]

Confocal microscopy is a contact technique that acquires measurements through focusing a confocal microscope through the thickness of the cornea.[40] It has the advantage of providing detailed sublayer cellular structure and identification of corneal microbial pathology.

The Pentacam Scheimpflug Camera is a noncontact technique that uses a rotating Scheimpflug camera to rapidly capture images of the anterior segment of the eye, allowing it to measure corneal thickness from limbus to limbus.

Laser Doppler interferometry is a noncontact technique that utilizes a dual-beam infrared laser Doppler interferometry to measure pachymetry.

INTRAOCULAR PRESSURE

Intraocular pressure (IOP) is the fluid pressure inside the eye. Intraocular pressure (IOP) may be defined as the resulting balance between aqueous humor production and removal.[48] By means of mechanisms that are not yet well known, its increase is considered to be one of the main risk factors leading to the development of glaucoma.[49]

An important quantitative relationship is provided below[18] :

$$Po=(F-U)/C+Pv$$

Where:

- Po is the IOP in millimeters of mercury (mmHg)
- F the rate of aqueous humour formation in microliters per minute (μL/min)
- U the resorption of aqueous humour through the uveoscleral route (in μL/min)
- C is the facility of outflow in microliters per minute per millimeter of mercury (μL/min/mmHg)
- Pv is the episcleral venous pressure in millimeters of mercury (mmHg).

Although 21 mmHg is commonly accepted as the maximum arbitrary value for normalcy [51] one should bear in mind, as with many other biological parameters, that this is a variable value determined by multiple factors: age [52], gender [53], race [54], tobacco consumption[55], local ocular problems[56], obesity[57], hormonal changes[58], physical exercise[59], etc.

Intraocular pressure is measured by technique called tonometry. Tonometry are of different types depending upon their mechanism.

TONOMETRY

APPLANATION TONOMETRY

It is based on the Imbert-Fick principle, which implicates that the pressure inside an ideal dry, thin-walled sphere equals the force necessary to flatten its surface divided by the area of flattening (P = F/A, where P = pressure, F = force and A = area). In applanation tonometry, the cornea is flattened and the IOP is determined by varying the applanating force or the area flattened.[60]

Goldmann and Perkins Applanation Tonometry

The Goldmann applanation tonometer measures the force necessary to flatten an area of the cornea of 3.06mm diameter. At this diameter, the resistance of the cornea to flattening is balanced by the capillary attraction of the tear film meniscus for the tonometer head. A split-image prism placed in a manner that the image of the tear meniscus is divided into a superior and inferior arc and their inner margins meet.

Central corneal thickness (CCT) affects the applanation tonometry measurements. When Goldmann designed his tonometer, he estimated an average corneal thickness of 520 microns to cancel the opposing forces of surface tension and corneal rigidity to allow indentation. There is wide variation in corneal thickness among people. Thicker CCT may give false high IOP measurement, while thinner CCT can give false low reading.

Excessive or insufficient fluorescein in the tear film, high astigmatism, irregular or scarred cornea, pressure from a finger on the eyelid, and breath holding and Valsalva maneuver by the patient also affects the reading of Goldmann applanation tonometer.

The Perkins tonometer is essentially a portable Goldmann applanation tonometer that can be used with the patient in either upright or supine position. [60]

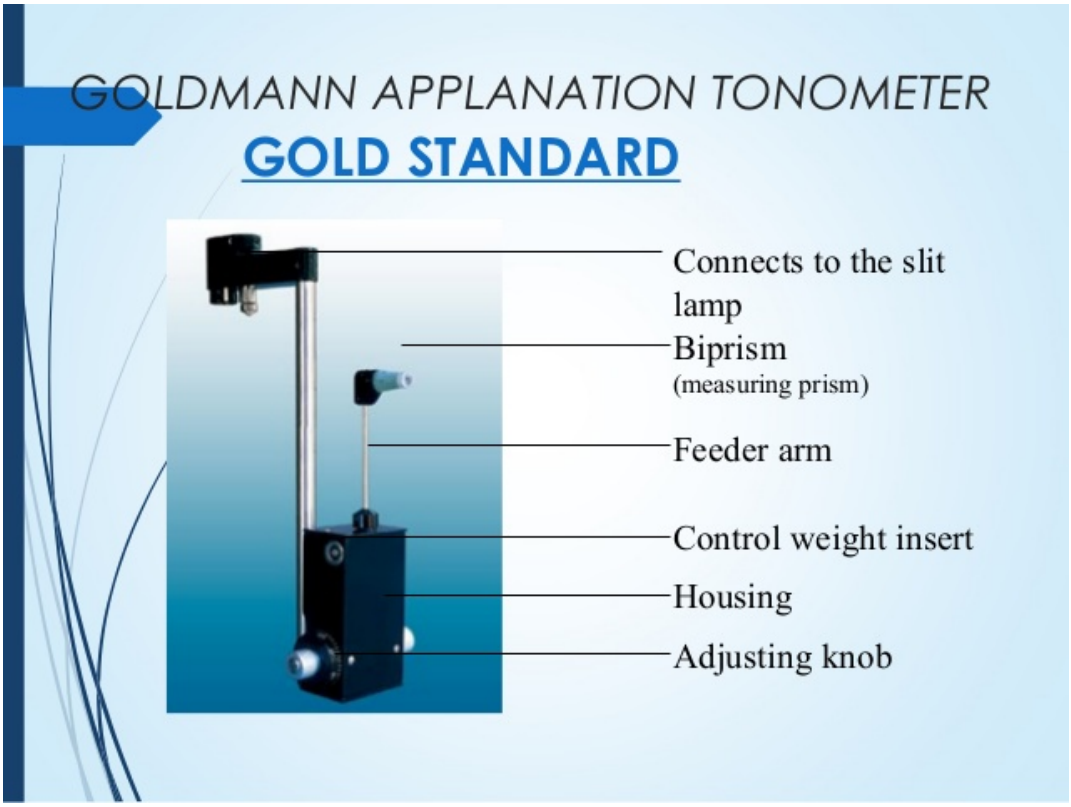


Figure 3: Goldmann Applanation tonometer.

Non-Contact Tonometry

In air puff tonometry, the applanating force is a column of air which is emitted with gradually increasing intensity. Readings from these machines usually underestimate IOP at high ranges and overestimate IOP at low ranges when compared with Goldmann applanation tonometer.

Ocular Response Analyzer

The ocular response analyzer is a newer type of non-contact tonometer. It uses a column of air of increasing intensity as the applanating force.[61]

INDENTATION TONOMETRY

The principle of indentation tonometry is that a force or a weight will indent or sink into a soft eye further than into a hard eye.

Schiotz Tonometer

The Schiotz tonometer consists of a curved footplate which is placed on the cornea of subject in supine position. A scale at the top of the plunger provides a reading depending on how much the plunger sinks into the cornea, which is then converted using conversion tables.

Pneumotonometer

The pneumotonometer is an applanation tonometer with some characteristics of indentation tonometry. The cornea is indented by the silicone tip. When the cornea and the tip becomes flat, the pressure on the tip becomes equal to the IOP.[62]

Tono-Pen

The Tono-Pen involves both applanation and indentation processes. As the tonometer makes contact with the eye, the plunger gets resistance from the cornea and IOP producing a rising record of force by a strain gauge. At the moment of applanation, the force is on the foot plate and the plunger results in small decrease from the steadily increasing force. At this point the value are recorded.[61-63]

REBOUND TONOMETRY

The newest version of the rebound tonometer is the ICare device (Helsinki, Finland). When a button is pushed, a spring pushes the wire and ball forward. When the ball hits the cornea, the ball and wire decelerate. The speed of deceleration is measured and converted into intraocular pressure.[61] IOP measurements obtained with this tonometer can be influenced by central corneal thickness, with higher IOP readings with thicker corneas.[64,65] This tonometer has been shown to be affected by other biomechanical properties of the cornea, including corneal hysteresis and corneal resistance factor.[66,67]

PASCAL DYNAMIC CONTOUR TONOMETER

The Pascal Dynamic Tonometer (Zeimer Ophthalmic systems AG, Port, Switzerland) utilizes a piezoelectric sensor embedded in the tip of the tonometer to measure the dynamic pulsatile fluctuations in IOP.[68]

MENSTRUAL CYCLE

Menstrual cycle is recurring cycle of physiological changes in the ovaries, uterus and other sexual structures that occur from the beginning of one menstrual period through the beginning of the next. The first period usually begins between twelve and fifteen years of age, a point in time known as menarche.[69] The duration between onset of one periodic cycle from is 21 to 45 days in young women and 21 to 35 days in adults (an average of 28 days).[70,71] Bleeding usually lasts around 2 to 7 days.[70] Menopause is the cessation of menstrual cycle, which usually happens between 45 and 55 years of age.[72]

The menstrual cycle is usually related as ovarian or uterine cycle. The changes that occur in the follicles of the ovary is known as ovarian cycle, whereas changes in the endometrial lining of the uterus is described as uterine cycle. Both cycles can be divided into three phases. The ovarian cycle is explained in follicular phase, ovulation, and the luteal phase whereas the uterine cycle has menstruation, proliferative phase, and secretory phase.[74]

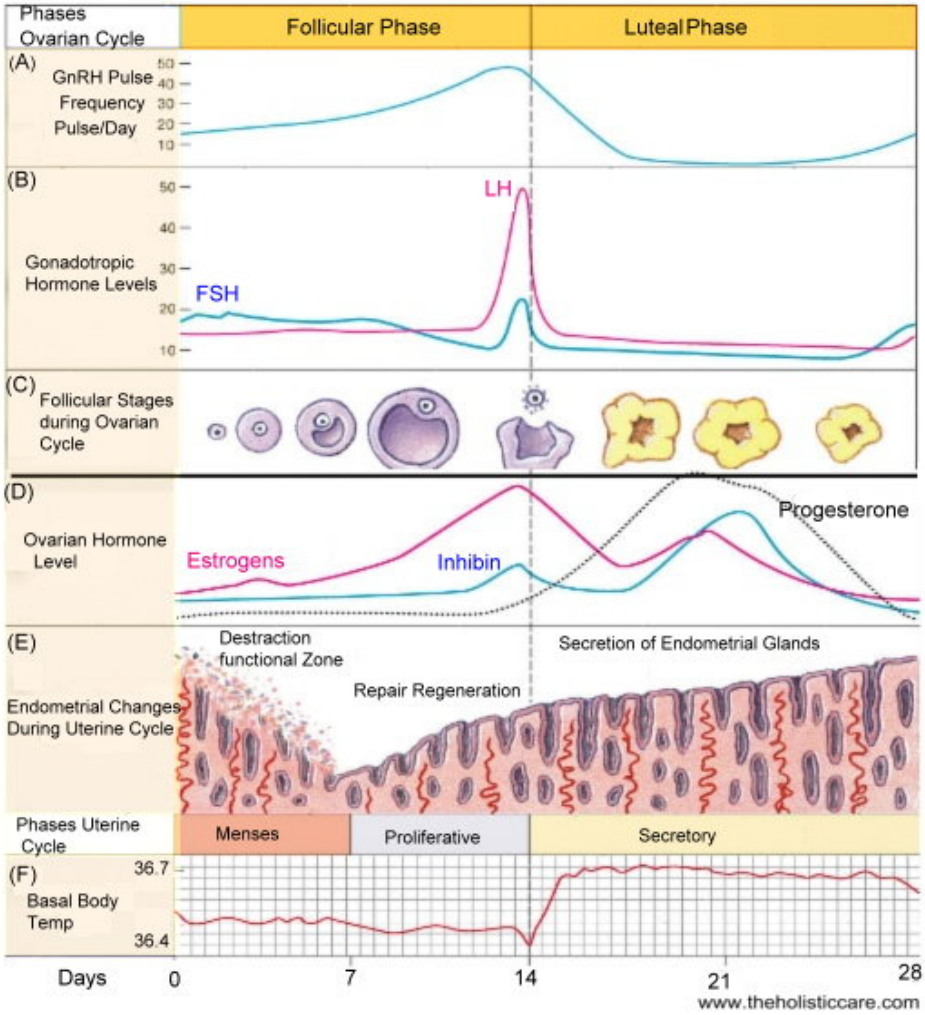


Figure 4: Different phases of menstrual cycle.

OVARIAN CYCLE

FOLLICULAR PHASE

The follicular phase is the first phase of the ovarian cycle. During this phase, the ovarian follicles mature and gets ready to release an egg.[74] The latter part of this phase overlaps with the proliferative phase of the uterine cycle.

There is rise in follicle stimulating hormone (FSH) during the first days of the cycle, a few ovarian follicles are stimulated. These follicles, which were present at birth[75] and have been developing in a process known as folliculogenesis, compete for

dominance. Under the influence of several hormones, one of the follicle matures. The follicle that reaches maturity contains ovum is called a tertiary, or Graafian follicle.[75]

OVULATION

Ovulation is the second phase of the ovarian cycle in which a mature egg is released from the ovarian follicles. During the follicular phase, estradiol suppresses production of luteinizing hormone (LH) from the anterior pituitary gland. When the egg has reached maturity, threshold levels of are reached above which this effect is reversed and estrogen stimulates the formation of a large amount of LH. This process starts around day 12 of the cycle and may last 48 hours which is known as LH surge. The exact mechanism of these opposite responses of LH levels to estradiol is not well understood.[76]

In animals, a gonadotropin-releasing hormone (GnRH) surge has been shown to precede the LH surge, suggesting that estrogen's main effect is on the hypothalamus, which controls GnRH secretion.[76] This may been abled by the presence of two different estrogen receptors in the hypothalamus: estrogen receptor alpha, which is responsible for the negative feedback estradiol-LH loop, and estrogen receptor beta, which is responsible for the positive estradiol-LH relationship.[77]

The release of LH matures the egg and weakens the wall of the follicle in the ovary, causing the fully developed follicle to release its secondary oocyte. The secondary oocyte matures into an ootid and which then matures into a mature ovum. The mature ovum has a diameter of about 0.2 mm.[78] The egg is moved into the fallopian tube by the fimbria after being released from the ovary. After one day, an unfertilized egg will disintegrate or dissolve in the fallopian tube.[75]

LUTEAL PHASE

It is the final phase of the ovarian cycle and it co relates to the secretory phase of the uterine cycle. During the luteal phase, FSH and LH cause the remaining parts of the dominant follicle to transform into the corpus luteum, which produces progesterone. The increased progesterone starts to induce the production of estrogen. The hormones produced by the corpus luteum also suppress production of the FSH and LH. Sequently, the level of FSH and LH fall quickly over time, leading to atrophy of corpus luteum.[76] Menstruation and the beginning of the next cycle is triggered by falling level of progesterone. From the time of ovulation until progesterone withdrawal has caused menstruation to begin, it takes around 14 days. The loss of the corpus luteum is prevented by fertilization of the egg. The syncytiotrophoblast, which is the outer layer of the resulting embryo-containing structure (the blastocyst) and later also becomes the outer layer of the placenta, produces human chorionic gonadotropin (hCG), which is very similar to LH and which preserves the corpus luteum. The corpus luteum can then continue to secrete progesterone to maintain the new pregnancy. Most pregnancy tests look for the presence of hCG.[76]

UTERINE CYCLE

MENSTRUATION

Menstruation (also called menstrual bleeding, menses, catamenia or a period) is the first phase of the uterine cycle. The flow of menses normally serves as a sign that a woman has not become pregnant.[79] The average blood loss during menstruation is 35 milliliters with 10–80 ml considered normal.[80] Women who experience Menorrhagia are more susceptible to iron deficiency then the average

women of that age.[81]An enzyme called plasmin inhibits clotting in the menstrual fluid.[82]

PROLIFERATIVE PHASE

The proliferative phase is the second phase of the uterine cycle when estrogen causes the lining of the uterus to grow, or proliferate, during this time. As they mature, the ovarian follicles secrete increasing amounts of estradiol, and estrogen. The estrogen starts the formation of a new layer of endometrium in the uterus, histologically seen, as the proliferative endometrium. The estrogen also stimulates crypts in the cervix to form fertile cervical mucus, which may be noticed by women practicing fertility awareness.[83]

SECRETORY PHASE

The secretory phase is the final phase of the uterine cycle and it relates to the luteal phase of the ovarian cycle. During the secretory phase, the corpus luteum secretes progesterone, which makes endometrium receptive to blastocyst and also supports pregnancy, by increasing blood flow and uterine secretions and reducing the contractility of the smooth muscle in the uterus;[84] it also has the side effect of raising the woman's basal body temperature.

CHANGES IN EYE DURING DIFFERENT MENSTRUAL PHASES

Sex steroid hormones (SSHs), such as estrogen, progesterone, and androgen, can cause various changes in eye, as they can act through SSH receptors which are present in ocular tissue. Any physiological and pathological changes that may lead to change in level of hormones will affect the ocular tissue also.[85,86]

1. SSH, act on epithelial acinar cells that contain receptors for messenger RNA and/or protein receptors for androgens. These cells respond to androgens by binding them to a specific lipid-producing area on the cell surface, which then transcribes specified genes that increase the lipid layer's distribution over the ocular surface. Thus, causing dysfunction in tear film and also Meibomian gland. The observations have been established with the increased association of dry eye during pregnancy and lactation.[87]
2. Variations in conjunctival epithelium is seen during menstruation and menopause. The level of estrogen level co relates with conjuctival tissue maturity. Ocular tissue accounts for 1% of all extragonadal sites for bleeding, of vicarious menstruation.[88]
3. The incidence of cataract seems to be higher in postmenopausal females as compared to males of similar age groups. One large study has shown that SSHs plays an important role in prevention of cataract formation in post-menopausal women. Maintenance of the ionic composition and hydration status of lens is supposed to be the cause of the protective action of estrogen.[89]
4. Co relationship between estrogen and retinal disorders has been substantially established. Estrogen has a protective role in prevention of retinal changes by

various genomic and nongenomic effects by various mechanism.[90] There is increased incidence of macular degeneration associated with estrogen deficiency in post-menopausal women as has been observed by the Eye Disease Case–Control Study Group.[91]

5. Role of SSH in treatment of glaucoma has also been observed. There is ample literary evidence present which co relates the lowering of intraocular pressure (IOP) in post-menopausal females with estrogen treatment, as compared to no significant clinical effects in males and pre-menopausal females with similar therapeutic interventions. The hormonal control of IOP has been established by various studies which have shown an increase in IOP during the menstrual period and lowering of IOP with estrogen and progesterone in glaucoma patients.[92]
6. There is an increased evidence showing programmed cell death in different ocular tissues which is mediated by variable gene expression.[93] Melatonin, which is also secreted from retina, tends to control the hypothalamic neuroendocrine axis, thereby controlling the secretion of SSH.[94]
7. Various studies have shown a significant relationship between SSH and changes in corneal functions and topography under different physiological conditions. The same has been seen by the presence of estrogen receptors, progesterone receptors, and androgen receptors present in the corneal epithelium. The changes in the corneal curvature and thickness during pregnancy, premenstrual phase, and lactation can lead to visual changes and can have deranged performance due to vision disturbances.[95]

CENTRAL CORNEAL THICKENSS AND MENSTRUAL CYCLE

Change in central corneal thickness due to menstrual cycle is one of the important changes affecting various surgeries as well as day-to-day OPD procedures. The exact mechanism of effect of sex hormones on corneal thickness is not known. The proposed hypothesis is the action of estrogen on sodium and chloride balance and on the hydration of tissues; estrogen enhances sodium reabsorption by the tissue leading to water retention and edema.[6] Estrogen and progesterone can readily gain access to the cornea as sex receptors are present on corneal epithelium, via the aqueous humor or tear film due to their high lipid solubility[7]and exert their direct effect on the corneal tissue causing hydration of the cornea and increase in central corneal thickness.

There many studies have tried to find the co relationship between menstrual cycle and central corneal thickness but conclusive results were not find, as sample size was small, as well as, the results were different in different studies.

INTRAOCULAR PRESSURE AND MENSTRUAL CYCLE

The cyclic changes in estrogens and progesterone during the menstrual cycle are well documented.[96,97,98] The first peak of IOP, occurs from the 20th -22nd days, may be due to highest concentration of progesterone, which occurs during this period of menstrual cycle. The second peak of mean lOP, is seen from the 13th -15th days, maybe due to ovulation. Luteinizing hormone (LH) is necessary for ovulation process. Approximately two days before ovulation, secretion of LH by anterior pituitary gland increases for unknown reason which leads to increase in LH level from six-to tenfold and peaking about 16 hours before ovulation. The LH has the specific effect on the granulosa and theca cells of converting them more to progesterone secreting cells and less estrogen secretion. Therefore, the rate of secretion of estrogen begins to fall approximately one day prior to ovulation, while small amounts of progesterone begin to be secreted. Near ovulation, the higher levels of LH may be the reason of higher lOP value. Till now, there is no information regarding whether menstrual cycle (sex hormones) plays any role in the physiologic regulation of lOP.

This proposed hypothesis was tested by many studies, yet no conclusive results were not found.

As intraocular pressure is very important in diagnosing and treatment of glaucoma, one need to know the factor affecting it.

MATERIALS AND METHODS

Study setting

The study was conducted in Department of Ophthalmology, Dhiraj Hospital, SBKS medical institute and research center, Piparia, Vadodara Gujarat from May 2016 to September 2017. It is a multispecialty tertiary care center for patients from Vadodara as well as from its neighbouring villages.

Study Design

- Study was cohort.
- Sample size: 100 participants.
- Sample selection was random.

Inclusion Criteria

- Females with regular menstrual cycle.
- Age between 13 to 55 years

Exclusion Criteria

- Any active gynaecology diseases.
- Corneal pathologies like corneal scar, ectasia, trauma.
- Post refractive surgery.
- Participants taking drugs like hormonal drugs, Beta blockers, Diuretics, Oral Contraceptive pill, prostaglandins.
- Contact lens use.
- Participants with history of viral keratitis, simplex keratitis.
- Participants with any systemic disease like diabetes mellitus.

- Participants with connective tissue disorder.

Method of data collection

- Participants were selected on basis of inclusion and exclusion criteria.
- Written informed consent was taken from all patients prior to inclusion in the study.

Assessment of patient

100 participants were selected according to the inclusion and exclusion criteria at Dhiraj Hospital. Detailed present, past, menstrual and personal history was taken. All the individuals underwent routine ophthalmological examination. The visual acuity was checked with Snellen's chart. Complete eye examination was done using the slit lamp. Fundus was examined with indirect ophthalmoscope. Autore fractometry was done to check refractive error, dimensions of corneal curvature were evaluated using keratometry. Schirmer 1 and TBUT were also performed. Intraocular pressure and central corneal thickness were measured using Goldmann applanation tonometer and ultrasonic pachymetry on Days 1-3, Days 13-15 and Days 26-28 days of menstrual cycle (Day 1 being first day of menstruation)

Then following tests was performed on all the participants.

Goldmann Applanation Tonometery; Local anaesthetic drops were instilled and then the fluorescein strip is used to stain. The participant is asked to look straight ahead, with both eyes open wide, and fixed gaze. With the thumb, the patient's top eyelid is held up, taking care not to put any pressure on the eye. Blue light is directed from the slit lamp or the Perkins tonometer onto the prism head. Tonometer head is kept perpendicular to the eye. The tonometer is moved forward slowly until the prism rests

gently on the centre of the participant's cornea. With the other hand, calibrated dial is turned clockwise until the two fluorescein semi-circles in the prism head are seen to meet and form a horizontal 'S' shape. (Note: the correct end point is when the inner edges of the two fluorescein semi-circle images just touch). The reading is then multiplied with 10. A value of 10-21 mmhg is considered normal.

Pachymetry: Local anaesthetic is instilled in the eyes. Patient is asked to look straight ahead. The probe is held perpendicular to the cornea and moved forward until the probe touches the central cornea. Reading shown on the screen is noted. This is repeated twice in the same eye and average is taken.

Figure 5: Slit lamp bio-microscopic examination being performed

Figure 6: Goldmann applanation tonometry being performed

Figure 7: Ultrasound pachymetry being performed.

OBSERVATION AND RESULTS

A hospital based cohort study "STUDY OF CORNEAL THICKNESS CHANGES DURING DIFFERENT PHASES OF MENSTRUAL CYCLE." was conducted in a tertiary care centre in Western India (Gujarat) from May 2016 to September 2017. 100 participants were selected as per the pre-decided inclusion and exclusion criteria. The women included in the study aged from 19 years to 28 years with mean age of 22.15 years.

All participants went through complete ophthalmic examination and had normal anterior and posterior segment, including, schirmers 1 mean 15mm in 3.34 min (right eye, 15mm in 3.52 min (left eye); TBUT mean 9.61 sec (right eye), 9.30 sec (left eye) respectively.

All participants had regular menstrual cycle, with mean menstruation days of around 5 days.

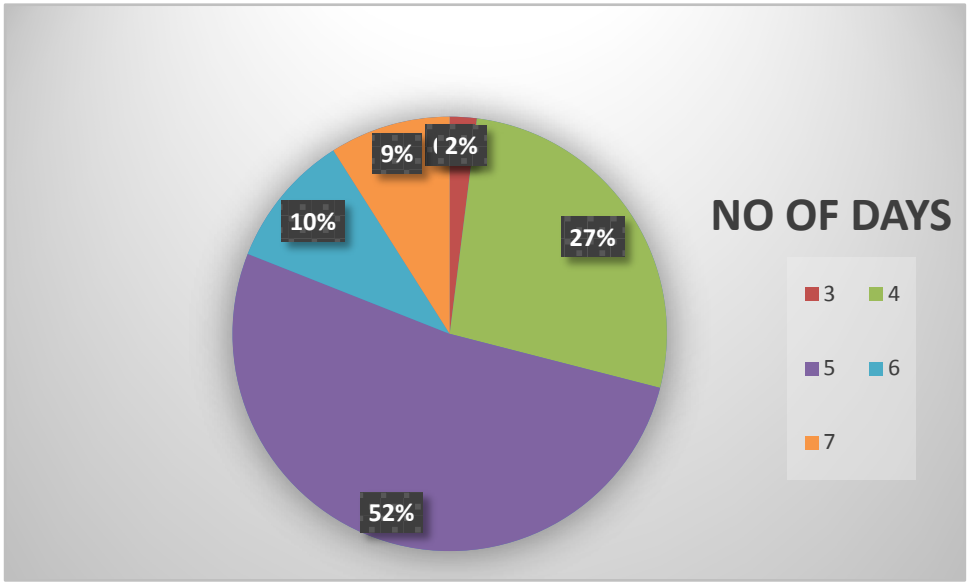
Table 1 shows the percentage distribution of the participants according to the days of menstruation.

TABLE-1: PERCENTAGE DISTRIBUTION ACCORDING TO NUMBER OF DAYS OF MENSTRUATION

Days Of Menstruation	**N**	**Perecentage(%)**
3	2	2
4	27	27
5	52	52
6	10	10
7	9	9

N: number of participants

CHART 1: DISTRIBUTION ACCORDING TO NUMBER OF DAYS OF MENSTRUATION



Participants had a menstrual cycle length mean of about 28.96 days ranging from 27 to 31 days. Table 2 shows a percentage distribution of participants according to menstrual cycle length.

TABLE-2: PERCENTAGE DISTRIBUTION ACCORDING TO MENSTRUAL CYCLE LENGTH

Menstrual cycle length (Days)	N	Percentage(%)
27	3	3
28	42	42
29	16	16
30	32	32
31	7	7

N: Number of participants.

CHART 2: DISTRIBUTION ACCORDING TO MENSTRUAL CYCLE LENGTH

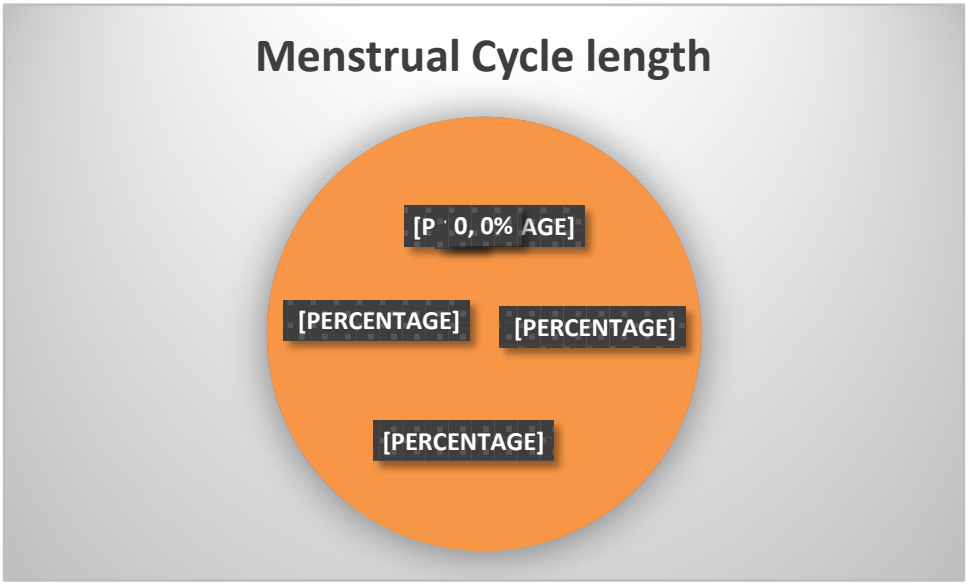


CHART-3: CENTRAL CORNEAL THICKNESS CHANGES DURING DIFFERENT PHASES OF MENSTRUAL CYCLE.

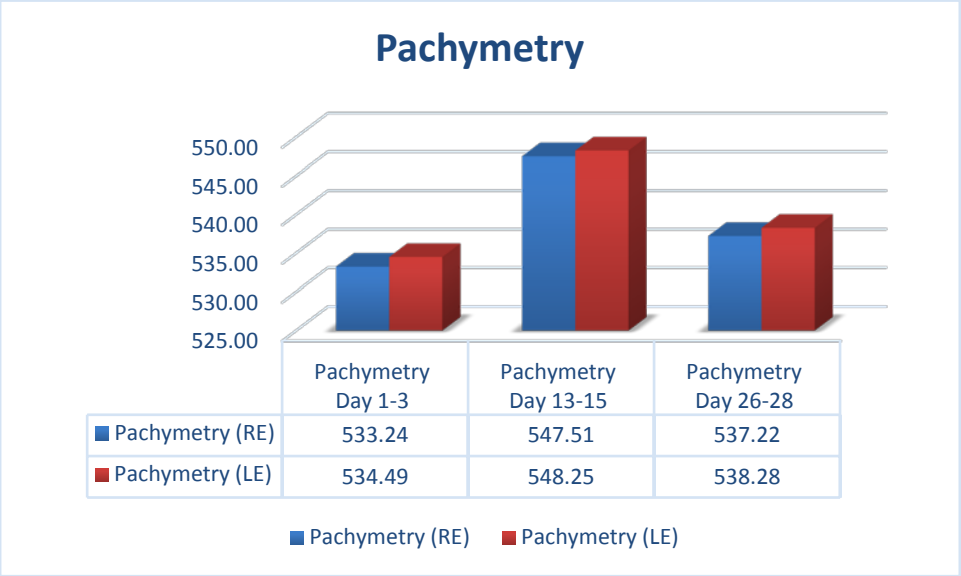


Chart 3 shows a central corneal thickness was thickest at the time of ovulation and thinnest at the time onset of menstruation in both eyes.

The central corneal thickness of right eye was thickest, at ovulation, with mean values of547.51±31.82(mean ± standard deviation). The mean values on days 26 to 28 was 537.22±29.62. Central corneal thickness was thinnest on days 1 to 3 with mean values of 533.24±22.44. Table 3 shows changes in right eye central corneal thickness during different phases of menstrual cycle, as we can see p value is 0.00, which is significant.

TABLE-3: RIGHT EYE CENTRAL CORNEAL THICKENSS CHANGES DURING MENSTRUAL CYCLE.

Pachymetry (Right Eye)	**N**	**Mean**	**SD**	**F Value**	**p value**
Pachymetry Day 1-3	100	533.24	29.444	156.238	**0.000**
Pachymetry Day 13-15	100	547.51	31.824		
Pachymetry Day 26-28	100	537.22	29.629		

N: Number of participants; Pachymetry: Central corneal thickness;

SD: Standard deviation

TABLE-4: PAIRWISE COMPARISON OF RIGHT EYE CENTRAL CORNEAL THICKNESSCHANGES DURING MENSTRUAL CYCLE

Pairwise Comparison					
Pachymetry (Right Eye)		**Std. Error**	**p value**	**95% Confidence Interval for Difference**	
				Lower Bound	**Upper Bound**
Pachymetry Day 1-3	Pachymetry Day 13-15	1.01	0.000	-16.722	-11.818
	Pachymetry Day 26-28	0.35	0.000	-4.837	-3.123
Pachymetry Day 13-15	Pachymetry Day 1-3	1.01	0.000	11.818	16.722
	Pachymetry Day 26-28	0.97	0.000	7.923	12.657
Pachymetry Day 26-28	Pachymetry Day 1-3	0.35	0.000	3.123	4.837
	Pachymetry Day 13-15	0.97	0.000	-12.657	-7.923

Pachymetry: Central corneal thickness;

On comparing value of central corneal thickness by Bonferroni method, in right eye there was a significant difference between Days 1-3 on comparison with Days 13-15 and Days 26-28 with p value being 0.000. These findings were seen on Days 13- 15 and Days 26-28 on comparison with other days with p value being 0.000 and 0.000 respectively as seen in table 4.

TABLE-5: LEFT EYE CENTRAL CORNEAL THICKENSS CHANGES DURING MENSTRUAL CYCLE

Pachymetry (Left Eye)	**N**	**Mean**	**SD**	**F Value**	**p value**
Pachymetry Day 1-3	100	534.49	30.087	134.974	**0.000**
Pachymetry Day 13-15	100	548.25	29.948		
Pachymetry Day 26-28	100	538.28	29.972		

N: Number of participants; Pachymetry: Central corneal thickness;

SD: Standard deviation

The central corneal thickness of left eye was thickest, at ovulation, with mean values of548.25±29.94 (mean ± standard deviation). The mean values on days 26 to 28 was 538.28±29.97. Central corneal thickness was thinnest on days 1 to 3 with mean values of 534.40±30.08. Table 5 shows changes in left eye central corneal thickness during different phases of menstrual cycle, as we can see p value is 0.00, which is significant (Table 5)

TABLE-6: PAIRWISE COMPARISON ON LEFT EYE CENTRAL CORNEAL THICKNESSCHANGES DURING MENSTRUAL CYCLE

Pairwise Comparison					
Pachymetry (Left Eye)	**Std. Error**		**p value**	**95% Confidence Interval for Difference**	
				Lower Bound	**Upper Bound**
Pachymetry Day 1-3	Pachymetry Day 13-15	1.02	0.000	-16.252	-11.268
	Pachymetry Day 26-28	0.39	0.000	-4.749	-2.831
Pachymetry Day 13-15	Pachymetry Day 1-3	0.39	0.000	11.268	16.252
	Pachymetry Day 26-28	1.02	0.000	7.482	12.458
Pachymetry Day 26-28	Pachymetry Day 1-3	0.39	0.000	2.831	4.749
	Pachymetry Day 13-15	1.02	0.000	-12.458	-7.482

Pachymetry: Central corneal thickness.

On comparing value of central corneal thickness by Bonferroni method, in left eye there was a significant difference between Days 1-3 on comparison with Days 13-15 and Days 26-28 with p value being 0.000. These findings were seen on Days 13- 15 and Days 26-28 on comparison with other days with p value being 0.000 and 0.000 respectively as seen in table 6.

CHART-4: INTRAOCULAR PRESSURE CHANGES DURING DIFFERENT PHASES OF MENSTRUAL CYCLE.

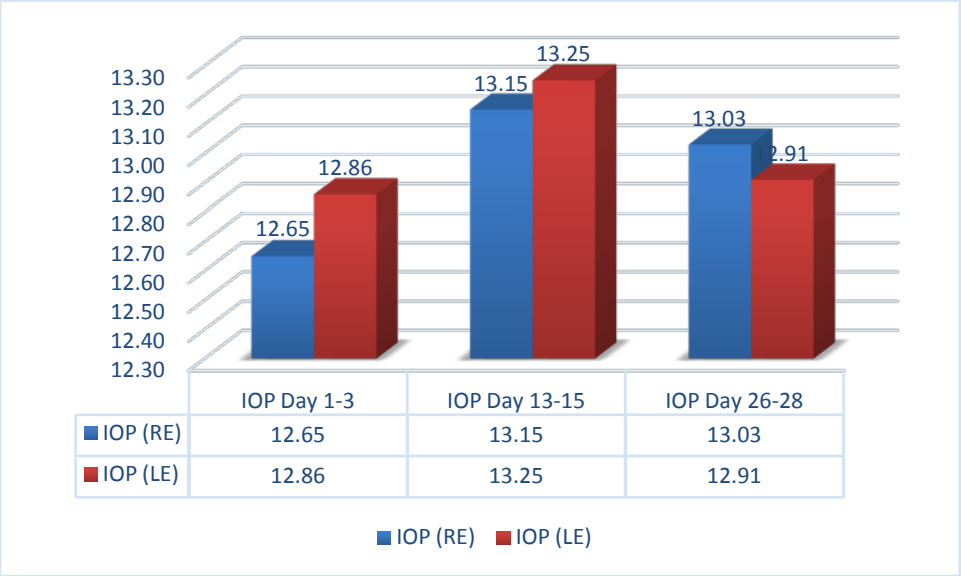


TABLE-7: RIGHT EYE INTRAOCULAR RESSURE CHANGES DURING MENSTRUAL CYCLE.

IOP (Right Eye)	**N**	**Mean**	**SD**	**F Value**	**p value**
IOP Day 1-3	100	12.65	2.40	10.905	**0.000**
IOP Day 13-15	100	13.15	2.29		
IOP Day 26-28	100	13.03	2.48		

IOP: Intraocular pressure; N: Number of participants

SD: Standard deviation

The Intraocular pressure of right eye was highest, at ovulation, with mean values of13.15±2.29(mean ± standard deviation). The mean values on days 26 to 28 was13.03±2.48. Intraocular pressure was lowest on days 1 to 3 with mean values of12.65±2.48. Table 7 shows changes in right eye intraocular pressure during different phases of menstrual cycle, as we can see p value is 0.00, which is significant.

TABLE-8: PAIRWISE COMPARISON ON RIGHT EYE INTRAOCULAR PRESSUE CHANGES DURING MENSTRUAL CYCLE

Pairwise Comparison					
IOP (Right Eye)		**Std. Error**	**p value**	**95% Confidence Interval for Difference**	
				Lower Bound	**Upper Bound**
IOP Day 1-3	IOP Day 13-15	0.09	0.000	-0.709	-0.291
	IOP Day 26-28	0.13	0.012	-0.693	-0.067
IOP Day 13-15	IOP Day 1-3	0.09	0.000	0.291	0.709
	IOP Day 26-28	0.12	0.918	-0.164	0.404
IOP Day 26-28	IOP Day 1-3	0.13	0.012	0.067	0.693
	IOP Day 13-15	0.12	0.918	-0.404	0.164

On comparing value of intraocular pressure by Bonferroni method, in right eye there was a significant difference between Days 1-3 on comparison with Days 13-15 and Days 26-28 with p value being 0.000, 0.012 respectively. There was significant difference on comparison of Days 13-15 to Days 1-3 p value being 0.000, but there was no significant difference on comparison with Days 26-28 with p value of 0.918. On comparing Days 26-28 with Days 1-3 there was significant change with p value of 0.15 but there was no significant difference seen with Days 13-15 with p value of 0.918 as seen in table 8.

TABLE-9: LEFT EYE INTRAOCULAR RESSURE CHANGES DURING MENSTRUAL CYCLE.

IOP (Left Eye)	N	Mean	SD	F Value	p value
IOP Day 1-3	100	12.86	2.165	11.916	0.000
IOP Day 13-15	100	13.25	2.086		
IOP Day 26-28	100	12.91	2.179		

IOP: Intraocular pressure; N: Number of participants

SD: Standard deviation

The Intraocular pressure of left eye was highest, at ovulation, with mean values of13.25±2.086(mean ± standard deviation). The mean values on days 26 to 28 was12.91±2.17. Intraocular pressure was lowest on days 1 to 3 with mean values of 12.86±2.165. Table 9 shows changes in left eye intraocular pressure during different phases of menstrual cycle, as we can see p value is 0.00, which is significant.

TABLE-10: PAIRWISE COMPARISON ON LEFT EYE INTRAOCULAR PRESSUE CHANGES DURING MENSTRUAL CYCLE

Pairwise Comparison					
IOP (Left Eye)		**Std. Error**	**p value**	**95% Confidence Interval for Difference**	
				Lower Bound	**Upper Bound**
IOP Day 1-3	IOP Day 13-15	0.10	0.000	-0.403	0.103
	IOP Day 26-28	0.11	0.015	-0.321	0.221
IOP Day 13-15	IOP Day 1-3	0.10	0.000	-0.103	0.403
	IOP Day 26-28	0.10	0.896	-0.156	0.356
IOP Day 26-28	IOP Day 1-3	0.11	0.015	-0.221	0.321
	IOP Day 13-15	0.10	0.896	-0.356	0.156

On comparing value of intraocular pressure by Bonferroni method, in left eye there was a significant difference between Days 1-3 on comparison with Days 13-15 and Days 26-28 with p value being 0.000, 0.015 respectively. There was significant difference on comparison of Days 13-15 to Days 1-3 p value being 0.000, but there was no significant difference on comparison with Days 26-28 with p value of 0.896. On comparing Days 26-28 with Days 1-3 there was significant change with p value of 0.15 but there was no significant difference seen with Days 13-15 with p value of 0.896 (table10).

DISCUSSION

The central corneal thickness changes under the influence of changing hormones level during menstrual cycle has been previously noted in many studies. Giuffre *et al*, in a study on 16 healthy women of reproductive age assessed central corneal thickness at 3 points, on days 1 to 3 and again at ovulation and at the end of the cycle (days 27-32). They found that the central cornea was thinnest at the beginning of the cycle (mean = 536 micron). Corneal thickness increased at ovulation (mean = 549 micron) and at the end of the cycle (mean = 559 micron). The difference in corneal thickness was statistically significant at ovulation (P = 0.003) and the end of cycle (P = 0.001) compared with values at the beginning of the cycle.[99]

Goldich *et al*, studied 22 women of mean age 19.5 years ± 1.5 [SD]) and found that the central cornea was thinnest at the beginning (535 μm)and statistically significantly thicker at ovulation (542 μm, P<.001) and at the end of the menstrual cycle (543 μm, P<.001) like in previous study.[100]

Ghahfarokhi NA *et al*, included fifty healthy women with normal past medical history. Central corneal thickness was measured with ultrasound pachymeter. Mean corneal thickness was thinnest on days 1 to 3, 541.40 ± 11.36 and 540.82 ± 11.70 microns for left and right eyes respectively. Mean thickness increased to 556.50 ± 7.11 and 555.98 ± 7.26 microns for left and right eyes respectively at time of ovulation, and at the end of the cycle, the corneal thickness turned in to 536.38 ± 12.83 and 535.48 ± 13.08 microns for left and right eyes respectively, and this data was statistically significant.[101]Our study is also in accordance with these studies as the central corneal thickness was thickest, at ovulation, and thinnest at the beginning with means values of central corneal thickness on days 1-3 533.24±22.44,

534.40±30.08(right eye, left eye respectively), days13-15 547.51±31, 548.25±29.94 (right eye, left eye respectively) and days 26-28 537.22±29.62 538.28±29.97 (right eye, left eye respectively), these changes may be cause of estrogen changes as they are present on the corneal epithelium and causes hydration of the central corneal thickness.

However, Harun Çakmak *et al*, in their study of 22 healthy women between the ages of 19 and 36 years with regular menstrual cycles did not find any major difference in central corneal thickness as mean values at beginning of cycle was 528±38.18, at time of ovulation was 528.64± 37.88, at the end of cycle was 529.82± 38.12 which was statistically insignificant p value of 0.498.[102]

Soni PS, studied in a group of 8 women and observed that the minimal corneal thickness occurred just before ovulation and the thickest cornea was seen at the beginning and end of the menstrual cycle.[103] The study of Feldman *et al*, included 11 women of reproductive age group and found that thinnest corneal thickness occurred just before ovulation.[104] As the size in the study was less and ultrasonic pachymetry was not used these study the results can not be relied on.

Kishor *et al*, [105] studied 50 menstruating women at the department of ophthalmology at Sri Lakshmi Narayana institute of Medical. Sciences, they noticed that increase intraocular pressure (IOP) from follicular and luteal phases were 15.16 and 16.892 respectively with p value of 0.003 in right eye. In left eye it was 15.638 and 16.99 with p value of 0.007.

While Brindha *et al* [106] studied 46 healthy females with regular menstrual cycle were included, who had no ophthalmic manifestations, noted that there was a mild increase in the mean IOP in luteal phase (from 15 day to start of menstruation) of both the eyes when compared to menstrual and proliferative phase though the value of is $P > 0.05$ which is statistically insignificant. Misra *et al* [107] studied 42 healthy females with regular menstrual cycle and found that cyclical variation in intraocular tension with a rise during the premenstrual phase (follicular phase), but only in 7 participants, thus making sample size very less to rely on. So both the studies had insignificant result.

On the other hand, Prajna *et al*[108] studied 75 female volunteers aged between 18-25 years (N=75). Out of the 75 volunteers, 62-66% subjects exhibited a significant increase in IOP. Most of them showed increase in intraocular pressure during follicular phase. Bankes *et al*[109] included almost 2000 women. The lowest mean tension was found to coincide with the twenty-first to the twenty-fourth (luteal phase) days of the cycle, and the highest mean tension occurred from the ninth to the twelfth day (follicular phase). Likewise, in our study the Intraocular pressure was highest during ovulation (follicular phase) and lowest at the beginning of the menstrual cycle. The comparison of Days 1-3 to other days showed significant difference but other days when compared did not show significant difference as p values were high. The values of intraocular pressure were on days 1-3, 12.65±2.48,12.86±2.165(right eye,

left eye respectively) and on days 13-15, 13.15± 2.29, 13.25± 2.086(right eye, left eye respectively).

Yet there is significant increase in intraocular pressure seen from starting of the menstrual cycle to beginning of menstruation phase, signifying increase in IOP during follicular phase. This peak of IOP occurring from 13-15 day, may be due to ovulation. Luteinzing hormone (LH)is required for ovulatory phase. The rate of secretion of LH by the anterior pituitary gland increases markedly, rising six to tenfold and peaking about 16 hours before ovulation. So, LH may play a role in physiologic regulation of IOP.

Further studies are required to see the changes in intraocular pressure during different phases of menstrual cycle, which should include more days of data collection on luteal and follicular phase as well as keep diurnal variation also in check.

SUMMARY AND CONCLUSION

The present hospital based cohort study "STUDY OF CORNEAL THICKNESS CHANGES DURING DIFFERENT PHASES OF MENSTRUAL CYCLE" was conducted in a tertiary care centre in Western India (Gujarat) from May 2016 to September 2017.

Total of 100 participants were included in the study. In this study a significant difference was seen in the central corneal thickness during various phases of menstrual cycle. The CCT of right eye mean value; at ovulation, on days 26 to 28, on days 1 to3, 547.51±31.82,537.22±29.62, 533.24±22.44 respectively, the left eye also showed similar results with mean value; at ovulation, on days 26 to 28, on days 1 to 3, 548.25±29.94, 538.28±29.97, 534.40±30.08. Thus it is clear that central corneal thickness is highest during 13-15 days of menstrual cycle and lowest at the beginning of the menstrual cycle. A difference of almost 14μm was seen from the beginning of the menstrual cycle and ovulation. The intraocular pressure was higher in both eyes at ovulation in comparison to beginning of the cycle it increased from increasing from beginning of the menstrual cycle to ovulation with mean values on days 1-3 was 12.65±2.48,12.86±2.165(right eye, left eye respectively) and on days 13-15 was 13.15± 2.29,13.25± 2.086(right eye, left eye respectively). Accordingly, in current study small increase in Intraocular pressure of around 0.50mmhg was only seen, which is not very significant.

Since the present study is hospital based with a sample size of only 100, and we did not use urine test for hormones level, further studies are required with higher number of participants and urine tests for hormone levels analysis to yield better results.

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ANNEXURES

1. Annexure 1: Abbreviations
2. Annexure 2: Patient information sheet (English)
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4. Annexure 4: Consent form (English)
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ANNEXURE 1

LIST OF ABBREVIATIONS

TBUT – Tear film break up time

UCVA – Uncorrected visual acuity

BCVA – Best corrected visual acuity

IOP – Intraocular pressure

CCT – Central corneal thickness

SSH – Sex steroid hormone

LASIK –laser assisted in situ keratomileusis

PRK –Photorefractive keratectomy

hCG–human chorionic gonadotropin

ANNEXURE 2

PARTICIPANT INFORMATION SHEET

Study Title: STUDY OF CORNEAL THICKNESS CHANGES DURING DIFFERENT PHASES OF MENSTRUAL CYCLE

1. Introduction

Cornea plays a very important part in the refractive power of the eye as explained earlier even the slightest of change occurring in corneal thickness leads to change in refractive power of the eye. Refractive surgeries aims at altering the corneal parameters hence changes in the corneal thickness or curvature have implications in determing the visual outcome of the refractive surgeries.

2. What is the purpose of this study?

The study will help us to know whether there is any significant change in corneal thickness during different phases of menstrual cycle.

3.Why have I been chosen?

Healthy females in reproductive age groups are chosen to see the alteration in corneal thickness during 3 phases of menstruation

4.Do I have to take part?

It is voluntary participation in the study program.

5.How long will the study last?

Until I complete 100 eyes.

6.What will happen to me if I take part?

- *Screening Period*: Participants complete ophthalmic evaluation including IOP, pachymetry is to be done.
- *Treatment Period:n/a*

- *Allocation of investigational product:n/a*

- *Follow-up period: on follow ups during 1-3,13-15,26-28 day of menstrual cycle pachymetry, vision, autorefraction, schirmers, tbut, k1, k2 to be repeated.*

7.What do I have to do?
After agreeing to participate in the study, the patients should extend full support. They should provide real facts when inquired into.

8.What is the drug being tested?
no new drug or procedure is being tested.

9.What are the benefits of the study?
. Refractive surgeries aims at altering the corneal parameters hence changes in the corneal thickness or curvature have implications in determing the visual outcome of the refractive surgeries.

10.What are the alternatives for treatment?

11.What are the side effects of the treatment received during the study?
Since, no new drug or procedure is being tested, there is no additional risk anticipated, for which you may need any protection or security.

12.What if new information becomes available?

13.What happens when the study stops?

14.What if something goes wrong?
If something goes wrong, will make sure that patient is not affected in any case.

15.Will my taking part be kept confidential?
Participants data and records collected will be kept confidential and secured.

16.What else should I know? NA

17.Additional Precautions NA

18.Who to call with questions?
Dr . POONAM RANA (9099340446)

ANNEXURE 3

ભાગીદારીમાહિતીશીટ

અભ્યાસશીર્ષક :STUDY OF CORNEAL THICKNESS CHANGES DURING DIFFERENT PHASES OF MENSTRUAL CYCLE

1. પરિચય

અગાઉપણકોર્નનિયલજાડાઈબનતુંફેરફારસહેજઆંખપ્રત્યાવર્તનક્ષમશક્તિબદલીતરફદોરી જાયછેસમજાવીતરીકેકોર્નીયાઆંખપ્રત્યાવર્તનક્ષમશક્તિએકખૂબજમહત્વપૂર્ણભાગભજવેછે. પ્રત્યાવર્તનક્ષમશસ્ત્રક્રિયાતેથીકોર્નનિયલજાડાઈઅથવાવળાંકપ્રત્યાવર્તનક્ષમશસ્ત્રક્રિયાદ્રશ્ય પરિણામdeterminગમાંબંધનોહોઈફેરફારકોર્નનિયલપરિમાણોફેરફારકરવાનોછે.

2. આઅભ્યાસહેતુશુંછે?

આઅભ્યાસમાંમાસિકસ્રાવનીઅલગતબક્કાઓદરમિયાનકોર્નનિયલજાડાઈકોઇનોંધપાત્રફેર ફારથયોછેકેકેમતેજાણવામાટેમદદકરશે.

3.શામાટેહુંપસંદકરવામાંઆવીછે?

તંદુરસ્તમહિલાઓinreproductiveવયજૂથોમાસિકસ્રાવ 3 તબક્કાઓદરમિયાનકોર્નનિયલજાડાઈમાંફેરફારજોવામાટેપસંદકરવામાંઆવેછે

4. મારેભાગલેવાહોયછે?

તેઅભ્યાસકાર્યક્રમએકસંપૂર્ણપણેસ્વૈચ્છિકભાગીદારીછે.

5.અભ્યાસકેટલોલાંબોચાલશે??

100 સહભાગીઓ સમાવેશસુધી

6.હુંભાગલઉંતોમનેશુંથશે?

•સ્ક્રીનીંગપીરિયડ: IOP સહિતદર્દીઓસંપૂર્ણનેત્રચેક, pachymetryકરીશકાયછે.

•સારવારપીરિયડ:

શોધરૂપીઉત્પાદનફાળવણી •:

•અનુસરોઅપપીરિયડ:.ફોલોઅપ્સપરદરમિયાન 1-3,13-15,26-28, માસિકચક્રpachymetry

2દિવસ, દ્રષ્ટિ, autorefraction schirmers tbut, K1, K2 પુનરાવર્તનકરવાની,

7.મારેશુંકરવાનુંછે?
અભ્યાસમાંભાગસંમતથયાપછી, દર્દીઓસંપૂર્ણઆધારવિસ્તારવાજોઈએ.
તપાસત્યારેતેઓવાસ્તવિકહકીકતોપૂરીપાડવીજોઇએ.

8.શુંડ્રગપરીક્ષણકરવામાંઆવેછે?
કોઈનવીદવાઅથવાપ્રક્રિયાપરીક્ષણકરવામાંઆવેછે ,.

9.અભ્યાસમાંશુંફાયદાછે?
પ્રત્યાવર્તનક્ષમશસ્ત્રક્રિયાતેથીકોર્નનિયલજાડાઈઅથવાવળાંકપ્રત્યાવર્તનક્ષમશસ્ત્રક્રિયાદ્રશ્ય પરિણામdetermingમાંબંધનોહોઈફેરફારકોર્નનિયલપરિમાણોફેરફારકરવાનોછે.

10.સારવારમાટેવિકલ્પોશુંછે?

11.અભ્યાસદરમિયાનપ્રાપ્તસારવારનીઆડઅસરોશુંછે?
કોઈનવીદવાઅથવાપ્રક્રિયાપરીક્ષણકરવામાંઆવીરહીછે,
કારણકેજોતમેકોઇરક્ષણઅથવાસુરક્ષાજરૂરપડીશકેછે,
જેનામાટેઅપેક્ષિતકોઈવધારાનાજોખમછે.

12.નવીમાહિતીઉપલબ્ધબનેત્યારેશુંકરવામાંઆવશે?
અભ્યાસઅટકેછેજ્યારે
13.અભ્યાસનાઅંતેતેનુંશુંથશે?

14.જોકઈખોટુંથાયતો?
કંઈકખોટુંથાયતો ,દર્દીકોઈપણસંજોગોમાંઅસરથતીનથીકેખાતરીરાખવામાંઆવશે.

15.મારોભાગલેવાનીબાબતગુપ્તરાખવામાંઆવશે?
હા. તમારા નામ પણ ગુપ્ત રાખવામાં આવશે.

16.મારેબીજુંશુંજાણવુંજોઈએ? NA
17.વધારાનીસાવચેતી NA

18.પ્રશ્નોઉભાથતાકોનેકૉલકરવા?
નામ: ડો. પૂનમરાણા (9099340446)

ANNEXURE 4

Informed Consent Form (ICF) for Participants in

Research Programmes involving studies on human beings

Study Title: - STUDY OF CORNEAL THICKNESS CHANGES DURING DIFFERENT PHASES OF MENSTRUAL CYCLE.

(i) I confirm that I have read and understood the information

(ii) I understand that my participation in the study is voluntary and

(iii) I understand that the Sponsor of the clinical trial, others

(iv) I agree not to restrict the use of any data or results that arise from this

(v) I agree to take part in the above study and have had the opportunity to ask questions, that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. Working on the Sponsor's behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. I agree to this access.

However, I understand that my identity will not be revealed in any information released to third parties or published in a study provided such a use is only for scientific purpose(s).

Signature/Thumb impression) of the Subject:

Date: / /

Signatory's Name:

Signature of the Investigator:

Date: / /

Study Investigator's Name:

Signature of the Impartial Witness

Date: / _ /

Name of the Witness:

ANNEXURE 5

ઇન્ફોર્મડકન્સેન્ટફોર્મ

અભ્યાસનુંશીર્ષક: - STUDY OF CORNEAL THICKNESS CHANGES DURING DIFFERENT PHASES OF MENSTRUAL CYCLE.

(1) મેંવાંચીઅનેમાહિતીસમજીછેતેનીખાતરી

(2) અભ્યાસમાંમારોસહયોગસ્વૈચ્છિકછે.

(3) હુંસમજીકેક્લિનિકલટ્રાયલસ્પોન્સર, અન્ય

(4) હુંઆમાંથીપેદાથાયછેકેજેકોઈપણમાહિતીઅથવાપરિણામોઉપયોગપ્રતિબંધિતનથીસંમત

(5) હુંઉપરઅભ્યાસમાંભાગલેવામાટેસંમતથાયછે.

શીટકઉપરઅભ્યાસઅનેમાટેઆવીહોયતકપ્રશ્નોપૂછો.

હુંકોઇપણઆપ્યાવગર,કોઈપણસમયેપાછીખેંચીમુક્તછુંકેમારાતબીબીકાળજીઅથવાકાનૂની અધિકારોવગરકારણઅસરથાયછે.

સ્પોન્સરવતીકામકરતાએથિક્સસમિતિઅનેનિયમનકારીસત્તાવાળાઓજોવામાટેમારાપરવા નગીજરૂરનથીમારાઆરોગ્યરેકોર્ડબંનેવર્તમાનઅભ્યાસઆદરઅનેતેસંબંધમાંહાથધરવામાંક રીશકાયછેકેજેકોઈપણવધુસંશોધન, પણહુંટ્રાયલખસીતો.

હુંઆએક્સેસકરવામાટેસંમતથાયછે. જોકે,

હુંમારીઓળખજાહેરકરવામાંઆવશેનહીંસમજેછેકેકોઇમાહિતીતૃતીયપક્ષોમાટેરજૂઅથવાપ્રકા શિત. અભ્યાસઆવાઉપયોગમાત્રવૈજ્ઞાનિકહેતુમાટે (ઓ) છેપૂરીપાડવામાંઆવિષય.

સહી / અંગૂઠાનીછાપ):

તારીખ: / /

સહીનામ:

તપાસનીસનીસહી:

તારીખ: / /

તપાસનીશનામ

સાક્ષીહસ્તાક્ષર

તારીખ: / _/

સાક્ષીનામ:

Annexure 6

PROFORMA FOR THESIS

Sr. No:
Date:

Name of Patient:-

Date of birth:-

Age/Sex/Occupation:-

Address/Contact no.:-

OPD number:-

IPD number:-

Chief Complaints:

Refraction Status:-

- H/O Glasses:
- H/O redness/discharge/pain/photophobia
- H/O ocular surgery/trauma/ocular disease
- H/O any systemic illness:

  (DM/HTN/COPD/Arthritis/Asthama/Allergy
- H/O of medication / oral contraceptives

Visual Acuity:-

	R.E	L.E
Vision (unaided)		
Vision with spectacles		
Present Spectacle power		
Vision with pinhole		
Auto Refractometer		
Best Corrected Visual Acuity		
Schirmer 1		
TBUT		

R.E L.E

-Head Posture:-

-Eye position:-

-Ocular Motility:-

-Lids/Lashes:-

-Conjunctiva:-

-Cornea:-

-Corneal Sensitivity:-

-Anterior Chamber:-

-Iris:-

-Pupil:-

-Lens:

Slit Lamp Examination:-

ST/PMT:

FUNDUS EXAM :

MENSTRUAL HISTORY

1.LMP:

2.Menstrual pattern

1. Cycle length
2. Duration of flow
3. Amount of flow

DAY OF MENSTRUAL CYCLE		**DAY 1-3**	**DAY 13-15**	**DAY 26-28**
INTRA OCULAR PRESSURE	**RT EYE**			
	LT EYE			
PACHYMETRY	**RT EYE**			
	LT EYE			

ANNEXURE 7

Key to Master chart

OD – Right eye

OS – Left eye

OU – Both eyes

Sr. No. – Serial number

H/O – History of

DM – Diabetes mellitus

HTN – Hypertension

mm – millimetre

sec – Seconds

min – Minutes

CASE No	Age	H/o Glasses	H/O Discharge / Pain/ Photophobia	H/o Ocular Surgery/trauma /ocular disease	H/o Systemic illness DM/HTN/ASTHMA	H/o Medication / Contraceptives	Uncorrected visual aquity		Best Corrected Visual Aquity		Vision with Spectacle		Auto Refractor		Anterior Segment	Posterior Segment	Keratometry		Schirmers		Tear Film Break Up Time		Menstrual history		Intraocular Pressure						Pachymetry(micrometer)					
																									Day 1-3		Day 13-15		Day 26-18		Day 1-3		Day 13-15		Day26-28	
							OD	OS	OD	OS	OD	OS	OD	OS			OD	OS	OD	OS			Cycle	Durati	OD	OS	OD	OS	OD	OS	OD	OS	OD	OS	OD	OS
1	23years	YES	NAD	NAD	NAD	NAD	6/18	'6/18	6/6	'6/6	'6/6	'6/6	-1.00/-0.50*10	-0.75/-0.75*167	WNL	WNL	Steep:45.85 Flat:44.60	Steep:45.75 Flat:44.85	15mm in 3 min	15mm in 3min	10 sec	10 sec	28 Days	7 Days	12mmhg	12mmhg	12mmhg	15mmhg	15mmhg	14mmhg	490	501	500	510	488	500
2	25years	YES	NAD	NAD	NAD	NAD	6/36	6/36	'6/6	'6/6	'6/6	'6/6	+0.75/-2.25*180	+0.75/-1.75*97	WNL	WNL	Steep:46.78 Flat:43.97	Steep:46.56 Flat:44.26	15mm in 4 min	15mm in 3min	10sec	11sec	29 Days	5 Days	14mmhg	14mmhg	15mmhg	15mmhg	15mmhg	15mmhg	560	560	574	572	564	563
3	26years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			-0.25dsp	-0.50*148	WNL	WNL	Steep:42.98 Flat:42.28	Steep:43.38 Flat:42.41	15mm in 4 min	15mm in 3min	10 sec	10sec	31 Days	7 Days	11mmhg	13mmhg	11mmhg	13mmhg	12mmhg	13mmhg	570	576	579	587	575	573
4	24years	YES	NAD	NAD	NAD	NAD	6/6(p)	6/6(p)	'6/6	'6/6	'6/6	'6/6	-0.50dsp	-0.50dsp	WNL	WNL	Steep:42.00 Flat:41.75	Steep:42.04 Flat:41.64	15mm in 5 min	15mm in 4min	11sec	11sec	27 Days	8 Days	13mmhg	14mmhg	14mmhg	14mmhg	13mmhg	15mmhg	530	530	546	542	538	540
5	24years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	6/6	'6/6	..	..	-0.50/-1.00*175	-0.25/-1.00*10	WNL	WNL	Steep:41.80 Flat:40.85	Steep:42.15 Flat:41.15	15mm in 3min	15mm in 4 min	10 sec	10 sec	28 Days	5 Days	14mmhg	14mmhg	14mmhg	14mmhg	12mmhg	13mmhg	543	550	558	560	548	547
6	24years	NO	NAD	NAD	NAD	NAD	6\9	6\9	'6/6	'6/6			-0.75dsp	-0.50dsp	WNL	WNL	Steep:42.55 Flat:42.35	Steep:42.25 Flat:41.85	15mm in 3 min	15mm in 4 min	11 sec	11 sec	28 Days	5 Days	12mmhg	12mmhg	13mmhg	13mmhg	12mmhg	14mmhg	509	507	520	521	518	516
7	25years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	-0.25/0.25*175	-0.25dsp	WNL	WNL	Steep:41.37 Flat:41.25	Steep:41.30 Flat:41.15	15mm in 2mim	15mm in 3 min	10 sec	10 sec	28 Days	5 Days	10mmhg	11mmhg	10 mmhg	11mmhg	11mmhg	11mmhg	509	508	519	517	508	506
8	28years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	+0.50dsp	+0.25dsp	WNL	WNL	Steep:40.57 Flat:40.26	Steep:40.38 Flat:40.47	15mm in 3min	15mm in 3 min	9 sec	11 sec	28 Days	5 Days	15mmhg	16mmhg	16mmhg	16mmhg	18mmhg	15mmhg	502	504	512	513	507	506
9	23years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			+0.25dsp	0.00	WNL	WNL	Steep:40.64 Flat:40.41	Steep:41.22 Flat:41.03	15mm in 3 min	15mm in 3min	10 sec	9 sec	28 Days	5 Days	10mmhg	9mmhg	10mmhg	9mmhg	9mmhg	9mmhg	511	513	522	524	515	516
10	22years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	+0.25dsp	+0.25/+0.25*118	WNL	WNL	Steep:40.27 Flat:40.16	Steep:40.48 Flat:40.18	15mm in 3 min	15mm in 4 min	10 sec	9 sec	30 Days	5 Days	16mmhg	16mmhg	15mmhg	17mmhg	15mmhg	16mmhg	510	511	525	525	515	519
11	26years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			-0.25/-0.25*116	-0.25dsp	WNL	WNL	Steep:42.10 Flat41.95	Steep:42.38 Flat:42.25	15mm in 3 min	15mm in 3 min	10 sec	10 sec	29 Days	5 Days	10mmhg	11mmhg	10mmhg	11mmhg	11mmhg	10mmhg	532	534	548	550	543	548
12	24years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	-0.25 dsp	-0.25/-0.25*110	WNL	WNL	Steep:42.34 Flat:42.09	Steep:42.21 Flat:42.16	15mm in 2 min	15 mm in 3 min	8 sec	8 sec	29 Days	4 Days	16mmhg	17mmhg	19mmhg	17mmhg	19mmhg	19mmhg	512	514	526	530	518	519
13	22 years	YES	NAD	NAD	NAD	NAD	CF 3mt	CF 3mt	6/6	'6/6	'6/6	'6/6	5.75dsp	-5.50/-0.25*84	WNL	WNL	Steep:42.60 Flat:42.25	Steep:42.60 Flat:42.20	15mm in 4 min	15mm in 4 min	11 sec	11 sec	31 Days	5 Days	17mmhg	17mmhg	16mmhg	18mmhg	17mmhg	16mmhg	524	524	535	536	524	525
14	22 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	-0.25/-0.25*146	-0.25/-0.50*21	WNL	WNL	Steep:42.75 Flat:42.10	Steep:42.50 Flat:42.05	15mm in 3 min	15 mm in 3 min	10 sec	11 sec	28 Days	4 Days	18mmhg	18mmhg	17mmhg	18mmhg	17mmhg	17mmhg	583	600	594	612	591	610
15	21 years	YES	NAD	NAD	NAD	NAD	6\9	6\24	'6/6	'6/6	'6/6	'6/6	-1.25/-0.50*175	-2.75	WNL	WNL	Steep:41.70 Flat:40.70	Steep:41.70 Flat:41.10	15mm in 3 min	15mm in 4 min	11 sec	11 sec	28 Days	5 Days	18mmhg	15mmhg	19mmhg	16mmhg	18mmhg	16mmhg	570	576	583	588	579	580
16	22 years	YES	NAD	NAD	NAD	NAD	6\6(p)	6\6(p)	'6/6	'6/6	6/6	'6/6	-0.50*11	-0.50*11	WNL	WNL	Steep:41.65 Flat:40.90	Steep:41.90 Flat:40.90	15mm in 3 min	15mm in 2 min	10 sec	9 sec	30 Days	4 Days	17mmhg	17mmhg	16mmhg	17mmhg	17mmhg	16mmhg	510	500	521	515	505	510

CASE No	Age	H/o Glasses	H/O Discharge / Pain/ Photophobia	H/o Ocular Surgery/trauma /ocular disease	H/o Systemic illness DM/HTN/ASTHMA	H/o Medication / Contraceptives	Uncorrected visual aquity		Best Corrected Visual Aquity		Vision with Spectacle		Auto Refractor		Anterior Segment	Posterior Segment	Keratometry		Schirmers		Tear Film Break Up Time		Menstrual history		Intraocular Pressure						Pachymetry(micrometer)					
17	22 years	YES	NAD	NAD	NAD	NAD	6/60	6/60	'6/6	'6/6	'6/6	'6/6	-1.50/-2.50*57	-0.50/-0.50*116	WNL	WNL	Steep:46.90 Flat:44.10	Steep:44.55 Flat:43.25	15mm in 4 min	15mm in 3 min	10 sec	8 sec	30 Days	4 Days	18mmhg	19mmhg	19mmhg	19nnhg	19mmhg	19mmhg	502	502	514	513	510	508
18	20 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	-0.50/-0.50*23	-1.00dsp	WNL	WNL	Steep:42.60 Flat:41.60	Steep:41.60 Flat:42.10	15mm in 3 min	15mm in 4 min	10 sec	9 sec	31 Days	6 Days	16mmhg	16mmhg	16mmhg	17mmhg	16mmhg	14mmhg	565	566	578	578	570	572
19	19 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	-0.75dsp	-0.75dsp	WNL	WNL	Steep:42.90 Flat:42.60	Steep:42.25 Flat:42.10	15mm in 4 min	15 mm in 3 min	10 sec	11 sec	28 Days	5 Days	10mmhg	12mmhg	11mmhg	13mmhg	11mmhg	12mmhg	548	550	560	562	555	558
20	20 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	+0.50/+0.50*101	+0.50dsp	WNL	WNL	Steep:42.05 Flat:41.65	Steep:42.15 Flat:42.05	15mm in 4 min	15 mm in 5 min	10 sec	9 sec	28 Days	4 Days	14mmhg	14mmhg	13mmhg	14mmhg	14mmhg	14mmhg	616	616	626	628	605	607
21	20 years	YES	NAD	NAD	NAD	NAD	6\9(P)	6\6(P)	'6/6	'6/6	'6/6	'6/6	-0.75dsp	-0.75dsp	WNL	WNL	Steep:44.40 Flat:43.95	Steep:44.45 Flat:43.90	15mm in 3 min	15 mm in 3 min	9 sec	9 sec	28 Days	6 Days	17mmhg	14mmhg	16mmhg	14mmhg	16mmhg	12mmhg	577	576	590	589	583	583
22	20 years	YES	NAD	NAD	NAD	NAD	CF 4mt	CF 4mt	'6/6	'6/6	'6/6	'6/6	-3.50/-0.50*62	-4.25dsp	WNL	WNL	Steep:41.05 Flat:39.35	Steep:41.15 Flat:39.75	15mm in 4 min	15mm in 4 min	10 sec	11 sec	28 Days	4 Days	14mmhg	14mmhg	15mmhg	14mmhg	15mmhg	16mmhg	563	568	674	580	574	580
23	20 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	+0.50*174	+0.25*/6/	WNL	WNL	Steep:42.25 Flat:41.65	Steep:42.10 Flat:41.65	15mm in 3 min	15 mm in 4 min	10 sec	10 sec	27 Days	6 Days	16mmhg	15mmhg	16mmhg	16mmhg	16mmhg	14mmhg	587	586	600	600	590	592
24	20 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	-0.75*108	-0.50*171	WNL	WNL	Steep:43.40 Flat:42.00	Steep:44.35 Flat:43.75	15mm in 4 min	15 mm in 4 min	10 sec	10 sec	30 Days	5 Days	13mmhg	13mmhg	12mmhg	14mmhg	13mmhg	12mmhg	525	525	535	536	523	525
25	20 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			+0.25*124	+0.25*13	WNL	WNL	Steep:42.30 Flat:42.15	Steep:42.45 Flat:42.15	15mm in 3 min	15 mm in 3 min	10 sec	8 sec	28 Days	4 Days	15mmhg	17mmhg	17mmhg	18mmhg	16mmhg	16mmhg	534	534	544	545	540	541
26	20 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	-0.75/-0.25*180	-0.50/-0.25*93	WNL	WNL	Steep:41.75 Flat:41.15	Steep:41.65 Flat:41.35	15mm in 4 min	15 mm in 4 min	9 sec	10 sec	27 Days	4 Days	17mmg	17mmhg	16mmhg	17mmg	17mmhg	16mmhg	620	621	632	632	628	629
27	20 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			-0.25dsp	-0.25/-0.50*28	WNL	WNL	Steep:41.50 Flat:41.25	Steep:41.45 Flat:41.34	15mm in 4 min	15 mm in 4 min	10 sec	10 sec	28 Days	4 Days	17mmhg	17mmhg	16mmhg	17mmhg	16mmhg	16mmhg	455	458	469	469	460	461
28	20 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	-0.50dsp	-0.25dsp	WNL	WNL	Steep:42.35 Flat:41.05	Steep:42.15 Flat:41.65	15mm in 3 min	15mm in 3 min	10 sec	10 sec	30 Days	7 Days	12mmhg	12mmhg	11mmhg	12mmhg	11mmhg	11mmhg	505	505	518	518	511	512
29	20 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	-0.25dsp	-0.50dsp	WNL	WNL	Steep:42.00 Flat:41.80	Steep:42.15 Flat:41.80	15mm in 4 min	15mm in 4 min	10 sec	9 sec	30 Days	5 Days	19mmhg	19mmhg	19mmhg	20mmhg	19mmhg	18mmhg	518	518	530	531	525	526
30	20 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6	..	..	+0.25dsp	+0.25dsp	WNL	WNL	Steep:42.75 Flat:42.15	Steep:42.70 Flat:42.10	15mm in 3 min	15mm in 3 min	10 sec	9 sec	30 Days	3 Days	14mmhg	14mmhg	16mmhg	16mmhg	16mmhg	16mmhg	547	545	559	559	552	553
31	21 years	YES	NAD	NAD	NAD	NAD	6\36	6\36	'6/6	'6/6	'6/6	'6/6	-2.00/-0.50*90	-2.50/0.50*100	WNL	WNL	Steep:41.90 Flat:41.25	Steep:41.60 Flat:40.65	15mm in 4 min	15mm in 4 min	9 sec	9 sec	29 Days	4 Days	13mmhg	13mmhg	14mmhg	14mmhg	15mmhg	12mmhg	554	554	567	566	561	563
32	23 years	NO	NAD	NAD	NAD	NAD	6\6(P)	6\6(P)	'6/6	'6/6			+0.50/+0.25*120	+0.50/0.25*16	WNL	WNL	Steep:41.35 Flat:41.16	Steep:41.50 Flat:41.25	15mm in 4 min	15mm in 3 min	11 sec	9 sec	28 Days	4 Days	12mmhg	12mmhg	14mmhg	16mmhg	10mmhg	13mmhg	540	540	552	554	548	547
33	22 years	YES	NAD	NAD	NAD	NAD	6\60	6\60	'6/6	'6/6	'6/6	'6/6	-2.25/-0.75*40	-2.25/-0.50*140	WNL	WNL	Steep:45.77 Flat:44.91	Steep:45.94 Flat:44.97	15mm in 3 min	15 mm in 2 min	9 sec	9 sec	28 Days	4 Days	13mmhg	12mmhg	14mmhg	13mmhg	14mmhg	12mmhg	560	560	573	574	563	564

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34	22 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6			+0.25dsp	+0.50dsp	WNL	WNL	Steep:40.89 Flat:40.71	Steep:41.32 Flat:41.27	15mm in 3 min	15mm in 3 min	11 sec	10 sec	28 Days	5 Days	10mmhg	11mmhg	10mmhg	11mmhg	11mmhg	10mmhg	510	512	525	525	513	515
35	22 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6	..	..	+0.75dsp	+0.75dsp	WNL	WNL	Steep:42.20 Flat:41.75	Steep:42.08 Flat:41.85	15mm in 3 min	15mm in 4 min	10 sec	9 sec	28 Days	5 Days	11mmhg	10mmhg	11mmhg	11mmhg	10mmhg	11mmhg	508	509	513	514	512	513
36	22 years	Yes	NAD	NAD	NAD	NAD	6\60	6\60	'6/6	'6/6	6/9	6/9	-2.75/-1.00*79	-1.75/-1.25*5	WNL	WNL	Steep:43.14 Flat:42.22	Steep:42.66 Flat:43.78	15mm in 2 min	15mm in 3 min	10 sec	8 sec	28 Days	4 Days	15mmhg	14mmhg	15mmhg	14mmhg	15mmhg	14mmhg	495	495	517	516	512	511
37	21 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6	..	..	+0.50*175	+0.25*161	WNL	WNL	Steep:41.76 Flat:41.35	Steep:41.56 Flat:41.25	15mm in 5 min	15mm in 4 min	9 sec	8 sec	28 Days	5 Days	10mmhg	11mmhg	10mmhg	11mmhg	11mmhg	10mmhg	530	532	543	545	535	535
38	22 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6	..	..	+0.25dsp	+0.25dsp	WNL	WNL	Steep:43.06 Flat:42.28	Steep:42.43 Flat:42.13	15mm in 4 min	15mm in 4 min	9 sec	9 sec	30 Days	5 Days	11mmhg	10mmhg	12mmhg	11mmhg	12mmhg	11mmhg	520	521	535	536	524	526
39	22 years	YES	NAD	NAD	NAD	NAD	6\36	6\36	'6/6	'6/6	'6/6	'6/6	-1.00/0.25*165	-0.50/1.75*96	WNL	WNL	Steep:42.96 Flat:42.46	Steep:43.76 Flat:43.45	15mm in 4 min	15mm in 4 min	10 sec	11 sec	30 Days	5 Days	11mmhg	10mmhg	11mmhg	12mmhg	11mmhg	13mmhg	485	485	498	597	494	493
40	23 years	YES	NAD	NAD	NAD	NAD	6\24	6\60	6/6	'6/6	'6/6	'6/6	-1.75/-0.50*69	-2.50dsp	WNL	WNL	Steep:42.70 Flat:41.69	Steep:42.60 Flat:42.00	15mm in 4 min	15 min 4 min	10 sec	10 sec	28 Days	5 Days	10mmhg	11mmhg	10mmhg	11mhg	9mmhg	12mmhg	505	505	513	515	506	507
41	21 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6			+0.25/+0.25*120	+0.50dsp	WNL	WNL	Steep:41.32 Flat:41.18	Steep:41.43 Flat:41.24	15mm in 3 min	15mm in 4 min	11 sec	9 sec	30 Days	5 Days	11mmhg	12mmhg	12mmhg	13mmhg	12mmhg	13mmhg	508	508	520	522	510	512
42	22 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6	..	..	+0.25dsp	+0.25dsp	WNL	WNL	Steep:42.25 Flat:41.65	Steep:42.16 Flat:41.84	15mm in 4 min	15mm in 4 min	9 sec	8 sec	30 Days	4 Days	10mmhg	11mmhg	11mmhg	12mmhg	11mmhg	10mmhg	515	515	528	528	517	516
43	23 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6	..	..	-0.50dsp	-0.25dsp	WNL	WNL	Steep:41.13 Flat:41.09	Steep:41.44 Flat:41.36	15mm in3 min	15 mm in 4 min	11 sec	9 sec	31 Days	5 Days	11mmhg	12mmhg	10mmhg	12mmhg	11mmhg	11mmhg	510	509	524	523	514	513
44	23 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6	..	..	-0.75dsp	-0.75dsp	WNL	WNL	Steep:42.38 Flat:42.09	Steep:42.64 Flat:42.19	15mm in 4 min	15mm in 4 min	10 sec	11 sec	28 Days	7 Days	11mmhg	11mmhg	12mmhg	11mmhg	11mmhg	10mmhg	510	512	526	526	513	514
45	22 years	NO	NAD	NAD	NAD	NAD	6\9	6\24	'6/6	'6/6			-0.50/-0.50*140	-1.50/-1.25*70	WNL	WNL	Steep:44.45 Flat:43.80	Steep:44.37 Flat:43.83	15mm in 3 min	15mm in 3 min	9 sec	10 sec	30 Days	5 Days	10mmhg	11mmhg	11mmhg	12mmhg	11mmhg	11mmhg	555	555	568	570	560	559
46	22 years	YES	NAD	NAD	NAD	NAD	6\60	6\60	'6/6	'6/6	'6/6	'6/6	-2.00dsp	-2.25dsp	WNL	WNL	Steep:45.25 Flat:44.72	Steep:45.10 Flat:44.78	15mm in 3min	15mm in 3min	11sec	10 sec	30 Days	7 Days	10mmhg	12mmhg	11mmhg	13mmhg	10mmhg	13mmhg	490	490	507	506	492	494
47	22 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6	..	…	-0.50dsp	-0.25dsp	WNL	WNL	Steep:42.37 Flat:42.09	Steep:42.67 Flat:42.08	15mm in 3 min	15mm in 4 min	12 sec	10 sec	30 Days	7 Days	10mmhg	11mmhg	10mmhg	11mmhg	11mmhg	12mmhg	510	510	523	522	508	505
48	22 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6	..	..	-0.25dsp	-0.50dsp	WNL	WNL	Steep:42.20 Flat:41.90	Steep:42.34 Flat:41.97	15mm in 3 min	15mm in 4 min	11 sec	12 sec	28 Days	5 Days	11mmhg	9mmhg	11mmhg	10mmhg	10mmhg	10mmhg	520	525	535	538	523	524
49	22 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	6/6	'6/6	..	..	+0.25dsp	0.00	WNL	WNL	Steep:42.03 Flat:41.76	Steep:42.11 Flat:41.87	15mm in 3 min	15 mm in 4 min	9 sec	11 sec	30 Days	6 Days	10mmhg	13mmhg	11mmhg	14mmhg	11mmhg	12mmhg	560	560	572	572	570	571
50	22 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6	..	..	-0.50dsp	-0.50dsp	WNL	WNL	Steep:42.09 Flat:42.01	Steep:42.42 Flat:42.32	15mm in 3 min	15mm in 3 min	11 sec	8 sec	28 Days	7 Days	10mmhg	11mmhg	11mmhg	11mmhg	9mmhg	12mmhg	510	510	515	516	512	513

CASE No	Age	H/o Glasses	H/O Discharge / Pain/ Photophobia	H/o Ocular Surgery/trauma /ocular disease	H/o Systemic illness DM/HTN/ASTHMA	H/o Medication / Contraceptives	Uncorrected visual aquity		Best Corrected Visual Aquity		Vision with Spectacle		Auto Refractor		Anterior Segment	Posterior Segment	Keratometry		Schirmers		Tear Film Break Up Time		Menstrual history		Intraocular Pressure						Pachymetry(micrometer)					
51	22 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6			-0.25/-0.25*112	-0.25dsp	WNL	WNL	Steep:42.87 Flat:42.60	Steep:42.68 Flat:42.54	15mm in 4 min	15mm in 4 min	10 sec	8 sec	30 Days	5 Days	11mmhg	13mmhg	12mmhg	14mmhg	12mmhg	14mmhg	510	507	521	525	512	513
52	22 years	YES	NAD	NAD	NAD	NAD	6/12(p)	6/18(p)	'6/6	'6/6	'6/6	'6/6	-0.50/-1.25*158	-0.75/-1.25*175	WNL	WNL	Steep:41.15 Flat:42.37	Steep:41.09 Flat:42.76	15mm in 4 min	15mm in 4 min	10 sec	10 sec	30 Days	4 Days	11mmhg	11mmhg	10mmhg	13mmhg	10mmhg	10mmhg	520	520	538	536	525	522
53	23years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6			+0.25dsp	+0.50dsp	WNL	WNL	Steep:42.65 Flat:41.70	Steep:42.85 Flat:41.62	15mm in in 3 min	15mm in 3 min	10 sec	9 sec	28 Days	5 Days	11mmhg	10mmhg	12mmhg	11mmhg	11mmhg	10mmhg	510	510	522	525	512	513
54	22 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6			-0.75dsp	-0.50dsp	WNL	WNL	Steep:41.25 Flat:41.07	Steep:41.36 Flat:41.28	15mm in 3 min	15mm in 4 min	10 sec	10sec	28 Days	4 Days	11mmhg	10mmhg	12mmhg	11mmhg	12mmhg	11mmhg	510	510	526	522	512	513
55	22 years	YES	NAD	NAD	NAD	NAD	6/24	6/24	'6/6	'6/6	'6/6	'6/6	-1.75/-0.25*41	-1.75/-0.75*98	WNL	WNL	Steep:42.75 Flat:42.06	Steep:42.90 Flat:42.59	15mm in 4 min	15mm in 3 min	10sec	9 sec	29 Days	7 Days	12mmhg	12mmhg	13mmhg	13mmhg	11mmhg	11mmhg	550	550	563	561	554	556
56	22 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6			-0.75dsp	-0.25dsp	WNL	WNL	Steep:41.78 Flat:41.69	Steep:41.56 Flat:41.36	15mm in 3 min	15mm in 3 min	8 sec	7 sec	28 Days	5 Days	12mmhg	12mmhg	13mmhg	14mmhg	15mmhg	12mmhg	510	512	526	524	512	513
57	22 years	YES	NAD	NAD	NAD	NAD	CF5mt	CF5mt	'6/6	'6/6	'6/6	'6/6	-2.50/-1.50*88	-3.00/-1.75*116	WNL	WNL	Steep:43.10 Flat:41.69	Steep:43.59 Flat:41.86	15mm in 4 min	15mm in 4 min	9 sec	7 sec	30 Days	7 Days	16mmhg	15mmhg	17mmhg	16mmhg	17mmhg	14mmhg	570	574	583	580	573	574
58	23 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6			-0.25/-0.25*112	-0.50dsp	WNL	WNL	Steep:42.32 Flat:42.08	Steep:42.63 Flat:42.30	15mm in 3 min	15mm in 4 min	10 sec	9 sec	30 Days	6 Days	13mmhg	15mmhg	14mmhg	16mmhg	12mmhg	16mmhg	532	537	547	549	537	540
59	23 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6			+0.75dsp	+0.50dsp	WNL	WNL	Steep:41.87 Flat:41.43	Steep:41.73 Flat:41.54	15mm in 3 min	15mm in 4 min	10 sec	10 sec	30 Days	4 Days	11mmhg	12mmhg	14mmhg	13mmhg	13mmhg	12mmhg	550	550	564	563	552	553
60	22 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6			+0.25dsp	0.00	WNL	WNL	Steep:42.32 Flat:42.08	Steep:42.64 Flat:42.19	15mm in 3 min	15mm in 4 min	10 sec	8 sec	30 Days	5 Days	14mmhg	12mmhg	14mmhg	13mmhg	16mmhg	12mmhg	560	564	574	573	563	562
61	22 years	NO	NAD	NAD	NAD	NAD	6/18(p)	6/36(p)	'6/6	'6/6			-1.50/-1.00*3	1.75/-0.50*17	WNL	WNL	Steep:42.21 Flat:41.14	Steep:41.90 Flat:41.34	15mm in 4 min	15 mm in 4 min	9 sec	10 sec	28 Days	4 Days	11mmhg	12mmhg	12mmhg	12mmhg	11mmhg	12mmhg	600	600	613	614	608	607
62	22 years	NO	NAD	NAD	NAD	NAD	6\6	6\6	'6/6	'6/6			-0.25dsp	-0.50dsp	WNL	WNL	Steep:42.84 Flat:42.70	Steep:42.63 Flat:42.54	15mm in 3 min	15mm in 4 min	10 sec	8 sec	28 Days	5 Days	10mmhg	12mmhg	11mmhg	12mmhg	11mmhg	11mmhg	550	555	564	569	560	562
63	22 years	YES	NAD	NAD	NAD	NAD	6/24(p)	6/18(p)	'6/6	'6/6	'6/6	'6/6	+0.50dsp	+0.25dsp	WNL	WNL	Steep:41.78 Flat:41.64	Steep:41.64 Flat:41.34	15mm in 4 min	15mm in 4 min	9 sec	8 sec	30 Days	4 Days	11mmhg	12mmhg	12mmhg	13mmhg	12mmhg	11mmhg	523	530	537	542	527	528
64	23 years	NO	NAD	NAD	NAD	NAD	6/6	'6/6	'6/6	'6/6			-0.50dsp	-0.75dsp	WNL	WNL	Steep:41.37 Flat:41.08	Steep:41.68 Flat:41.00	15mm in 4 min	15mm in 4 min	10 sec	9 sec	28 Days	4 Days	11mmhg	13mmhg	13mmhg	14mmhg	14mmhg	13mmhg	560	560	573	574	563	564
65	23 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			+0.50dsp	+0.75dsp	WNL	WNL	Steep:43.20 Flat:42.68	Steep:42.69 Flat:42.34	15mm in 3 min	15 mm in 2 min	9 sec	10 sec	28 days	6 Days	10mmhg	11mmhg	11mmhg	12mmhg	11mmhg	11mmhg	560	563	572	578	563	564
66	22 years	YES	NAD	NAD	NAD	NAD	6/60	6/60	'6/6	'6/6	'6/6	'6/6	-0.50/-2.25*4	-1.75/-2.25*179	WNL	WNL	Steep:46.37 Flat:43.88	Steep:46.06 Flat:42.68	15mm in 3 min	15mm in 3 min	8 sec	8 sec	29 Days	5 Days	15mmhg	16mmhg	15mmhg	17mmhg	16mmhg	17mmhg	515	515	528	529	517	519
67	23 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			-0.50dsp	-0.75dsp	WNL	WNL	Steep:42.54 Flat:42.15	Steep:42.79 Flat:42.36	15mm in 3 min	15 mm in 3 min	10 sec	9 sec	30 days	5 Days	12mmhg	12mmhg	12mmhg	13mmhg	14mmhg	12mmhg	560	560	574	576	563	562

CASE No	Age	H/o Glasses	H/O Discharge / Pain/ Photophobia	H/o Ocular Surgery/trauma /ocular disease	H/o Systemic illness DM/HTN/ASTHMA	H/o Medication / Contraceptives	Uncorrected visual aquity		Best Corrected Visual Aquity		Vision with Spectacle		Auto Refractor		Anterior Segment	Posterior Segment	Keratometry		Schirmers		Tear Film Break Up Time		Menstrual history		Intraocular Pressure						Pachymetry(micrometer)					
68	22 years	NO	NAD	NAD	NAD	NAD	6/6	'6/6	'6/6	6/6			-0.25/-0.50*112	-0.50dsp	WNL	WNL	Steep:42.55 Flat:42.07	Steep:42.34 Flat:42.17	15mm in 3 min	15mm in 4 min	10 sec	8 sec	28 Days	5 Days	12mmhg	13mmhg	13mmhg	14mmhg	11mmhg	14mmhg	526	528	539	540	530	531
69	22 years	NO	NAD	NAD	NAD	NAD	6/6	'6/6	'6/6	'6/6			-0.25/-0.50*112	0.50dsp	WNL	WNL	Steep:42.54 Flat:42.39	Steep:42.63 Flat:42.19	15mm in 4 min	15mm in 4 min	8 sec	7 sec	31 Days	4 Days	11mmhg	11mmhg	12mmhg	12mmhg	14mmhg	12mmhg	560	560	573	569	563	562
70	22 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			+0.50dsp	+0.50dsp	WNL	WNL	Steep:41.78 Flat:41.64	Steep:41.64 Flat:41.34	15mm in 4 min	15mm in 4 min	9 sec	8 sec	30 Days	4 Days	11mmhg	12mmhg	12mmhg	13mmhg	12mmhg	11mmhg	523	530	537	542	527	528
71	22 years	YES	NAD	NAD	NAD	NAD	6/60	6/60	6/6	6/6	'6/6	'6/6	-2.00/-1.00*4	-2.00/-1.00*172	WNL	WNL	Steep:45.37 Flat:43.49	Steep:45.24 Flat:43.76	15mm in 3 min	15mm in 3 min	10 sec	8 sec	28 Days	4 Days	14mmhg	12mmhg	15mmhg	12mmhg	14mmhg	13mmhg	510	510	524	520	511	513
72	22 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			0.00	+0.50dsp	WNL	WNL	Steep:41.28 Flat:41.06	Steep:41.64 Flat:41.37	15mm in 4 min	15mm in 3 min	10sec	10sec	29 Days	5 Days	13mmhg	11mmhg	13mmhg	12mmhg	13mmhg	12mmhg	550	550	563	564	552	553
73	23 years	YES	NAD	NAD	NAD	NAD	6/60	6/60	6/6	6/6	'6/6	'6/6	-2.00/-0.25*86	-2.00dsp	WNL	WNL	Steep:43.45 Flat:42.86	Steep:43.81 Flat:42.81	15mm in 2 min	15mm in 3 min	9 sec	9 sec	30 Days	5 Days	11mmhg	11mmhg	11mmhg	12mmhg	12mmhg	12mmhg	545	545	557	558	547	548
74	23 years	NO	NAD	NAD	NAD	NAD	6/6	'6/6	'6/6	'6/6			0.50dsp	0.25dsp	WNL	WNL	Steep:41.67 Flat:41.37	Steep:41.52 Flat:41.47	15mm in 3 min	15 mm in 4 min	8 sec	10 sec	28 Days	3 Days	11mmhg	11mmhg	12mmhg	12mmhg	12mmhg	11mmhg	550	550	564	564	553	552
75	22 years	NO	NAD	NAD	NAD	NAD	6/6	'6/6	'6/6	'6/6			-0.50dsp	-0.75dsp	WNL	WNL	Steep:42.63 Flat:42.30	Steep:42.58 Flat:42.48	15mm in 3 min	15mm in 4 min	10 sec	9 sec	29 Days	5 Days	11mmhg	12mmhg	12mmhg	13mmhg	12mmhg	11mmhg	563	567	578	579	567	563
76	22 years	NO	NAD	NAD	NAD	NAD	6/6	'6/6	'6/6	'6/6			-0.50dsp	-0.50dsp	WNL	WNL	Steep:42.77 Flat:42.65	Steep:42.79 Flat:42.45	15mm in 3 min	15mm in 4 min	9 sec	9 sec	30 Days	5 Days	11mmhg	11mmhg	12mmhg	12mmhg	11mmhg	12mmhg	532	532	548	549	536	538
77	22 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			-0.50dsp	0.25dsp	WNL	WNL	Steep:42.32 Flat:42.06	Steep:42.42 Flat:42.16	15 mm in 4 min	15mm in 4 min	10 sec	9 sec	29 Days	5 Days	11mmhg	11mmhg	11mmhg	12mmhg	12mmhg	11mmhg	516	517	528	529	518	519
78	22 years	YES	NAD	NAD	NAD	NAD	6/60	6/60	6/6	6/6	'6/6	'6/6	-2.25dsp	-1.75/-0.50*177	WNL	WNL	Steep:43.39 Flat:43.08	Steep:43.94 Flat:43.30	15mm in 4 min	15 mm in 3 min	9 sec	9 sec	30 Days	5 Days	10mmhg	11mmhg	11mmhg	12mmhg	11mmhg	10mmhg	490	490	506	502	492	493
79	22 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	6/6			+0.75dsp	+0.50dsp	WNL	WNL	Steep:42.58 Flat:42.45	Steep:42.83 Flat:42.34	15mm in 3 min	15mm in 4 min	10 sec	10 sec	28 Days	6 Days	11mmhg	12mmhg	12mmhg	12mmhg	11mmhg	11mmhg	560	560	578	576	562	562
80	23 years	YES	NAD	NAD	NAD	NAD	6/60	6/60	6/6	6/6	'6/6	'6/6	-3.25/-0.25*35	-3.00/-0.50*2	WNL	WNL	Steep:42.84 Flat:42.69	Steep:42.90 Flat:42.72	15mm in 3 min	15mm in 4 min	9 sec	9 sec	29 Days	5 Days	11mmhg	12mmhg	12mmhg	13mmhg	12mmhg	12mmhg	530	532	543	542	533	536
81	22 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	6/6	'6/6			-0.50/-0.25*86	-0.50dsp	WNL	WNL	Steep:42.63 Flat:42.45	Steep:42.97 Flat:42.84	15mm in 3 min	15mm in 4 min	9 sec	8 sec	30 Days	4 Days	12mmhg	12mmhg	12mmhg	12mmhg	12mmhg	11mmhg	552	552	564	566	554	556
82	22 years	NO	NAD	NAD	NAD	NAD	6/6	6/6	'6/6	'6/6			+0.50dsp	+0.25dsp	WNL	WNL	Steep:43.16 Flat:42.64	Steep:43.23 Flat:42.78	15mm in 2 min	15mm in 3 min	10 sec	11 sec	29 Days	5 Days	11mmhg	12mmhg	12mmhg	12mmhg	12mmhg	11mmhg	537	538	552	553	540	539
83	23 years	YES	NAD	NAD	NAD	NAD	6/60	6/60	6/6	6/6	6/6	6/6	-2.00/-0.50*64	-2.00-0.50*102	WNL	WNL	Steep:43.13 Flat:42.64	Steep:43.29 Flat:43.01	15mm in 2 min	15mm in 3 min	10 sec	10 sec	28 Days	6 Days	11mmhg	13mmhg	12mmhg	12mmhg	12mmhg	13mmhg	560	560	573	574	562	561
84	22 years	NO	NAD	NAD	NAD	NAD	6/6	6/6	'6/6	'6/6			-0.75dsp	-0.50dsp	WNL	WNL	Steep:42.78 Flat:42.69	Steep:42.60 Flat:42.34	15mm in 4 min	15mm in 4 min	11 sec	9 sec	30 Days	5 Days	16mmhg	15mmhg	16mmhg	15mmhg	15mmhg	14mmhg	512	513	526	528	519	519

CASE No	Age	H/o Glasses	H/O Discharge / Pain/ Photophobia	H/o Ocular Surgery/trauma /ocular disease	H/o Systemic illness DM/HTN/ASTHMA	H/o Medication / Contraceptives	Uncorrected visual aquity		Best Corrected Visual Aquity		Vision with Spectacle		Auto Refractor		Anterior Segment	Posterior Segment	Keratometry		Schirmers		Tear Film Break Up Time		Menstrual history		Intraocular Pressure						Pachymetry(micrometer)					
85	22 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			-0.25dsp	-0.50dsp	WNL	WNL	Steep:41.83 Flat:41.63	Steep:42.90 Flat:42.73	15mm in 4 min	15mm in 3 min	8 sec	9 sec	28 Days	5 Days	11mmhg	12mmhg	12mmhg	13mmhg	11mmhg	16mmhg	536	538	550	549	539	539
86	23 years	NO	NAD	NAD	NAD	NAD	6/60	6/60	6/6	'6/6			-1.75/-0.50*116	-2.00/-0.50*4	WNL	WNL	Steep:43.43 Flat:42.53	Steep:43.45 Flat:42.61	15mm in 4 min	15 mm in 3 min	8 sec	9 sec	29 Days	5 Days	11mmhg	13mmhg	12mmhg	13mmhg	13mmhg	12mmhg	560	560	573	574	562	561
87	22 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			+0.25dsp	+0.50dsp	WNL	WNL	Steep:42.03 Flat:41.63	Steep:42.15 Flat:41.78	15mm in 3 min	15mm in 2 min	8 sec	8 sec	28 Days	5 Days	11mmhg	10mmhg	12mmhg	11mmhg	11mmhg	11mmhg	510	512	524	527	512	513
88	23 years	YES	NAD	NAD	NAD	NAD	6/60	6/60	'6/6	'6/6	6/6	6/6	-2.00dsp	-2.00dsp	WNL	WNL	Steep:43.45 Flat:42.86	Steep:43.18 Flat:42.86	15mm in 3 min	15mm in 4min	8 sec	9 sec	26 Days	5 Days	12mmhg	12mmhg	12mmhg	13mmhg	8mmhg	12mmhg	555	556	568	564	552	554
89	22 years	NO	NAD	NAD	NAD	NAD	6/6	'6/6	6/6	'6/6			-0.50dsp	0.00	WNL	WNL	Steep:43.11 Flat:42.63	Steep:43.01 Flat:42.80	15mm in 4 min	15mm in 4 min	9 sec	10sec	29 Days	5 Days	12mmhg	13mmhg	13mmhg	14mmhg	13mmhg	12mmhg	556	553	570	568	558	559
90	22 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			+0.50dsp	+0.75dsp	WNL	WNL	Steep:43.12 Flat:42.82	Steep:43.22 Flat:42.82	15mm in 4 min	15 mm in 3 min	10 sec	9 sec	29 days	5 days	14mmhg	12mmhg	13mmhg	14mmhg	14mmhg	14mmhg	570	572	584	586	573	576
91	22 years	YES	NAD	NAD	NAD	NAD	6/60	6/60	'6/6	'6/6	6/6	6/6	-1.75/-1.25*4	1.75/-1.00*175	WNL	WNL	Steep:45.34 Flat:43.45	Steep:45.24 Flat:43.76	15mm in 3 min	15mm in 3 min	10 sec	10sec	28 Days	5 Days	16mmhg	15mmhg	17mmhg	16mm	17mmhg	15mmhg	536	538	548	550	538	540
92	23 years	YES	NAD	NAD	NAD	NAD	CF5mt	CF5mt	6/6	'6/6	'6/6	'6/6	5.50/-0.50*110	-6.00/-0.25*90	WNL	WNL	Steep:44.10 Flat:43.46	Steep:44.05 Flat:43.83	15mm in 3 min	15 mm in 2 min	9 sec	10 sec	30 Days	6 Days	16mmhg	15mmhg	16mmhg	14mmhg	13mmhg	14mmhg	563	567	578	577	568	570
93	22 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			-0.25dsp	-0.25dsp	WNL	WNL	Steep:42.24 Flat:41.93	Steep:42.34 Flat:41.86	15mm in 3 min	15mm in 3 min	9 sec	9 sec	29 Days	4 Days	14mmhg	13mmhg	14mmhg	13mmhg	12mmhg	14mmhg	526	527	538	540	530	532
94	21 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			+0.50dsp	;0.00	WNL	WNL	Steep:42.36 Flat:41.88	Steep:42.25 Flat:41.98	15mm in 2 min	15mm in 2 min	8 sec	10 sec	28 Days	4 Days	15mmhg	15mmhg	15mmhg	15mmhg	14mmhg	16mmhg	476	474	492	490	481	482
95	22 years	YES	NAD	NAD	NAD	NAD	6/24	6/24	'6/6	'6/6	6/6	6/6	-1.00/-0.25*173	-1.00/-0.50*25	WNL	WNL	Steep:43.03 Flat:42.57	Steep:43.12 Flat:42.67	15mm in 3 min	15mm in 4 min	8 sec	9 sec	28 Days	5 Days	14mmhg	14mmhg	15mmhg	14mmhg	16mmhg	15mmhg	512	516	528	527	520	522
96	23 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	6/6	'6/6			+0.50dsp	+0.50dsp	WNL	WNL	Steep:41.64 Flat:41.23	Steep:41.74 Flat:41.34	15 mm in 4 min	15 mm in 4 min	9 sec	8 sec	31 Days	5 Days	16mmhg	15mmhg	15mmhg	15mmhg	14mmhg	14mmhg	526	524	540	541	530	531
97	22years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			0.00	-0.50dsp	WNL	WNL	Steep:42.68 Flat:42.45	Steep:42.57 Flat:42.34	15mm in 4 min	15 mm in 3 min	7 sec	7 sec	29 Days	5 Days	12mmhg	12mmhg	13mmhg	12mmhg	13mmhg	13mmhg	543	548	560	561	550	552
98	22 years	YES	NAD	NAD	NAD	NAD	6/18	6/18	'6/6	'6/6	'6/6	'6/6	-1.50dsp	-2.00dsp	WNL	WNL	Steep:43.54 Flat:43.14	Steep:43.65 Flat:43.24	15mm in 3 min	15 mm in 2 min	8 sec	9 sec	31 Days	6 Days	11mmhg	13mmhg	12mmhg	13mmhg	12mmhg	12mmhg	518	519	534	535	522	523
99	21 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			+0.50dsp	+0.75dsp	WNL	WNL	Steep:42.34 Flat:41.67	Steep:42.12 Flat:41.54	15mm in 4 min	15 mm in 3 min	9 sec	9 sec	30 Days	4 Days	13mmhg	12mmhg	13mmhg	13mmhg	12mmhg	11mmhg	520	524	538	537	526	527
100	22 years	NO	NAD	NAD	NAD	NAD	'6/6	'6/6	'6/6	'6/6			-0.25dsp	0.00	WNL	WNL	Steep:42.47 Flat:42.13	Steep:42.34 Flat:42.09	15mm in 3 min	15mm in 3 min	9 sec	8 sec	30 Days	5 Days	12mmhg	12mmhg	13mmhg	14mmhg	13mmhg	13mmhg	489	485	503	497	493	489