CORNEAL CHARACTERISTICS IN MYOPIC PATIENTS

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CERTIFICATE

Certified that this dissertation entitled "Corneal Characteristics in Myopic Patients" submitted for the Master of Surgery (Branch III) Ophthalmology, is a bonafide work done by **Dr.M.NISHANTH** under our supervision and guidance in the Department of Cornea Service Clinic of Aravind Eye Hospital and Postgraduate Institute of Ophthalmology, Madurai during his residency period from May 2009 to April 2012.

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CONTENT

PART 1

INTRODUCTION

Myopia is a significant public health problem, affecting 33% of individuals over the age of 12 years in the United States 1 and a much higher percentage in parts of Asia such as Taiwan and Singapore, 2, 3 and the prevalence may be increasing over time.4,5

Single vision spectacle lenses and contact lenses are commonly prescribed for myopia and more recently refractive surgery has become a popular option. While these treatments correct the myopic refractive error, they do not slow the accompanying eye growth or retard the physiological changes associated with excessive axial elongation 6. The World Health Organization has set a goal to eliminate preventable blindness in the world by the year 2020, with refractive error, including myopia, as one of its top five priorities7. The high prevalence of myopia and its prominence as a public health problem emphasize the importance of gaining increased understanding of the mechanisms of eye growth and of finding effective treatments that slow progression and axial elongation.

Refractive surgery is becoming popular worldwide. Most of the surgery is performed at the corneal plane, known as kerato-refractive surgery. Therefore, surgeons who perform the surgery should have extensive knowledge about the cornea and anterior segment of the eye. In the circumstance of rare complications, suitable management will be carried out instantly based on this basic knowledge[8,9] .It is essential for a surgeon to know and understand the normal corneal characteristics before taking the patient for any refractive surgery.

There are no large population based studies for the corneal characteristics of myopic patients in the Indian subcontinent. The purpose of this study was to analyze the corneal characteristics of myopic patients undergoing refractory surgery at a tertiary eye care institute.

MYOPIA

"Short sightedness” is a condition of the eye where the light that comes in does not directly focus on the retina which is in the back of the eye. Because of this, the image that one sees is out of focus when looking at distant object but comes into focus when looking at a close object.

Myopia is a significant public health problem and its prevalence may be increasing over time. The main treatment options of single vision spectacle lenses, contact lenses, and refractive surgery do not slow the accompanying eye growth or retard the physiological changes associated with excessive axial elongation.

High myopia is a predisposing factor for retinal detachment, myopic retinopathy, and glaucoma, contributing to loss of vision and blindness. The high prevalence of myopia and its prominence as a public health problem emphasize the importance of finding effective treatments that slow myopia progression and axial elongation. Treatments that have been investigated include various types of spectacle lenses and contact lenses, as well as pharmaceutical agents such as atropine.

Eye care professionals most commonly correct myopia through the use of corrective lenses, such as glasses or contact lenses. The corrective lenses have a negative optical power (*i.e.* are concave) which compensates for the excessive positive diopters of the myopic eye.

AGE:- The prevalence of myopia varies with age[10,11]. Myopia is rare among infants of industrialist countries.

SEX:- Some studies have found females to have a slightly higher myopia prevalence than males[10,12].

CLASSIFICATION

Myopia has been classified in various manners.

Borish and Duke-Elder classified myopia by cause:

- **Axial myopia** is attributed to an increase in the eye's axial length.
- **Refractive myopia** is attributed to the condition of the refractive elements of the eye.
- **Curvature myopia** is attributed to excessive, or increased, curvature of one or more of the refractive surfaces of the eye, especially the cornea.
- **Index myopia** is attributed to variation in the index of refraction of one or more of the ocular media. Nuclear changes in the lens cause a myopic shift.

-Elevation of blood-glucose levels can also cause edema as a result of sorbitol (sugar alcohol) accumulating in the lens. This edema often causes temporary myopia.

CLINICAL ENTITY

Various forms of myopia have been described by their clinical appearance:

- **Simple myopia** is more common than other types of myopia and is characterized by an eye that is too long for its optical power or optically too powerful for its axial length. Both genetic and environmental factors, particularly significant amounts of near work, are thought to contribute to the development of simple myopia.
- **Degenerative myopia**, also known *as malignant, pathological, or progressive myopia*, is characterized by marked fundus changes, such as posterior staphyloma, and associated with a high refractive error and subnormal visual acuity after correction. This form of myopia gets progressively worse over time. Degenerative myopia has been reported as one of the main causes of visual impairment.
- **Nocturnal myopia**, also known as *night myopia* or *twilight myopia*, is a condition in which the eye has a greater difficulty seeing in low illumination areas, even though its daytime vision is normal. Essentially, the eye's far point of an individual's focus varies with the level of light. Night myopia is believed to be caused by pupils dilating to let more light in, which adds aberrations resulting in becoming more nearsighted. A stronger prescription for myopic night drivers is often

needed. Younger people are more likely to be affected by night myopia than the elderly.

- **Pseudomyopia** is the blurring of distance vision brought about by spasm of the ciliary muscle.
- **Induced myopia**, also known as **acquired myopia**, results from exposure to various pharmaceuticals, increases in glucose levels, nuclear sclerosis, oxygen toxicity (e.g., from diving or from oxygen and hyperbaric therapy) or other anomalous conditions. The encircling bands (Buckle) used in the repair of retinal detachments may induce myopia by increasing the axial length of the eye.
- **Index myopia** is attributed to variation in the index of refraction of one or more of the ocular media. Cataracts may lead to index myopia.
- **Form deprivation myopia** is a type of myopia that occurs when the eyesight is deprived by limited illumination and vision range, or the eye is modified with artificial lenses or deprived of clear form vision.
- **Near work Induced Transient Myopia (NITM),** is defined as short-term myopic far point shift immediately following a sustained near visual task. Some authors argue for a link between NITM and the development of permanent myopia.

DEGREE

Myopia, which is measured in diopters by the strength or optical power of a corrective lens that focuses distant images on the retina, has also been classified by degree or severity:

- **Low myopia** usually describes myopia of −3.00 diopters or less.
- **Medium myopia** usually describes myopia between −3.00 and −6.00 diopters.
- **High myopia** usually describes myopia of −6.00 or more. Roughly 30% of myopes have high myopia.

AGE AT ONSET

Myopia is sometimes classified by the age at onset:

- **Congenital myopia**, also known as **infantile myopia**, is present at birth and persists through infancy.
- **Youth onset myopia** occurs prior to age 20.
- **School myopia** appears during childhood, particularly the school-age years. This form of myopia is attributed to the use of the eyes for close work during the school years.
- **Adult onset myopia**
- **Early adult onset myopia** occurs between ages 20 and 40.
- **Late adult onset myopia** occurs after age 40.

SIGNS AND SYMPTOMS

Myopia presents with blurry distance vision but generally gives good near vision. In High myopia, even near vision is affected and patients cannot read without their glasses for distance.

DIAGNOSIS

A diagnosis of myopia is typically confirmed during an eye examination by an ophthalmologist or optometrist .Frequently an autorefractor or retinoscope is used to give an initial objective assessment of the refractive status of each eye, then a phoropter is used to subjectively refine the patient's eyeglass prescription.

PREVENTION

The National Institutes of Health says that there is no known way of preventing myopia, and the use of glasses or contact lenses does not affect the progression of myopia.

There is no universally accepted method of preventing myopia. Commonly attempted preventative methods include wearing reading glasses, eye drops and participating in more outdoor activities Some clinicians and researchers recommend plus power (convex) lenses in the form of reading glasses when engaged in close work or reading instead of using single focal concave lens glasses commonly prescribed. The reasoning behind a convex lens's possible effectiveness in preventing myopia is simple to understand.

A recent Malaysian study reported in *New Scientist* suggested that under correction of myopia caused more rapid progression of myopia. Many myopia treatment studies suffer from any of a number of design drawbacks: small numbers, lack of adequate control group, failure to mask examiners from knowledge of treatments used, etc.

MANAGEMENT

Treatments that are currently available for slowing the progression of myopia include spectacle lenses and contact lenses. Many of the intervention studies evaluating these treatments have had methodological limitations, and their results should be interpreted with caution.

SINGLE VISION LENSES

An active emmetropization mechanism regulated by optical defocus is supported by results of numerous studies [13]. Strong evidence is provided by compensatory ocular growth seen in response to lens-induced defocus in animal models. [14] Based on these results, it has been suggested that spectacle intervention in myopic children with the commonly prescribed single vision lenses (SVLs) might lead to increased progression and axial elongation. Patterns of lens wear in myopic patients can vary from full-time wear, to the use of lenses for distance viewing only, to non-wear of prescribed lenses. Limited data are available on myopia progression by pattern of lens wear, though pilot data suggest that progression is similar for the different patterns.[15] Additional investigation using a large sample of children randomly assigned to a lens wear regimen is warranted.

Under-correction of myopia with SVLs is a treatment option advocated by some clinicians. Only one masked, randomized clinical trial has been conducted to evaluate this treatment.[16] Ninety-four of 106 (89%) myopic children aged 9-14 years completed two years of spectacle wear in SVLs, half randomized to full correction and half to under-correction by approximately 0.75 D. Two-year progression in the fully corrected group was 0.77 D, significantly less than the 1.0 D in the under-corrected group ($p < 0.01$).

CONTACT LENSES

Many early investigations of rigid gas permeable contact lenses (RGP) for myopia control suffered from lack of randomization and a high dropout rate from the contact lens group.[17,18] In an attempt to eliminate the high loss to follow-up found in previous studies, a recent randomized clinical trial, the Contact Lens and Myopia Progression (CLAMP) study, implemented a run-in period to ensure good compliance with rigid contact lens wear.[19] One hundred and sixteen children who successfully completed the run-in period were randomized to wear either RGP or soft contact lenses for three years.

Results showed a statistically significant difference in 3-year myopia progression in the RGP vs. soft lens group (−1.56 ± 0.95 D for RGP wearers vs. −2.19 ± 0.89 D for the soft lens group, $p<0.001$). Most of the slowed progression with RGP lenses was found in the first year. Corneal curvature steepened significantly less over three years in the RGP group (0.62 ± 0.60 D compared to the soft lens group (0.88 ± 0.57 D, $p=0.01$), again with most of the difference found in the first year. Three-year axial elongation was not significantly different between treatment groups. These results, taken together, suggest that the slowed myopia progression was mainly due to corneal flattening, which may be reversible with discontinuation of RGP lens wear.

BIFOCALS AND PROGRESSIVE ADDITION LENSES

The use of bifocals or progressive addition lenses (PALs), sometimes called no-line bifocals, for slowing the progression of myopia has produced relatively small treatment effects overall, on the order of 0.15 to 0.50 D over 1.5 to 3 years,[20-25] although treatment effects are reported to be larger in certain subgroups of myopic children, as described below.

The largest of the treatment trials with this type of lens was the Correction of Myopia Evaluation Trial (COMET), a multi-center, randomized, double-masked clinical trial to evaluate whether PALs slow the rate of progression of myopia compared to conventional SVLs.[23] COMET enrolled 469 children aged 6 -11 years who were ethnically diverse (46% white, 26% African-American, 14% Hispanic, and 8% Asian) and had baseline myopia between −1.25 D and −4.50 D. The primary outcome measure was progression of myopia by cycloplegic autorefraction with tropicamide. Retention was excellent, with 462/469 (98.5%) of the children completing the three-year visit.

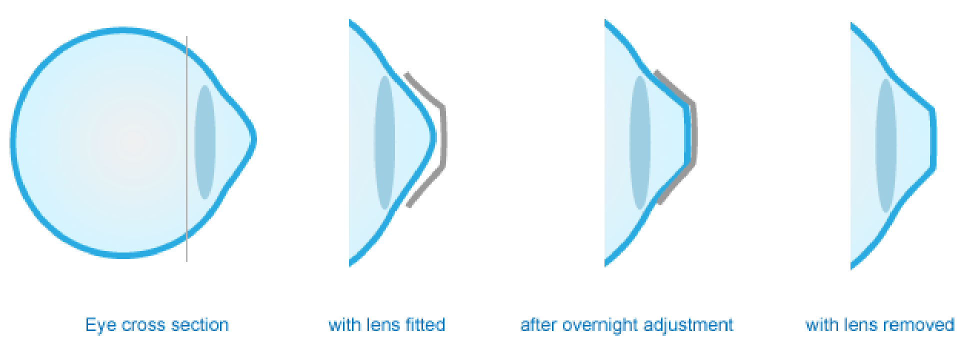
PHARMACEUTICAL AGENTS

Atropine

Recent well-designed studies using topical atropine, a non-selective muscarinic antagonist, have demonstrated statistically and clinically significant reductions in the progression of myopia.[26,27] Shih et al [26] reported that myopia progression was significantly slowed over 18 months in 6-13 year old children randomized to 0.5% atropine with multi-focal glasses (0.41 D) compared to multi-focal glasses alone (1.19 D) or SVLs alone (1.40 D). Chua et al[27] reported similar results in a two-year study of 400 eyes ,6-12 year-old myopic children in Singapore, although this study used a different experimental paradigm. Children were randomly assigned to either the atropine or the placebo-control group, with only one eye of each child treated with either 1% atropine or vehicle eye drops once nightly. Two-year progression in the atropine-treated eyes was found to be −0.28 D, significantly less than progression in the control eyes (−1.20 D). Myopia progression in the untreated eyes of both groups was similar to that of the control eyes. This outcome meant that many of the children in the atropine group were effectively anisometropic at the end of the study. The study did not report follow-up data to indicate whether a rebound effect (increased progression in the atropine-treated eyes after cessation of treatment) might have occurred. The side effects associated with atropine (e.g., photophobia, cycloplegia) are considered by many clinicians to be unacceptable for long-term therapy.

Eyeglasses, contact lenses, and refractive surgery are the primary options to treat the visual symptoms of those with myopia. Lens implants are now available offering an alternative to glasses or contact lenses for myopics for whom laser surgery is not an option.

Orthokeratology is the practice of using special rigid contact lenses to flatten the cornea to reduce myopia. Occasionally, pinhole glasses are used by patients with low-level myopia. These work by reducing the blur circle formed on the retina, but their adverse effects on peripheral vision, contrast and brightness make them unsuitable in most situations.



Chromatic aberration of strong eyeglasses

For people with a high degree of myopia, very strong eyeglass prescriptions are needed to correct the focus error. However, strong eyeglass prescriptions have a negative side effect in that off-axis viewing of objects away from the center of the lens results in prismatic movement and separation of colours, known as **chromatic aberration**. This prismatic distortion is visible to the wearer as colour fringes around strongly contrasting colours. Strongly nearsighted wearers of contact lenses do not experience chromatic aberration because the lens moves with the cornea and always stays centered in the middle of the wearer's gaze.

EYE EXERCISE AND BIOFEEDBACK

Practitioners and advocates of alternative therapies often recommend eye exercises and relaxation techniques such as the Bates method. However, the efficacy of these practices is disputed by scientists and eye care practitioners. A 2005 review of scientific papers on the subject concluded that there was "no clear scientific evidence" that eye exercises were effective in treating myopia.

MYOPIC CONTROL

Various methods have been employed in an attempt to decrease the progression of myopia. The use of reading glasses when doing close work may provide success by reducing or eliminating the need to accommodate.

Altering the use of eyeglasses between full-time, part-time, and not at all does not appear to alter myopia progression.

The American Optometric Association's Clinical Practice Guidelines for Myopia refers to numerous studies which indicated the effectiveness of bifocal lenses and recommends it as the method for “Myopia Control”. In some studies, bifocal and progressive lenses have not shown significant differences in altering the progression of myopia. More recently, robust studies on children have shown that Orthokeratology and Centre Distance bifocal contact lenses may arrest myopic development.

REVIEW OF LITERATURE

1. **Evaluation of Orbscan II corneal topography in individuals with myopia.**

Wei RH, Lim L, Chan WK, Tan DT. Ophthalmology. 2006 Feb;113(2):177-83 Singapore National Eye Center, Singapore.

OBJECTIVE

To evaluate Orbscan II (Bausch & Lomb, Orbtek Inc., Salt Lake City, UT) corneal topography in individuals with myopia .Retrospective, observational, consecutive, clinical case series.

METHODS

Manifest refraction results and the Orbscan II corneal topographic maps were reviewed retrospectively. One hundred forty eyes of 70 persons with myopia.

Refractive powers and the following test indices produced by Orbscan II were analyzed: anterior elevation best-fit sphere (BFS), posterior elevation BFS, maximum posterior elevation (Max PE), radius of Max PE, maximum keratometry, minimum keratometry, astigmatism, 3-mm irregularity, 3-mm mean power, 3-mm astigmatism, 5-mm irregularity, 5-mm mean power, 5-mm astigmatism, corneal diameter, pupil diameter, thinnest pachymetry, and anterior chamber depth. The correlations between right eyes and left eyes and between indices were explored.

RESULTS

Of the 140 eyes, the mean manifest refraction was -5.27±2.19 diopters (D; range, -10.50 to 0.00 D), the mean Max PE was 28±7 mum, and the mean maximum keratometry was 44.5±1.5 D. Maximum posterior elevation, corneal irregularity, and thinnest pachymetry did not vary with the degree of maximum keratometry.

CONCLUSIONS

This article provides a detailed description and analysis of Orbscan II corneal topography of a normal population with myopia. This helps in establishing normal standards in Orbscan II corneal topography that will aid in preoperative assessment in refractive surgery.

2. Relationship between corneal thickness and level of myopia.

Srivannaboon S. J Med Assoc Thai. 2002 Feb;85(2):162-6.

Department of Ophthalmology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand.

OBJECTIVE

A retrospective study of 533 eyes, which underwent complete pre-operative evaluation for refractive surgery, was done.

METHOD

Regression Analysis was performed to find the correlation between corneal thickness and level of myopia and between corneal thickness and corneal curvature.

RESULT

There was statistically significant correlation between corneal thickness and level of myopia ($p = 0.039$) and also in corneal thickness and corneal curvature ($p = 0.04$). No clinical correlation was demonstrated (R2 = 0.014 and R2 = 0.0153, respectively).

CONCLUSION

There was no clinical correlation between corneal thickness and level of myopia and also between corneal thickness and corneal curvature.

3. **No forward shifting of posterior corneal surface in eyes undergoing LASIK.**

Nishimura R, Negishi K, Saiki M, Arai H, Shimizu S, Toda I, Tsubota K.

Ophthalmology. 2007 Jun;114(6):1104-10. Epub 2007 Jan 18.

Department of Ophthalmology, Keio University School of Medicine, Tokyo, Japan.

OBJECTIVE

To evaluate structural changes in the cornea and anterior chamber (AC) after LASIK for myopia.Retrospective nonrandomized study.

METHODS

One hundred sixty-one eyes of 83 patients (mean age, 34.5+/-8.3 years) who underwent uneventful LASIK for myopia and myopic astigmatism. The preoperative refractive error (spherical equivalent) and corneal thickness were -6.02+/-2.10 diopters (D) and 549.9+/-29.3 mum, respectively.The AC volume (ACV), AC depth (ACD), corneal thickness, were measured before and 1 week and 1 month after surgery. In 84 eyes of 42 cases, anterior and posterior corneal elevations and corneal thicknesses also were measured by scanning-slit topography before and 1 month after surgery.

RESULTS

Preoperative and 1-month postoperative mean ACVs were 198.1 mm3 and 196.4 mm3, respectively, and preoperative and postoperative mean ACDs (center, midperiphery, periphery) were 3.24, 2.65, and 1.89 mm, and 3.21, 2.63, and 1.87 mm, respectively. The corneal thickness within the optical zone, subjective refraction, and central corneal true net power significantly changed by tissue subtraction after LASIK ($P<0.0001$). There were no significant differences in the ACV, ACDs (center, midperiphery, periphery), corneal thickness from preoperatively to 1 month after LASIK. However, using scanning-slit topography, the posterior corneal surface displayed a mean forward shift of 29.0+/-19.0 micron 1 month after surgery.

CONCLUSION

The posterior corneal curvature, peripheral corneal thickness, ACDs, and ACV were consistent. These observations indicated that neither forward shifting of the central posterior corneal surface nor backward shifting of the peripheral posterior corneal surface due to corneal swelling after ablation occurred after LASIK.

4. **Internal astigmatism and its correlation to corneal and refractive astigmatism.**

Srivannaboon S. J Med Assoc Thai. 2003 Feb;86(2):166-71.

Department of Ophthalmology, Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

OBJECTIVE

To evaluate the internal astigmatism and its relationship to corneal and refractive astigmatism in a refractive surgery patient population.

METHOD

Patients who underwent pre-operative evaluation for Laser in situ Keratomileusis (LASIK) at Excimer Laser Clinic, Siriraj Hospital, Mahidol

RESULTS

The mean age was 31.14 +/- 7.00 year. The mean astigmatism measured by manifest refraction was 0.76 +/- 0.72 diopters. The mean astigmatism measured by Orbscan Corneal Topography was 1.38 +/- 0.72 diopters. The mean difference in magnitude of refractive and corneal astigmatism was 0.62 +/- 0.67 diopters and 74 per cent were within +/- 1.00 diopters difference. The mean difference in axis of astigmatism was 0.95 +/- 23 degree and 79.6 per cent were within +/- 15 degree difference. There was low correlation between corneal and internal astigmatism, also low correlation between refractive and internal astigmatism. There was a statistically significant difference between magnitude of corneal and refractive astigmatism ($p < 0.05$) but no difference in the axis of astigmatism ($p = 0.55$).

CONCLUSION

This study demonstrated non-mutual agreement between refractive and corneal astigmatism (presence of internal astigmatism). High value (> 1.00 diopter) of internal astigmatism was demonstrated in 1/3 of the cases. Keratorefractive surgery that attempts to correct refractive astigmatism at corneal plane may affect long-term evaluation of the astigmatism.

5. **Accuracy of Orbscan II in the assessment of posterior curvature in patients with myopic LASIK.**

Cheng AC, Rao SK, Lam DS. J Refract Surg. 2007 Sep;23(7):677-80.

Department of Ophthalmology & Visual Sciences, The Chinese University of Hong Kong, Hong Kong Eye Hospital, Kowloon, Hong Kong.

OBJECTIVE

To evaluate the accuracy of Orbscan II measurements in assessing posterior corneal curvature in patients undergoing myopic LASIK.

METHODS

Using the Orbscan II, posterior corneal curvature was assessed pre- and postoperatively in 304 eyes that underwent myopic LASIK. The radius of curvature and corneal refractive power in diopters (D) were compared using the paired sample t test.

RESULTS

The mean pre- and postoperative radius of posterior corneal curvature were 6.49 +/- 0.26 mm and 6.35 +/- 0.30 mm, respectively. Mean pre- and postoperative posterior corneal power were -6.17 +/- 0.25 D and -6.32 +/-

0.30 D, respectively, and the difference (0.14 +/- 0.14 D) was statistically significant

CONCLUSIONS

Although the derived value for the power of the postoperative LASIK posterior corneal surface is overestimated using the Orbscan II, this small difference may not be clinically important. Orbscan II measurements can therefore be used (with caution) to measure posterior corneal curvature in patients with myopic LASIK for the assessment of intraocular lens power based on the Gaussian optics formula.

6. Corneal refraction and topography in school myopia.

Pärssinen TO. CLAO J. 1993 Jan;19(1):69-72.

Department of Ophthalmology, Central Hospital of Central Finland, Jyväskylä.

OBJECTIVE

Changes in corneal refraction and topography among 145 myopic children were monitored over a three-year period as part of a clinical trial of myopia treatment.

RESULTS

The spherical equivalent of the right eye increased from -1.46 D to -3.13 D. Refractive astigmatism increased from 0.28 D to 0.46. Corneal astigmatism, horizontal and vertical corneal curvatures, as well as shape factors, did not change significantly. The mean deviation of the corneal apex from the visual axis increased from 0.48 mm to 0.67 mm.

CONCLUSION

Girls showed steeper corneal curvatures than boys. For both sexes the vertical corneal curvatures were steeper, and shape factors were smaller than those along the horizontal plane. Axial elongation of the eye was the primary explanation for myopic progression.

7. Pupil size, white-to-white corneal diameter, and anterior chamber depth in patients with myopia.

Alfonso JF, Ferrer-Blasco T, González-Méijome JM, García-Manjarres M, Peixoto-de-Matos SC, Montés-Micó R.

J Refract Surg. 2010 Nov;26(11):891-8. doi: 10.3928/1081597X-20091209-07. Epub 2009 Dec 15.

OBJECTIVE

To evaluate anatomical parameters in a population of patients with myopia.

METHODS

Nine hundred sixty-four myopic eyes (-3.00 to -20.00 diopters [D] spherical equivalent refraction) were evaluated to measure mesopic and photopic pupil size with an infrared pupillometer; anterior chamber depth and white-to-white corneal diameter were obtained with Orbscan II (Bausch & Lomb). Correlation analysis was performed to evaluate the relationships among anatomical parameters of the anterior segment of the eye.

RESULTS

Average change in pupil size between mesopic and photopic conditions shows a uniform gap of 1.5 mm in patients aged 18 to 62 years with a slight insignificant trend to decrease with age. Photopic and mesopic pupil size were highly correlated ($r=0.694$, $P<.001$) and the difference between both measures was positively correlated with mesopic pupil size ($r=0.207$, $P<.001$) and inversely correlated with photopic pupil size ($r=0.561$, $P<.001$). Anterior chamber depth and white-to-white corneal diameter were positively correlated ($r=0.389$, $P<.001$). White-to-white corneal diameter and anterior chamber depth were not correlated with age ($r=-0.096$, $P<.001$) or anterior chamber depth ($r=-0.183$, $P<.001$-0.183) as a function of age.

CONCLUSIONS

Average difference between photopic and mesopic pupil size remained constant across the range of ages included in this cohort. A positive correlation was noted between anterior segment dimensions, and anterior chamber depth decreased with age.

8. Pachymetric evaluation prior to laser in situ keratomileusis.

Jonsson M, Behndig A. J Cataract Refract Surg. 2005 Apr;31(4):701-6.

Department of Clinical Science/Ophthalmology, Umeå University Hospital, Umeå, Sweden.

OBJECTIVE

To determine whether deviations in the localization of the cornea's thinnest point or the magnitude and localization of posterior corneal ectasia is associated with deviations in the spherical equivalent, the astigmatism, or the magnitude of an anterior corneal ectasia and whether corneas at risk for iatrogenic keratectasia can be identified without a pachymetry map of the cornea.

METHODS

Three hundred eight eyes of 156 healthy volunteers with various refractive errors were examined with Orbscan II and autorefractometer-keratometer. The corneal thickness was registered at the fixation point, at the geometrical center, and at the thinnest point of the cornea. Keratometry and refraction were determined for all subjects.

RESULTS

The thinnest point of the cornea was predominantly located in the inferotemporal quadrant, and was significantly thinner than the fixation point (539.6 +/- 35.8 microm and 548.0 +/- 35.4 microm, respectively, P<.001).

Interestingly, the larger this difference was, the longer the distance between these points. No relationship was found between the refractive or external surface measurements and the internal surface measurements.

CONCLUSIONS

The absence of a clear relationship between the shape of the anterior corneal surface or the refractive error, and the shape of the posterior corneal surface, necessitates a thorough pachymetric evaluation of the cornea before a laser in situ keratomileusis procedure, with special attention to the inferotemporal area.

9. **Treatment of myopia and myopic astigmatism by customized laser in situ keratomileusis based on corneal topography.**

Knorz MC, Neuhann T. Ophthalmology. 2000 Nov;107(11):2072-6.

Faculty of Clinical Medicine Mannheim of the University of Heidelberg, Heidelberg, Germany.

OBJECTIVE

To evaluate the predictability, efficacy, and safety of customized laser in situ keratomileusis (LASIK) based on corneal topography in myopia and myopic astigmatism.

METHODS

One hundred fourteen patients (eyes) with myopia of -1 to -6 diopters (D) and astigmatism of 0 to -4D (low myopia group), and 89 patients (eyes) with myopia of -6.10 to -12.00 D and astigmatism of 0 to -4.00 D (high myopia group).

RESULTS

At 3 months, 51 patients in the low myopia group and 40 patients in the high myopia group were available. In the low (high) myopia group, 96.1% (75.0%) were within +/-0.50 D of emmetropia, and uncorrected visual acuity was 20/20 or better in 82.4% (62.5%), 20/25 or better in 98.0% (70.0%), and 20/40 or better in 100% (95.0%). A loss of two or more lines of spectacle-corrected visual acuity occurred in 3.9% of the low and 5. 0% of the high myopia group. In low myopia, spectacle-corrected visual acuity was 20/12.5 or better in 5.9% preoperatively and in 13.7% at 3 months and 20/15 or better in 37.3% and 47.1%, respectively. Differences were statistically significant.

CONCLUSIONS:

The customized LASIK based on corneal topography used in this study showed high predictability and efficacy in myopia and myopic astigmatism of -1.00 to -6.00 D, and could possibly improve spectacle-corrected visual acuity in myopia of -1.00 to -6.00 D. Predictability and efficacy were somewhat lower in myopia and myopic astigmatism of -6.10 to -12.00 D. In both groups, a small number of patients lost two or more lines of spectacle-corrected visual acuity.

10.Laser in situ keratomileusis for myopia and myopic astigmatism.

Salchow DJ, Zirm ME, Stieldorf C, Parisi A. J Cataract Refract Surg. 1998 Feb;24(2):175-82.

OBJECTIVE

To evaluate the precision and safety of myopia and astigmatism correction using laser in situ keratomileusis (LASIK).

METHODS

In this prospective study, LASIK was performed on 66 eyes of 39 patients with myopia ranging from 1.50 to 16.00 diopters (D). Astigmatism, ranging from -0.00 to -3.00 D, was treated simultaneously. Surgery was performed with the Chiron Keracor 117 excimer laser and the Chiron Automated Corneal Shaper microkeratome. During the 6 month follow-up, manifest refraction as well as best corrected and uncorrected visual acuities were measured; corneal topographies were produced and slitlamp biomicroscopy was performed. Changes in visual acuity and corneal topography were evaluated.

RESULTS:

After 6 months, mean myopia had decreased from 6.78 D +/- 3.48 (SD) to 0.40 +/- 0.98 D. Fifty-one of 63 eyes (81.0%) were within +/- 1.00 D of spherical emmetropia and 61 of 63 (96.8%) within +/- 1.00 D of cylindrical emmetropia. Uncorrected visual acuity improved in all eyes; it was 20/40 or better in 82.5% 6 months postoperatively. Best corrected visual acuity did not change in most eyes; 9.5% lost two or more Snellen lines. No central islands or corneal scars were detected postoperatively. Haze was noted in only 6 eyes (9.1%); it was transient and less than grade 1. No sight-threatening complications occurred intraoperatively.

CONCLUSION

Laser in situ keratomileusis(LASIK) was an exact and predictable procedure for correcting low, moderate, and high myopia and myopic astigmatism.

ORBSCAN TOPOGRAPHY

Clinicians have a number of methods for measuring corneal power and/or corneal shape including keratometry, keratoscopy, photokeratography, interferometry, computer assisted videokeratography, and raster stereography[28-33].Orbscan is one of the most reliable methods to assess the characteristics of cornea.

Measurement of shape, refractive power, and the thickness of the cornea are very important for designing vision correction surgeries and diagnosing corneal diseases. The majority of the commercial computerised video keratography instruments measure the topography of the anterior corneal surface, which accounts for the majority of the refractive power of the cornea. However, the posterior surface of the cornea also contributes to its refractive power.Corneal thickness is an important factor to evaluate corneal barrier and endothelial pump function.Accurate measurement of corneal thickness is helpful in the diagnosis of corneal diseases and avoidance of keratorefractive surgery complications.

The Orbscan corneal topography system is a recently developed device that evaluates anterior and posterior corneal surface topography as well as the thickness of the entire cornea.

This instrument has the potential to greatly increase our knowledge about corneal shape and function in health and disease. The Orbscan corneal topography system measures anterior and posterior corneal elevation surface curvature, as well as corneal thickness using a scanning optical slit device.

Corneal thickness can be evaluated by a number of methods including ultrasonic pachymetry,[34-36] optical slit lamp pachymetry,[37] specular microscopy,[38] confocal microscopy, [39,40] and partial coherence interferometry. [41] Each of these methods has different clinical disadvantages. Large discrepancies in optical pachymetry results can be obtained by different observers or with different instruments. Ultrasonic measurement requires corneal contact and it is difficult to locate accurately the same points of measurement in serial examinations. This may result in falsely large variation in corneal thickness measurement. The Orbscan corneal topography system evaluates corneal thickness across the entire corneal surface and it is non-invasive. Using the Orbscan corneal topography system software, the standard location of central and periphery cornea can be designed according to clinical requirements.

Pachymetry is determined by this instrument from the difference in elevation between the anterior and posterior surface of the cornea. This instrument averages pachymetry in nine circles of 2 mm diameter that are located in the centre of the cornea and at eight locations in the mid-peripheral cornea (superior, superotemporal, temporal, inferotemporal, inferior, inferonasal, nasal, superonasal), each located 3 mm from the visual axis.

Bausch & Lomb Orbscan

The Orbscan corneal topography system software also identifies the thinnest point on the cornea and marks its distance from visual axis and its quadrant location (superotemporal, inferotemporal, superonasal, and inferonasal). The colour coded maps showing the elevation pattern of the anterior and posterior surface of cornea were classified according to a classification scheme for anterior elevation maps of normal corneas made with the PAR corneal topography system. Orbscan system may also measure the hydrated mucous gel covering the corneal surface that has been reported to be up to 40 µm thick.[40]

This scheme classifies maps into regular ridge, irregular ridge, incomplete ridge, island, and unclassified patterns .The axial curvature maps of the anterior corneal surface were classified into round, oval, symmetric bow tie, asymmetric bow tie, and irregular patterns, using a proposed classification scheme of corneal topography obtained.

Because there was no existing method for classifying corneal pachymetry maps, the following classification system was devised. The warmest colour in the pachymetry map, identifying the thinnest area of the cornea, was used to designate one of four different patterns round, oval, decentred round, and decentred oval.

The following objective criteria defined the categories used for this classification:-

Round

The ratio of the shortest to the longest diameter of the warmest colour zone was two thirds or greater, and the warmest colour was either entirely located at the centre of the map or more than half of the area of the warmest colour entered the central 3 mm diameter zone.

Oval

The ratio of the shortest to the longest diameter at the warmest colour zone was less than two thirds, and the warmest colour was either entirely located at the centre of map or more than half of area of the warmest colour entered the central 3 mm diameter zone.

Decentred round

The warmest colour was round, and more than half of its area was outside of the central 3 mm diameter zone or it was entirely located in the peripheral cornea.

Decentred oval

The warmest colour was oval, and more than half of its area was outside the central 3 mm diameter zone or it was entirely located in the peripheral cornea.

The Orbscan corneal topography system evaluates corneal thickness across the entire corneal surface and it is non-invasive. Using the Orbscan corneal topography system software, the standard location of central and periphery cornea can be designed according to clinical requirements.

The ORBSCAN IIz topographer

PRINCIPLES

Multiple light concentric rings are projected on the cornea. The reflected image is captured on a charge-coupled device camera. Computer software analyzes the data and displays the results in various formats.

INTERPRETATION OF TOPOGRAPHIC MAPS

Every map has a colour scale that assigns a particular colour to a certain keratometric dioptric range. Never base an interpretation on colour alone. The value in keratometric D is crucial in the clinical interpretation of the map and has to be looked at with the interpretation of every map.

Absolute maps have a preset colour scale with the same dioptric steps, dioptric minimum and maximum assigned to the same colours for a particular instrument. These maps allow direct comparison of 2 different maps. However, because the steps are in large increments (generally 1.5 D), their disadvantage is that they do not show subtle changes of curvature and can miss subtle local changes (eg, early keratoconus).

CORNEAL TOPOGRAPHY MEASUREMENTS

Corneal topography most commonly is thought of as Placido-based reflective image analysis. It does not directly measure the x, y, and z coordinates of the points on the corneal surface that are usually used for characterization of objects in 3-D space. Instead, it typically measures the deviation of reflected rings and primarily calculates the curvature of the corneal surface points in axial direction.

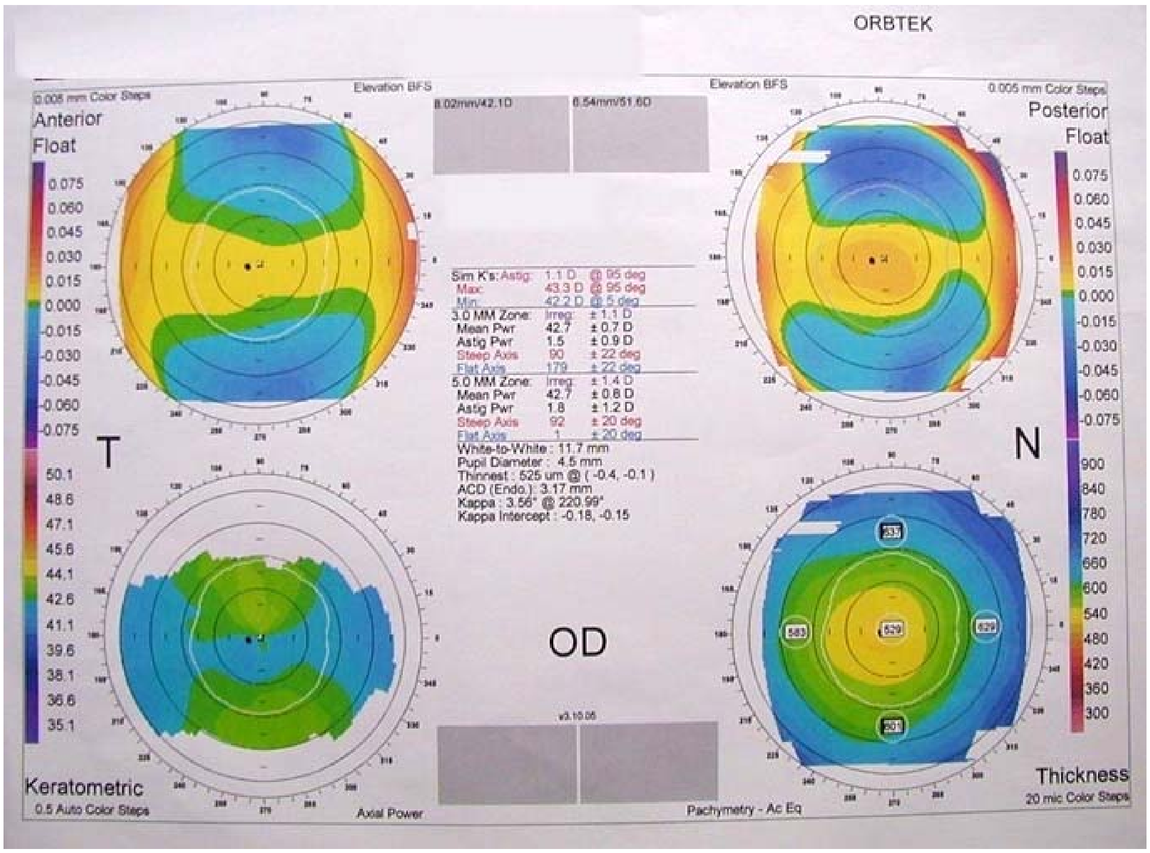
CURVATURE / POWER MAP

Surface curvature measures how fast the surface bends at a certain point in a certain direction.

Axial curvature (formerly termed sagittal curvature) measures the curvature at a certain point on the corneal surface in axial direction relative to the center. It requires the calculation of the center of the image, which cannot be measured directly.

Meridional curvature (formerly termed tangential and instantaneous curvature) measures the curvature at a certain point on the corneal surface in meridional direction relative to the other points on the particular ring.

ORBSCAN TOPOGRAPHY



CORNEA CHARACTERISTICS

Characteristics of the cornea can be divided into several aspects such as the geometrical and optical properties of the cornea[42]. The geometrical property is the basic property and demonstrates the gross anatomy of the cornea. In contrast, optical property is an intrinsic property and demonstrates how light should be refracted through the corneal surface. Diameter and thickness are among the most important geometrical properties of the cornea. From this data, the average correction of near sightedness at the corneal plane can be calculated up to -8.00 to -9.00 diopters at 6 mm zone by using **Munnerlyn's equation** depending on the type of correction (equivalent to 95 to 110 microns of tissue available)[43].

The **Munnerlyn Formula** is the theoretical formula discovered by Charles Munnerlyn, which gives the depth an excimer laser will need to ablate during LASIK surgery or similar medical interventions. The formula states that the depth of the ablation (in micrometres) per diopter of refractive change is equal to the square of the diameter of the optical ablation zone measured in millimeters, divided by three.

For example, to change refraction by 4 diopters with an optical zone of 3 mm would require ablation of 12 micrometeres. As the depth of ablation is proportional to the square of the optical zone, changing the refraction by 4 diopters but with an optical zone of 6 mm would require a much deeper ablation of approximately 48 micrometers. The ablation depth does not include the transition zone of the surgery.

The actual ablation depth and surface shape will be slightly different than the theoretical Munnerlyn formula. Many factors must be taken into account at the time of the surgery. The sex, age, and race of the patient, and such things as the barometric pressure and ambient humidity will change slightly the required ablation.

Curvature (which determines the amount of corneal astigmatism) and angle kappa are also very important for the optical property of the cornea. Astigmatism (both corneal and internal) in the present study is also similarly found as in previous reports. Angle kappa is the angle between the visual axis and the anatomic pupillary axis of the eye. It can be measured by the **Hirschberg test** which roughly looks at the location of the corneal light reflex. It is slightly 0.5 mm nasal to the center of the cornea due to temporal displacement of the fovea to the pupillary axis. This is termed **positive angle kappa**. If the reflex is located in a position other than 0.5 mm nasally, the Hirschberg test is positive[44-46]. With the modern technology of Orbscan Topography, the location of the corneal light reflex can be measured to the exact location in x-y axis.

Surgeons should know the normal finding of the cornea in order to identify any abnormal finding. Any finding that is out of the normal range requires caution. The normal characteristics of the cornea vary from one to another; depending mostly on the race of the population. Misinterpretation of the corneal finding can sometimes lead to serious complications[47-48]

Excimer LASER ablation of the cornea can also successfully correct myopia and myopic astigmatism[49-57].Different concepts are used to characterize optical properties of the cornea.

Curvature of its anterior and posterior surface can be expressed as radii of curvature in millimetres or clinically more often in keratometric diopters. The shape of the anterior and posterior surface also can be expressed in micrometers as the elevation of the actual surface relative to a chosen reference surface (eg, sphere). These 2 concepts can characterize the overall shape and the macro-irregularities of the corneal surface (eg, corneal astigmatism).Power of the cornea expressed as refraction in diopters is an optical property dependent on the shape of the surfaces and the refractive index of the surface.

The keratometric diopter is a concept inherited from keratometry and is calculated simply from radii of curvature, as follows: K=refractive index of 337.5/radius of curvature.

This concept is a simplification ignoring the fact that the refracting surface is air-tear interface, and it does not account for the oblique incidence of incoming light in the corneal periphery. As a result, it miscalculates a true corneal refractive index of 1.376 to 1.3375 to correct for some of these factors. That is why these diopters more correctly are termed keratometric diopters to distinguish them from the diopters expressing more precisely the true refractive power at certain corneal point.

CORNEAL SHAPE

The average anterior and posterior corneal power is 48.6 diopter (D) and –6.8 D, respectively. To simplify it in clinical practice or in keratometry, a substitution with one refractive surface with the resulting corneal power of 42-44 keratometric D often is used. The average cornea changes little with age. It flattens about 0.5 D by age 30 years and steepens about 1 D by age 70 years.

During adulthood, an average cornea is steeper in the vertical meridian by about 0.5 D compared to the horizontal meridian, which contributes to higher incidence of with-the-rule astigmatism in young adults. Lenticular changes contribute significantly to the higher incidence of against-the-rule astigmatism with age.

Normal cornea is a prolate surface, ie, steeper in the center and flatter in the periphery. Oblate surface (eg, surface after myopic laser photorefractive keratectomy) is flatter in the center and steeper in the periphery.

The average central corneal thickness is approximately 550 µm. The average thickness in temporal, nasal, inferior, and superior quadrants of the cornea was 590, 610, 630, and 640 µm, respectively. The **thinnest site** on the entire cornea is located on an average 0.9 mm from the visual axis most commonly in the inferotemporal quadrant.

MECHANICAL PROPERTIES

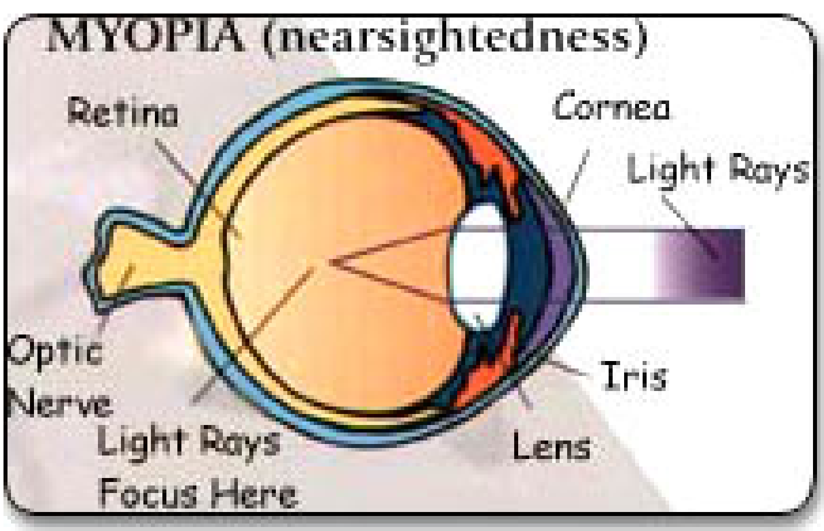
The mechanical properties of human corneal tissue are less well understood. The intact central corneal thickness of 250 µm is considered enough to ensure long-term mechanical stability of the cornea. The peripheral thickness is not well studied, but it is certainly clinically important in some refractive procedures such as intracorneal rings or radial and astigmatic keratotomy. With the advances in corneal imaging and widespread refractive surgeries, corneal behaviour likely will be understood better.

In practice, the colours in the same region of elevation and axial curvature maps are often reversed. The vertical 90° axis is steeper in those incidences of with-the-rule corneal astigmatism. Therefore, the superior area is typically depressed (blue on elevation map and steeper, red on axial map) as seen on the image below. The bow tie pattern on the axial map is just a different mathematical representation of an oval sphero-cylindrical surface. It is not seen on the elevation map that is created from the x, y, and z coordinates of the usual representation of data in a 3-D world.

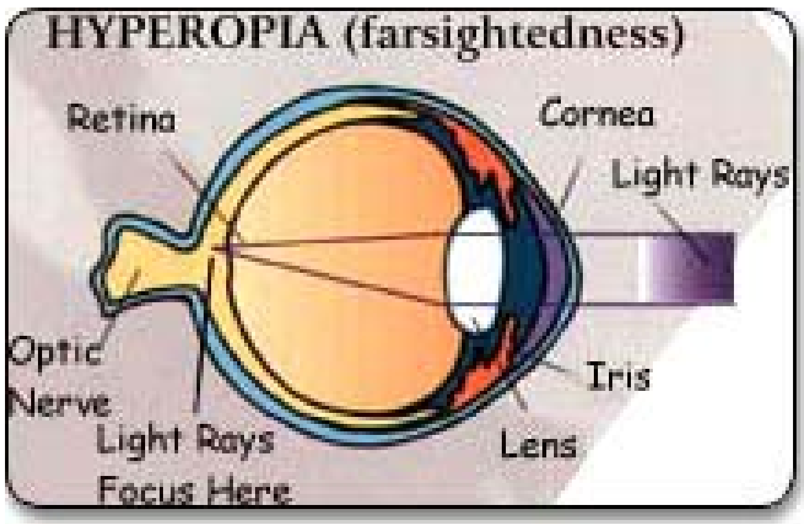
REFRACTIVE ERROR

The function of the eye is to see clearly the objects around us. The inability of the eye to accurately focus the rays of light coming from distance on the retina is called refractive error. This condition may be either because the eye is too short or long in length, or because the cornea or lens does not have the required refractive power. There are three types of refractive errors:

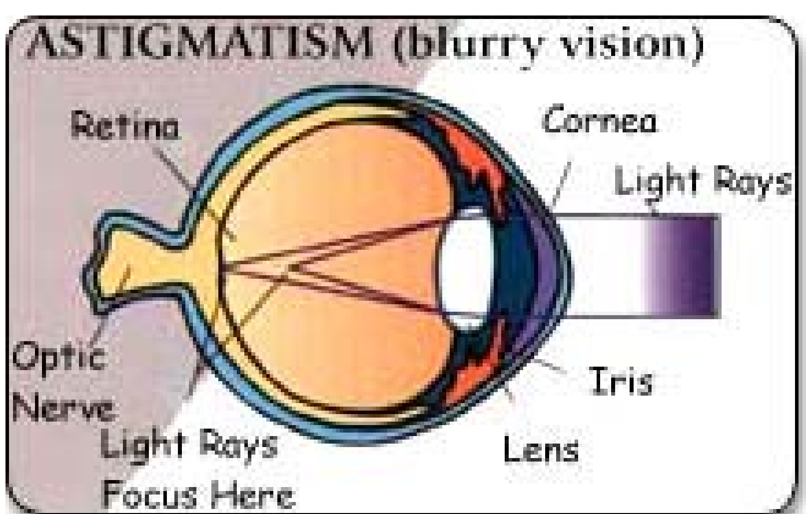
Myopia (near-sight): This is the condition in which the eye is too long and the light is focused in front of the retina. Distant objects are blurred but the near objects are seen clearly. The eye has too much optical power and to correct it the optical power is reduced by either minus glasses or contact lenses, or by surgery.



Hypermetropia (long-sight): This is the condition in which the eye is too short and the light is focused behind the retina. The eye has less optical power than is needed. When young the eye can use the lens within the eye to compensate, but reading glasses are needed at a relatively early age. Later, distance glasses (plus) are needed as well, such that glasses for distance and near are required.



Astigmatism: This is the condition where the eye does not focus the light evenly, usually due to the cornea of the eye being more curved in one direction.



Presbyopia:- This is the normal ageing process, where the lens progressively loses its capacity to increase its power for near vision (loss of accommodation). The distance vision may be normal, but the near vision becomes blurred with age greater than about 45 years. This is corrected by wearing reading glasses (plus) for the near work. This condition may occur in itself or may be present along with pre-existing myopia, hypermetropia or astigmatism. Various Surgical procedures have recently been introduced to correct presbyopia.

AIM AND OBJECTIVE

To evaluate corneal and refractive characteristics of Indian myopic patients seeking refractive surgery at a tertiary care eye centre.

MATERIALS AND METHODS

STUDY DESIGN

A retrospective study of 910 eyes in 455 patients who were screened by Orbscan topography (Bausch and Lomb) before undergoing myopic refractive surgery (LASIK / ZYOPTIX) from April 2011 to October 2011 in Aravind eye hospital Madurai.

INCLUSION CRITERIA

Age group between 21-40 years both male and female.

- Myopia with at least-0.25 sphere and astigmatism of-0.25 cylinder.
- Refractive power has been constant for at least 1 year.
- Cylindrical power not more than 5 D.

EXCLUSION CRITERIA

- Keratoconus / subclinical/ Forme Fruste.
- Ocular surface disease including severe dry eye.
- Other Ethnic groups.

METHODOLOGY

- A detailed history is taken, including history of contact lens wear.
- Undilated subjective refraction and auto refractometry is done.
- A complete pre-operative work up is done in all patients including slit lamp- bio microscopy.

- Schirmer’s 1 test in Contact Lens wearers and symptomatic patients to rule out dry eye.
- The Orbscan Topography (Bausch & Lomb) was used to evaluate the corneal diameter, corneal curvature, corneal thickness, angle kappa and AC depth.
- An Indirect Ophthalmoscopic examination was done with a dilated pupil for periphery examination of the posterior segment.
- A dilated subjective refraction is done.
- If all parameters are normal , the patients is advised LASIK

PRE LASIK EVALUATION FORM

Name: - **Date of Birth:-** **Sex:-** M/F

Orbscan for: - BE ☐ RE☐ LE☐

History:-

Defective Vision: - Duration

Glasses: - Duration Wearing Regularly: - Y/N

Contact Lens: - Ever Tried: - Y/N Duration

Comfortable: - Y/N Intolerant: - Y/N

Type of CL: - Hard ☐ Semisoft ☐ Soft ☐

History of: - Flashes ☐ Floaters ☐

Ocular Problems: - Keratoconus ☐ Glaucoma ☐ RD ☐ Sqint ☐

Family History: - Keratoconus ☐ DM ☐ Glaucoma ☐ Others ☐

VISUAL ACUITY	**RE**	**LE**
Uncorrected		
Best Corrected		

REFRACTION

	RE	LE
Dynamic		
Autorefractometry		
Cycloplegic		
Keratometry		
Pachymetry		

EXAMINATION BY SLIT LAMP

	RE	LE
Lids		
MGD		
Deformities		
Tear Meniscus		
Conjunctiva		
Pretigium		
Scarring		
Spring Catarrh		
Keratoconus (Striae/Coning/Thinning)		
PMD		

Vascularisation		
BUT		
Lenticular Myopia		
Cataract Changes		
Subluxation		
Spherophakia		
Retinal Examination (Dilated Fundus)		
Topography (Abnormalities)		

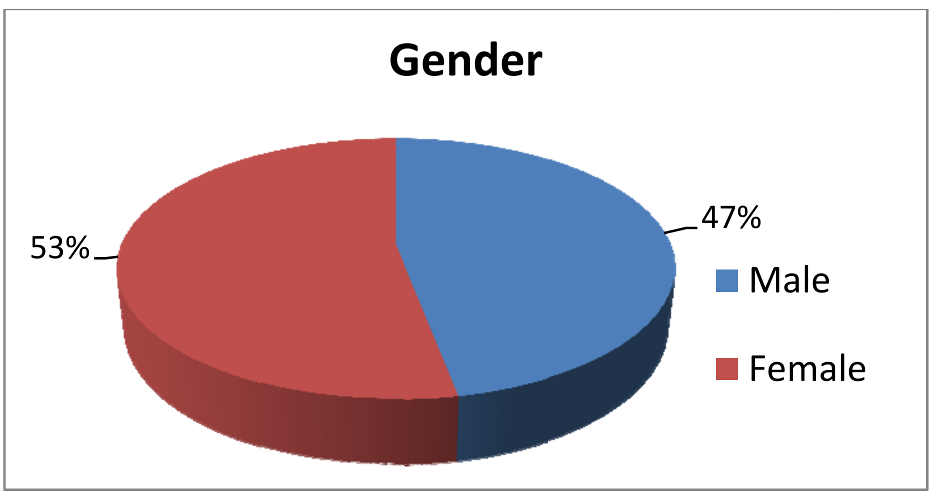
Only patients found suitable for myopic LASIK were included in this study.

OBSERVATIONS & RESULTS

Total number of patients: - 455. (910 eyes)

GENDER

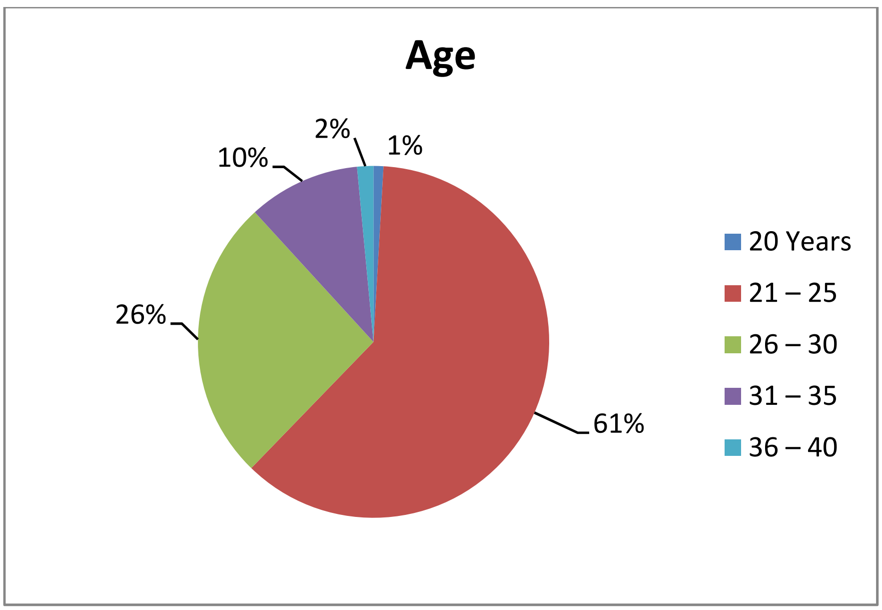
Gender	**No.**	**%**
Male	214	47.0
Female	241	53.0
Total	455	100.0



- The percentage of females was marginally more than males with a percentage of 53% to 47% respectively.

AGE

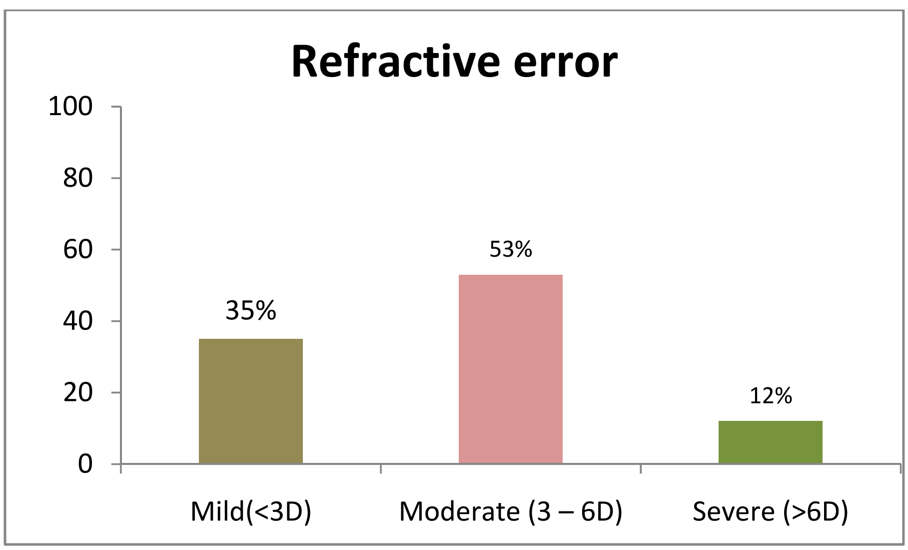
Age	No.	%
20 Yrs	4	0.9
21 – 25	279	61.3
26 – 30	118	25.9
31 – 35	47	10.3
36 – 40	7	1.5
Total	455	100



- The results showed that 61.3% of the people were in the age group from 21-25years, followed by 25.9% in the 26-30 age group.
- The 0.9% at the age of 20 or less wanted to undergo LASIK for professional reasons.

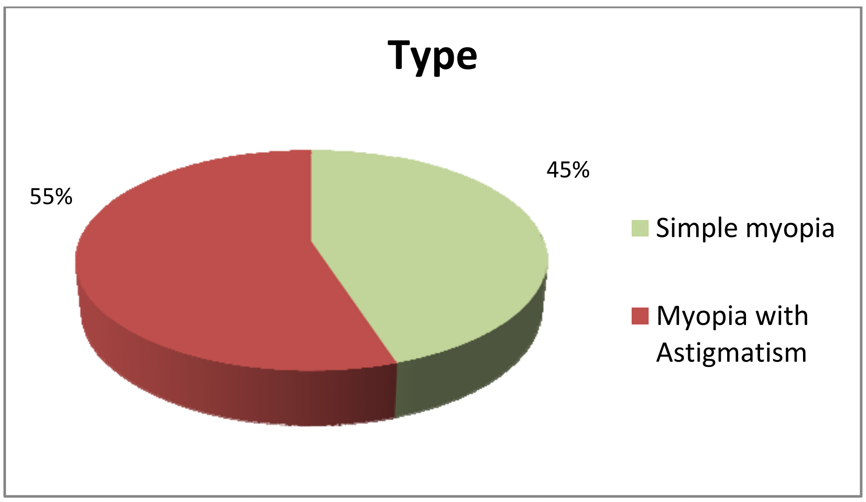
REFRACTIVE ERROR

Degree	OD		OS	
	No.	**%**	**No.**	**%**
Mild(<3D)	161	35.4	160	35.2
Moderate (3 – 6D)	239	52.5	243	53.4
Severe (>6D)	55	12.1	52	11.4
Total	455	100	455	100.0



- The results showed that 35% of people of the study population had mild (<3D), 53% of the people had moderate (3-6D) and 12% of the people had severe (>6D) refractive error.

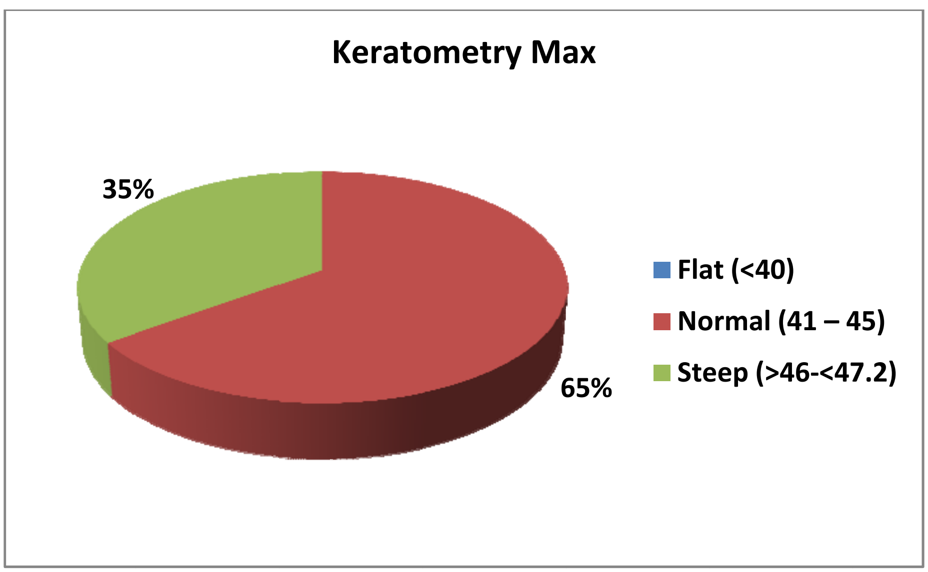
TYPE	OD		OS	
	n	**%**	**n**	**%**
Simple myopia	201	44.2	207	45.5
Myopia with Astigmatism	254	55.8	248	54.5
Total	455	100	455	100



- The results showed that 45% of the study patients were having only spherical correction, and 55% showed sphero-cylindrical correction.
- The mean manifest refraction (spherical equivalent) was 3.90D±2.28 diopters (ranging from -0.25 to -14.00D).

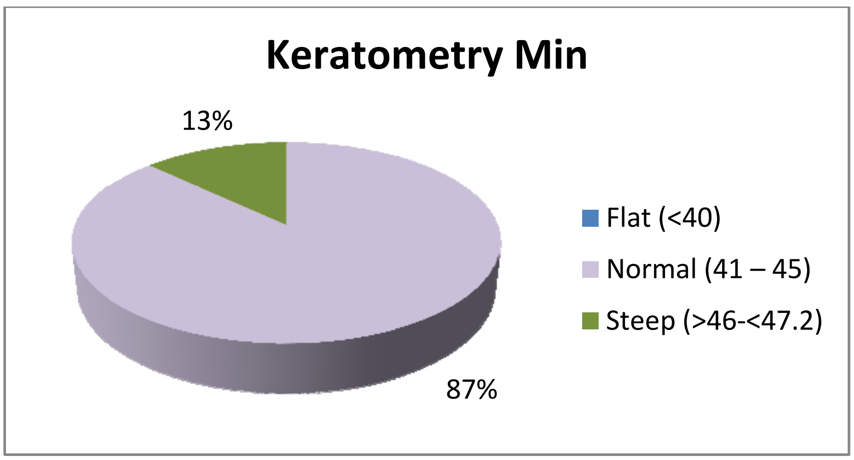
KERATOMETRY VALUE

Keratometry Max	OD		OS	
	No.	**%**	**No.**	**%**
Flat (<40)	-	-	-	-
Normal (41 – 45)	288	63.3	307	67.5
Steep (>46-<47.2)	167	36.7	148	32.5
Total	455	100.0	455	100.0



- 65% of the study population had maximum keratometry values within normal range, while 35% had steep corneas in the maximum keratometry value.

Keratometry Min	OD		OS	
	No.	%	No.	%
Flat (<40)	-	-	-	-
Normal (41 – 45)	400	87.9	395	86.8
Steep (>46-<47.2)	55	12.1	60	13.2
Total	455	100.0	455	100.0



- 87% of the study population had normal minimum keratometry value, whereas 13% had steeper corneas in the minimum keratometry value.
- K- Maximum had a Mean (SD) of 44.52 D ±1.34 D and the range is a Minimum of 41.0 D to a Maximum of 47.2 D.
- K- Minimum had a Mean (SD) of 43.62 D ±1.29 D and the range is a Minimum of 40.2 D to a Maximum of 47.1 D.

CORNEAL DIAMETER AND AC DEPTH

Variable	No.	Mean(SD)	Min – Max(mm)
Corneal diameter-OD	455	11.75(0.39)	10.6 – 12.9
Corneal diameter-OS	455	11.74(0.41)	10.6 – 13
AC depth-OD	455	3.04(0.27)	2.27 – 3.74
AC depth-OS	455	3.04(0.27)	2.27 – 3.68

- Mean (SD) of the corneal diameter is 11.75± 0.4mm and the range is 10.6mm to 13mm.
- Mean (SD) of AC depth is 3.04± 0.27mm and the range is a minimum of 2.27mm to a maximum of 3.74mm.

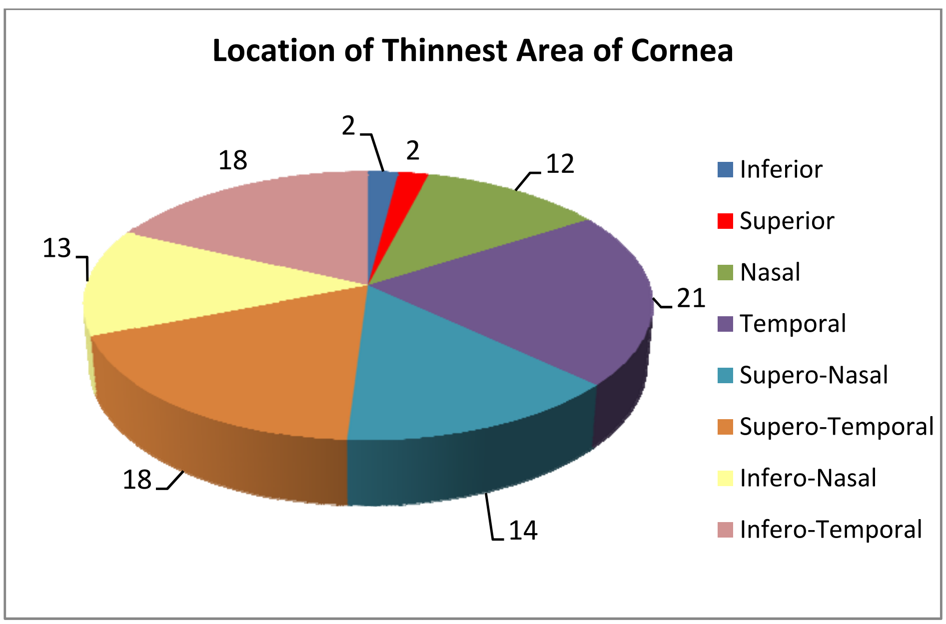
PACHYMETRY

	Number	Mean	SD	Minimum (μ)	Maximum (μ)
OD	455	556.82	30.14	494	657
OS	455	558.03	29.32	476	665
Total	910	557.43	29.72	496	665

- The Mean (SD) of the thickness of the cornea is 557.43±29.72µm and the range is a Minimum of 496µm to a Maximum of 665µm.

Location of thinnest area of cornea

Area	OD		OS	
	No.	%	No.	%
Inferior	9	2.0	10	2.2
Superior	10	2.2	12	2.6
Nasal	77	16.9	28	6.1
Temporal	76	16.7	117	25.7
Supero-Nasal	72	15.8	57	12.5
Supero-Temporal	69	15.2	95	20.9
Infero-Nasal	62	13.6	52	11.4
Infero-Temporal	80	17.6	84	18.5
Total	455	100	455	100



- The thinnest areas of the cornea were found to be predominantly temporal with 21%, followed by the Infero-temporal and Supero-temporal quadrants with 18%.

DISCUSSION

Laser in Situ Keratomileus (LASIK) is one of the most popular refractive surgical procedures in India. Other procedures include Photorefractive Keratectomy (PRK), Laser Epithelial Keratomileus (LASEK), Phakic Intraocular lens Implantation and other incisional refractive procedure such as Radial Keratotomy (RK) or Astigmatic Keratotomy (AK) which are rarely performed today. Most of the surgeries mentioned above are performed at the corneal plane. Therefore, proper pre-operative evaluation of the cornea in refractive surgery is very critical for the success of the procedure and to avoid post LASIK kerectectasia.

One of the key points in corneal evaluation is to know the normal findings of the cornea for our population in order to understand the normal range of various corneal and refractive error parameters. There have been very few studies on corneal characteristics of myopic patients. Literature review showed just one study in Thai population. It would be interesting to know the normal range of parameters of the cornea in our population group. Corneal thickness, AC depth, Keratometry values, the thinnest point of cornea are probably influenced by race and in understanding the values will allow us to plan our refractive surgery and allow for better decision making in borderline cases.

The main aim of my thesis is to find out the corneal characteristics in Indian myopic population.

With the growth of refractive surgery, large volumes of patients will undergo one or another type of procedure in a year. Screening these patients properly is one of the keys to a success of a refractory surgery. By understanding these normal characteristics of the cornea, a refractive surgeon might be able to perform Pre-Operative screening more easily and faster.

CONCLUSION & SUMMARY

- Characteristics of cornea in a sample of an Indian population showed.
- The percentage of females was marginally more than males with the percentage of 53% to 47% respectively.
- The results showed that 61.3% of the people were in the age group from 21-25 years.
- 35% of people had mild (<3D), 53% of the people had moderate (3-6D) and 12% of the people had severe (>6D) refractive error.
- The mean manifest refraction (spherical equivalent) was 3.90D±2.28 diopters (ranging from -0.25 to -14.00D).
- K- Maximum had a Mean (SD) of 44.52 D ±1.34 D ranging from 41.0 D to 48.1 D.
- K- Minimum had a Mean (SD) of 43.62 D ±1.29 D ranging from 40.2 D to 47.5 D.
- Mean (SD) of the corneal diameter is 11.75± 0.4mm ranging from 10.6mm to 13mm.
- Mean (SD) of AC depth is 3.04± 0.27mm ranging from 2.27mm to a Maximum of 3.74mm.
- The Mean (SD) of the thickness of the corneal is 557.43±29.72µm and the range is a Minimum of 496µm to a Maximum of 665µm.

- The thinnest areas of the cornea were found to be predominantly temporal with 21%, followed by Infero-temporal and Supero-temporal with 18%.
- There was no statistically significant difference between the findings of the right and left eye.

A larger population based study may help us to further understand the corneal characteristics of Indian population. This has important implication in surgical planning and this will enable the surgeon to screen patients more appropriate both for LASIK and for Phakic IOL's.

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ABBREVIATIONS

LASIK	-	Laser In Situ Keratomileus
PRK	-	Photorefractive Keratectomy
LASEK	-	Laser Epithelial Keratomileus
RK	-	Radial Keratotomy
SVL	-	Single Vision Lenses
PE	-	Posterior elevation
BFS	-	Best Fit Sphere
ACD	-	Anterior Chamber Depth
ACV	-	Anterior Chamber volume
SD	-	Standard Deviation
Kvalue	-	Keratometric value