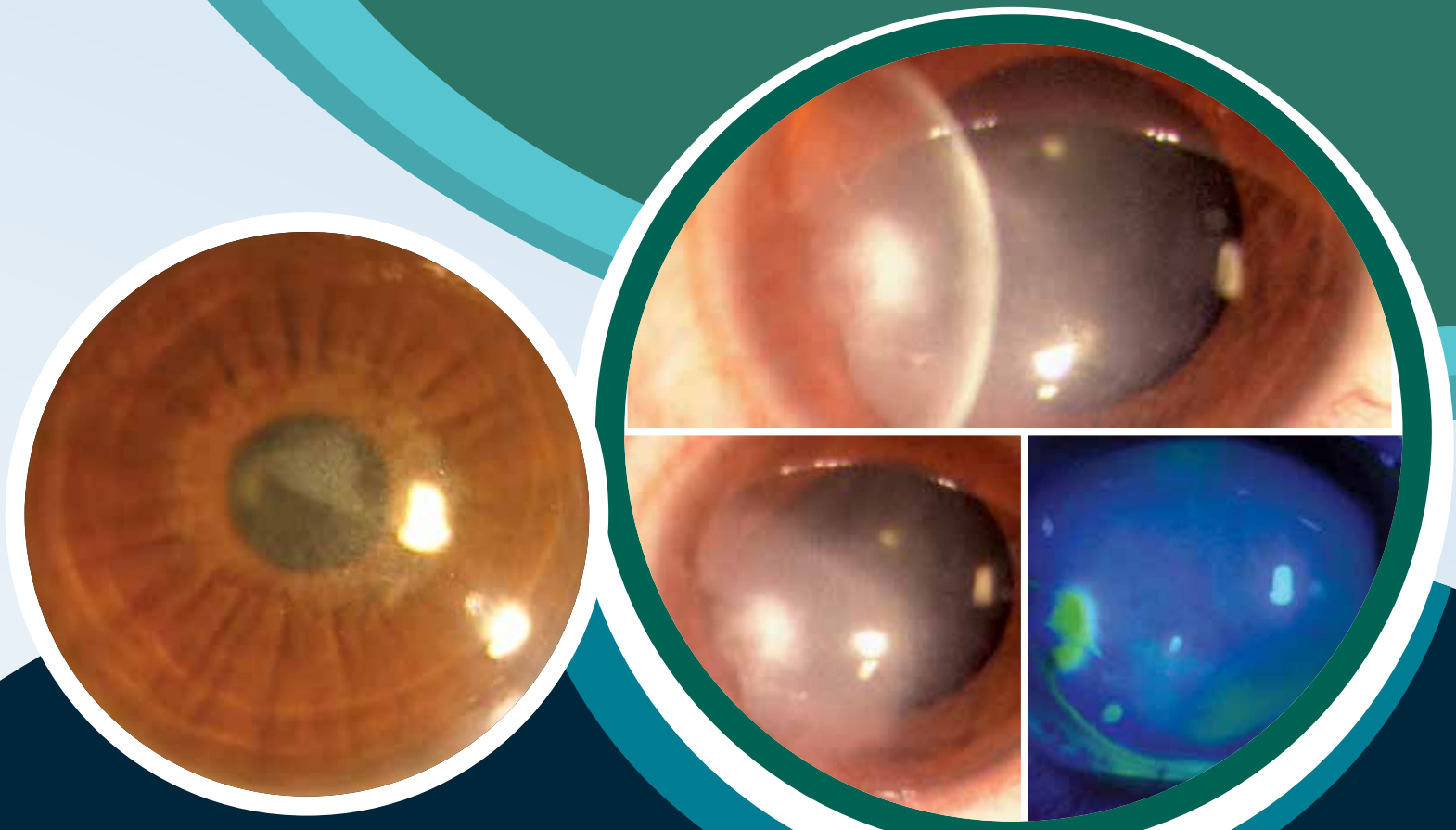
KeraSight

Official Publication of Indian Society of Cornea and Keratorefractive Surgeons

Volume 4; January - April 2018



Special Features

- Intra-corneal Ring Segments
- Optical Biometry: Recent Advances
- Tests for Dry Eye
- Rare causes of Explantation of Implantable Collamer Lens

ISCKRS

INDIAN SOCIETY OF CORNEA AND KERATOREFRACTIVE SURGEONS

Cipla

Moxicip

ZERO PRESERVATIVE

Moxifloxacin 0.5%

Livewire for Infection Control

A global & trusted quality Brand Offering 24x7 hour protection

- The most Widely Prescribed brand by Ophthalmologists[1]
- Preservative free: Contributes to comfort and tolerability[2,3]
- Now also available as Singules

References:

1. *Cipla Data on File*
2. *Wagner RS, D'Arienzo PA, Hallas SJ, Thomson MB, Shapiro AM. A Comparative Study In a Normal Pediatric Population of the Relative Comfort of Moxifloxacin 0.5% Ophthalmic Solution versus a Tear Substitute. Invest Ophthalmol Vis Sci 2004; 45: E-Abstract 4936.*
3. *Katz et al. A fourth generation ocular fluoroquinolone, A suppl. To retractive care for Opthalmologists.Vol. 7 No.3 March 2003*

Cipla FORESIGHT™ vision becomes reality

"For any further information, please contact"

Cipla

Cipla Ltd. Regd, Office:

Cipla House, Peninsula Business Park, Ganpatrao Kadam Marg,
Lower Parel, Mumbai 400 013, INDIA
Website: www.cipla.com

KeraSight

Official Publication of Indian Society of Cornea and Keratorefractive Surgeons

Volume 4; January - April 2018

Contents

KeraSight

Official Publication of Indian Society of Cornea and Keratorefractive Surgeons

Volume 4; January - April 2018

Editorial

Dear Friends,

By the time you will receive this Newsletter, the preparation of the ISCKRS West Zone Meet 2018 will be in full swing. The meeting will be held at the Duke's Retreat, Khandala on 6-7 January 2018. The meeting is focussed on Ectatic Corneal Disorders and I am sure that the delegates would like it and benefit by the discussion. The sessions will have topics that are encountered by the practitioners in their day to day practice and nearly half of the time of the session will be spent on discussion. There will also be panel discussion on specific issues like cataract in Keratoconus patients and developments in ophthalmic industry. Along with scientific sessions we will have a great evening with Bollywood celebrities and Gala dinner. I am hoping that the delegates will enjoy the meeting.

Year's end is neither an end nor a beginning but a going on, with all the wisdom that experience can instill in us. As we are approaching towards the new year, there are fresh ideas and resolutions coming into the minds of everyone. Life is all about thinking in the positive direction and perhaps that is the reason why people make resolution for the new year. We should definitely make resolutions and even if we fail to fulfil that completely, we may learn by our mistakes and our journey towards fulfilling our dreams and resolutions.

I wish our fellow ophthalmologists a very happy new year 2018. May you all succeed and perform well in all your future endeavours.

Best regards

Rajesh Sinha

Rajesh Sinha
MD, DNB, FIACLE, FRCS
Gen. Secretary ISCKRS

INDIAN SOCIETY OF CORNEA
AND KERATOREFRACTIVE SURGEONS

KeraSight

Official Publication of Indian Society of Cornea and Keratorefractive Surgeons

Executive Members

Prof. Jeewan S Titiyal
President

Dr. Rishi Mohan
Vice President

Prof. Rajesh Sinha
General Secretary

Dr. Rajib Mukerjee
Treasurer

Prof. Namrata Sharma
Chairperson Scientific Committee

Dr. Ritika Sachdev
Joint Secretary cum Joint Treasurer

Dr. G. Mukherjee
Ex-Officio Member

Dr. Ajay S Dave
Ex-Officio Member

Intra-corneal Ring Segments


Sridevi Nair

Sridevi Nair, MD; **Manthan Chaniyara**, MD;
Prafulla K Maharana, MD
Cornea & Ocular Surface Services, Dr Rajendra Prasad Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi - 110029, India

Corresponding author:
Dr. Prafulla K Maharana
Cornea & Ocular Surface Services,
Dr Rajendra Prasad Centre for Ophthalmic Sciences,
All India Institute of Medical Sciences,
New Delhi - 110029, India

Introduction

Intra-corneal ring segments (ICRS) are made up of PMMA material, which are inserted intrastromally in the cornea with the aim of bringing about a change in its curvature. The idea of a ring implant inserted into the corneal storm to alter the corneal curvature was first given by Reynolds et al in the mid 1980s.(1) The thickness of the device was found to have direct and linear effect on the corneal flattening.(2) Studies thereafter reported a modification of these ring into ring segments to be an effective, viable and reversible alternative for treatment of myopia. The need for segments arose from the need for an easier implantation and reduction in incision related complications as compared to the complete rings.(3)(4)(5)

The first Corneal ring segments to gain FDA approval were Intacs, for the treatment of low to moderate myopia. Intacs were used in treating keratoconus by Colin in 2000. He reported that they could be an effective way to delay corneal transplant in these patients and aid a better contact lens fitting. He also found that the effect on the corneal was more than that in myopic patients since the thinner cornea in these patients flattened more easily (6)

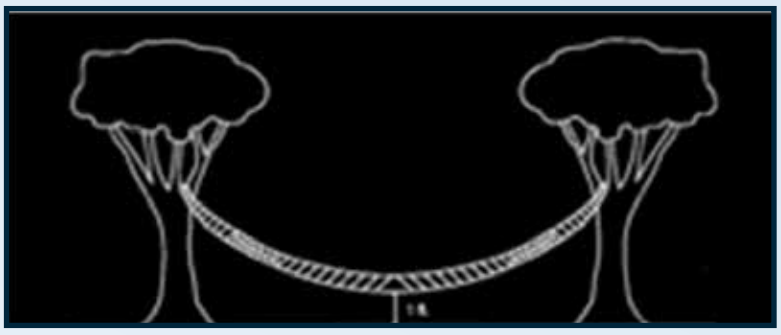


Figure 1a

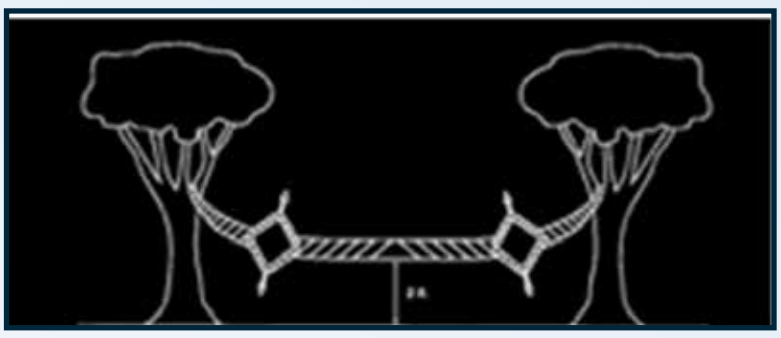


Figure 1b

Though it was first introduced for myopes, its popularization for the same indication was prevented by advent of laser refractive surgeries. However, it has been found to be an effective and safe modality for keratoconus patients even in the long-term. Today intracorneal ring segments have evolved further in terms of designs, and creation of the corneal channel with femtosecond laser. It has also been used in combination with other treatment modalities such as corneal collagen cross-linking (CXL) and phakic IOLs.

Mechanism of Action

Modern keratorefractive surgery is based on the Barraquer's law of thickness according to which "removal of tissue from corneal center makes it flatter while steeping happens on adding tissue to the periphery".(7)

The ICRS works on the "arc shortening effect" principle wherein the segment acting as a spacer element between the stromal lamellae shortens the central arc length in proportion to the thickness of the segment. (See Figure 1a, 1b) The flattening effect of the segment also increases as its diameter reduces. However, it patients with corneal ectatic disorder this lamellar arrangement is distorted and thus effect of the segments on these corneas may be different from that seen in normal cornea.(8)(2)

Types of Corneal ring segments

The currently available ICRS are of 2 types: the arc segments and 360-degree rings. Keraring, Intacs, Ferrara and The Corneal Ring are the ring segments available while Myoring is the 360-degree ring.(9) Table 1 describes the salient features of each the models.

Table 1: Salient Features of Currently Available ICRS

ICRS model	Arc Length (degrees)	Inner diameter	Outer diameter	Cross section shape	Thickness (mm)	Indications
Intacs (Fig. 2)	150	6.77 mm	8.1 mm	Hexagonal	0.25-0.45	Low-moderate myopia, Keratoconus, post LASIK ectasia PMD
KeraRing (Fig. 3)	90, 120, 150, 160, 210, 355	- SI 5-5 mm optical zone	- SI 6-6 mm optical zone	Triangular	0.15-0.35	Keratoconus, PMD, post LASIK ectasia
Ferrara (Fig. 4)	90, 120, 160, 210, 320	4.4	AFR-5 mm AFR6-6 mm	Triangular	0.15-3.5	Myopia, Keratoconus, PMD, post LASIK ectasia, Post RK/PK astigmatism
Corneal Ring (Fig. 5)	155, 220	4.7 mm	5.9 mm	Spindle	0.15-0.35	
Myoring (Fig. 6)	Full 360 degree ring	- Diameters- 5-8 mm	-	No data	0.2-0.32	Myopia, Keratoconus, PMD, post LASIK ectasia
KeraTacx plus (Fig. 7)	45, 90, 120, 160, 1210, 320, 355	4.5	5.7	Dome shaped (no sharp edges)	0.1-0.35	Myopia, Keratocnous, PMD, post LASIK ectasia, Post RK/PK astigmatism
Intacs SK (Fig. 8)	150	6	7	Elliptical	0.40-0.45	Mod-Severe Keratoconus with steep Km>55D

Figure 2a. *Intacs.*

Figure 2b. *Intacs in a patient on postoperative day 1.*

Figure 3. *Keraring*

Figure 4. *Ferrara ring*

Figure 5. *Cornealring*

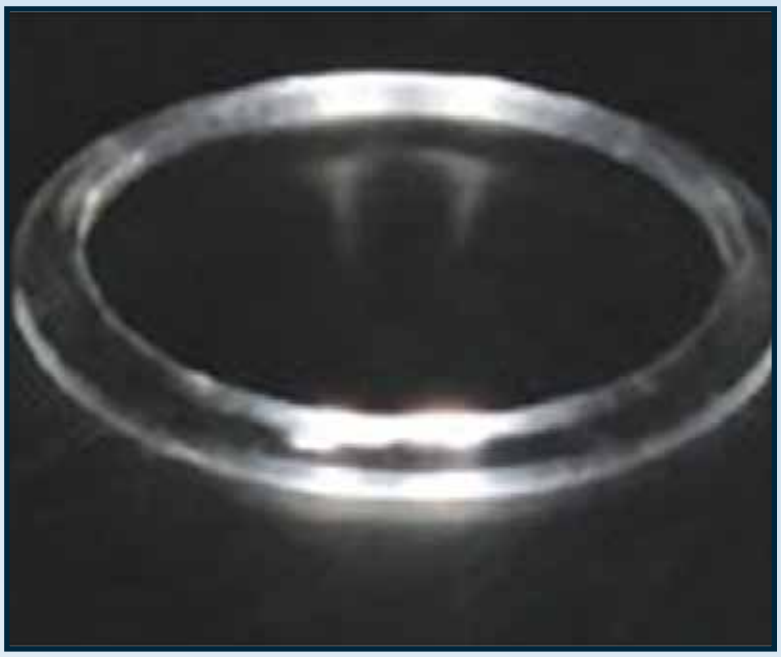


Figure 6. *Myoring*

Figure 7. *Keratacx*

Figure 8. *IntacSK*

In the following section we shall discuss the indications, surgical techniques, visual outcomes and complications for ICRS.

Indications for use

Though initially conceptualized and designed for treating myopic refractive error, the ICRS are most commonly used today as a management modality for corneal ectatic disorders.

Keratoconus

ICRS are indicated in patients with keratoconus with the following features. (10)(11)

- Moderate keratoconus with disabling VA, intolerant to contact lens/spectacles
- Patients should have a clear optical zone and corneal pachymetry >400 microns in the area of implantation i.e. at the 7 mm zone

Patients with mesopic pupil size >6 mm, steepest K >58D, post corneal hydrops, coexistent ocular diseases like glaucoma or posterior segment pathology, corneal opacity/scarring, autoimmune diseases and corneal dystrophies are not good candidates for ICRS implantation

Preoperative planning

In addition to a routine examination, including UCVA, BCVA, a good refraction, topography and pachymetry is required in pre-operative planning of cases for ICRS.

The best results with ICRS are obtained in patients with the following preoperative parameters:(12) (13)

1. Patients with CDVA <0.9 [decimal unit]
2. Patients with refractive and topographic stability
3. Aligned refractive and topographic axis, with difference <15 degrees
4. Internal astigmatism <3 D
5. Pachymetry at the tunnel incision area: >300 microns (Ferrara); >450 microns (Intacs); >250 microns (Kerarings)
6. Clear optical zone

The locations of cone whether central of decentered is helpful in decision making as 2 symmetrical segments are usually used in centrally located cones (more than 50% of the cone within the central 3 mm zone) while 2 asymmetric or a single segment are used in oval or decentered cones (more than 50% of the cone outside the 3 mm zone). The single segment is placed inferior to the cone while in asymmetric segments the thicker s placed blow and the thinner one above the cone.(13)(10) Though some authors advocate placing the incisions temporally, they are usually placed at the positive manifest cylinder or the steeper K axis. If both the axis don't match the topographic meridian is used.

The nomogram used for selecting the ICRS depends on the type of ring used. Several nomograms have been described for each of the ring segments by different authors based on different parameters. The following nomogram (Table 2) is recommended by the manufacturer for Intacs and Intacs SK based on the spherical equivalent of the patient. Other nomograms based on the topographical profile has also been described. (14)

Colin et al (2006) used the following nomogram for Intacs in keratoconus patients based in the type of cone and spherical equivalent (15)(Table 3)

There are 3 different normograms described for Keraring depending on the distribution of the area of irregularity on either side of the reference meridian (4 types), keratometric value, and the CDVA. The reference meridian taken is the steepest meridian corresponding with the plus refractive cylinder axis if CDVA>0.5. If CDVA <0.5, the steepest meridian as per topography or the total coma aberration axis is chosen as the reference meridian. The treatment is based on the refractive sphere and cylinder obtained by manifest refraction if CDVA>0.4, while in patients with CDVA<0.3 these maybe less reliable and the treatment is based on keratometric values.

Normogram for Ferrara Rings

While selecting the Ferrara ring for a patient, the treating doctor should follow the following steps:

Step 1 Determine the type of cone- Sag, Bowtie or Nipple

Step 2 Determine the distribution of the ectatic area- Central (nipple/bowtie) or Paracentral (asymmetric)

Step 3 Calculate the corneal asphericity or Q value- the expected postoperative Q value with the given segment should not be significantly below -0.23.

Step 4 Note the topographic astigmatism based on which the thickness of the ring is

determined; an exception being in the nipple type of cone where the thickness is based on the spherical equivalent and a 210 degree arc segment is used.

Step 5 The pachymetry at the steepest meridian in the 5 mm zone or the incision site to be noted as the depth of incision placed should be 80% of the thickness at this site.

Myorings are 360 degree rings and unlike the previously described ones, they do not have a significant impact on the astigmatism. They have a higher capacity to flatten and reduce the SE and are more suitable for cases with high spherical error and low astigmatism. The following inclusion criteria should be met:

1. UCVA < 0.3
2. Minimal corneal thickness >360 microns
3. Average central Km >44D
4. No central corneal scar
5. No history of past anterior segment surgery
6. Age <50 years

The nomogram for Myoring in keratoconus (Table-4) is simple and depends only on the average central Km or ACK (16)

Table 2. Nomogram for Intacs and Intacs SK for Keratoconus

Symmetric		
Intacs (7.0 mm)	Spherical Equivalent	*Intacs SK (6 mm)
0.210 mm	+1.0 to -0.75	0.210 mm
0.250 mm	-1.0 to -1.75	0.250 mm
0.300 mm	-2.0 to -2.75	0.300 mm
0.350 mm	-3.0 to -3.75	0.300 mm
0.400 mm	-4.0 to -4.75	0.350 mm
0.450 mm	-5.0 to -5.75	0.350 mm
	-6.0 to -7.75	0.400 mm
	-8.0 and higher	0.450 mm
Asymmetric		
Spherical Equivalent	Inferior Intacs	Superior Intacs
+1.0 to -2.0	0.300 mm	0.210 mm
-2.0 to -3.0	0.350 mm	0.210 mm
-3.0 to -4.0	0.400 mm	0.210 mm
-4.0 and higher	0.450 mm	0.210 mm

*Use Intacs SK when the conal anomaly on the posterior float is within the 5 mm zone

Table 3. Nomogram for Intacs in keratoconus (Colin et al)

Type of Cone	Preoperative SE<3 D	Preoperative SE>3 D
Asymmetric	0.250 mm/0.300 mm	0.250 mm/0.350 mm
Moderate Asymmetry	0.350 mm/0.400 mm	0.400 mm/0.450 mm
High Asymmetry	0.250 mm/0.400 mm	0.250 mm/0.450 mm
Global	0.400 mm/0.400 mm	0.450 mm/0.450 mm
Central	0.400 mm/0.400 mm	0.450 mm/0.450 mm

Table-4: Nomogram for Myoring in keratoconus

Average Central Km	Implant Diamter (mm)	Implant thickness (microns)
<44 D	7	280
44-48 D	6	240
48-52 D	6	280
52-55 D	5	280
>55 D	5	320

ICRS in post LASIK ectasia

Post LASIK ectasia is progressive corneal ectasia or deformation with refractive and optical instability seen after an otherwise uneventful LASIK surgery. (17) Brenner et al reported in a retrospective study evaluating ICRS in post LASIK ectasia that patients who had loss of 2 more lines in CDVA after developing ectasia compared to pre LASIK VA and those with CDVA>0.5 post ectasia are good candidates for ICRS treatment.(17)

Other authors have found improvement in CDVA, UDVA, Km and SE in these patients along with refractive stability on treatment with ICRS on long-term follow up (up to 5 years) though the sample of patients included in these studies were small(18) (20). Pinero et al found a significant improvement in BSCVA, coma like aberrometry and manifest cylinder in post LASIK ectasia patients on treatment with ICRS. They however emphasized that patients with higher preoperative primary coma and coma-like aberrations had poorer visual outcomes post treatment. Also they found that ICRS did not necessarily stall the progression of ectasia in all cases.(20)

Surgical technique

There are 2 channel dissection techniques for ICRS insertion- Mechanical and Femtosecond Laser aided.

Manual Dissection

The center of the cornea is marked first. The incision site is usually at the steepest topographic axis at the implantation site (at about 5mm zone) and a calibrated diamond knife is used to create an radial incision about 1mm in length at depth of 70-80 % of the corneal thickness at the site. (9) Pocketing hooks are then used to create stromal pockets on each side of the incision ensuring that an uniform depth is maintained. A semi-automated suction ring is the placed around the limbus and vacuum force created, following which 2 semicircular dissectors are placed into the lamellar pocket to be advanced by a rotational movement. The suction device and dissectors are then removes and the ring segments are inserted into each of the channels with a modified McPherson's forcep.(15)

Femtosecond Laser aided channel creation

Pupillary center is marked on the cornea. Cornea is applanated and flattened using a disposable applanation cone. Femtosecond laser is then applied to create the incision and stromal channels at a depth of 400 mm with preplanned diameters entered beforehand.(22) The ring segments are then inserted into the channels after opening them with a dissector. The incison site may then be usually sutured with a 10-0 MFN suture after both techniques of channel creation.

Though studies have reported comparable visual and refractive outcomes using the 2 techniques of channel creation, manual dissection may a higher incidence of complications such as epithelial defects and corneal perforation. The FS Laser aided technique also has better precision of depth, is faster, easier with better patient comfort.(22)(23) Pinero et al however found a better aberrometric correction with the use of femtosecond laser. (24)

ICRS in combination with other treatment modalities (PRK, CXL, Phakic IOL)

Corneal collagen crosslinking or CXL along with ICRS in progressive ectatic disease may provide a pivotal role in halting disease progression. Although there is no consensus on the sequence of treatment, which should be undertaken, some have hypothesized that ICRS after 1 year of CXL may allow corneal remodeling and thus a more predictable refractive effect to be achieved. (25) However others have also found CXL with simultaneous PRK following ICRS implantation in keratoconus and PMD to produce reasonably good visual outcomes.(25)(26) Alio et al compared simultaneous ICRS along CXL , performed with standard epithelium off technique and riboflavin infusion in intrstromal pocket to find comparable results with both the techniques.(27)

Authors have also prescribed a 3 step procedure starting with ICRS followed by CXL+ PRK (28) or ICRS followed by CXL culminating in toric ICL(29)

as an effective way visually rehabilitate patients with corneal ectatic disease. Phakic IOL has an advantage that it can correct larger amount of sphere and cylinder with no damage to the cornea. Also it Phakic IOL performed after a gap post ICRS may proived better outcomes as the refractive error and topography is more stable.(9)

Complications

The complications associated with ICRS implantation have significantly reduced since the advent of Femtosecond laser technology for channel creation (30). They may be broadly divided into intraoperative and postoperative.

Intraoperative complications

The intraoperative complications have mostly been reported with the mechanical dissection technique. Intraoperative complications seen with Intacs include segment decentration, asymmetry of segments, inadequate channel depth and anterior Bowman layer perforation due to superficial dissection. Mechanical epithelial defects, extension of the incision towards the visual axis and posterior corneal perforation have also been reported. (31) However, decentration has been reported with Femtosecond laser technique too. Ertan proposed that the shifting of the pupillary center during corneal applanation in Femtosecond laser aided channel creation contributed to segment decentration. They also found preoperative sphere and cylinder to be significantly associated with decentration. (32) Ensuring that the inner border of the segment is at the same distance from the pupillary center may be useful. The pupillary center can be marked on the cornea before applanation as a reference point.(33) Incomplete channel creation and endothelial perforation has also been reported with the Femtosecond laser aided channel creation.(34)

Postoperative complications

Segment movement or migration is the most commonly reported postoperative complication. Other postoperative complications include segment extrusion (more commonly seen post mechanical dissection) , infectious keratitis, corneal neovascularization, corneal melting associated with segment movement, epithelial plug or corneal haze at the incision site and deposits along the channel.(31)

Segment explanation rate varies from 0.6-30%, most commonly done for extrusion(35). Ferrer et al reported an explanation rate of 22.8 % among the 250 eyes, which underwent ICRS implanation over a period of 8 years. The main indications for explantation in the decreasing order of frequency were extrusion, unsatisfactory refractive outcome, infectious keratitis, corneal melt and perforation. (36) Rarely symptoms like chronic pain, haloes and glare have also been reported.

To conclude ICRS are an effective, safe and above all reversible modality for treating various corneal ectatic disorders. However, further studies are needed to evaluate its long-term effect, along with development of newer nomograms to treat corneal aberrations in addition to refractive and topographic abnormality. Also standard protocols need to devised for combining ICRS with other treatment modalities such as PRK, CXL and phakic IOL to provide better visual and anatomical outcomes to these patients.

References

1. Fleming JF, Reynolds AE, Kilmer L, Burris TE, Abbott RL, Schanzlin DJ. The Intrastromal Corneal Ring: Two Cases in Rabbits. J Refract Surg. 1987 Nov 1;3(6):227–32.
2. Burris TE, Baker PC, Ayer CT, Loomas BE, Mathis ML, Silvestrini TA. Flattening of central corneal curvature with Intrastromal Corneal Rings of increasing thickness: An eye-bank eye study. J Cataract Refract Surg. 1993 Jan 1;19:182–7.
3. Schanzlin DJ, Asbell PA, Burris TE, Durrie DS. The intrastromal corneal ring segments. Phase II results for the correction of myopia. Ophthalmology. 1997 Jul;104(7):1067–78.
4. Nosé W, Neves RA, Burris TE, Schanzlin DJ, Belfort Júnior R. Intrastromal corneal ring: 12-month sighted myopic eyes. J Refract Surg Thorofare NJ 1995. 1996 Feb;12(1):20–8.
5. Burris TE. Intrastromal corneal ring technology: results and indications. Curr Opin Ophthalmol. 1998 Aug;9(4):9–14.
6. Colin J, Cochener B, Savary G, Malet F. Correcting keratoconus with intracorneal rings. J Cataract Refract Surg. 2000 Aug;26(8):1117–22.
7. Barraquer JI. Modification of refraction by means of intracorneal inclusions. Int Ophthalmol Clin. 1966;6(1):53–78.
8. Silvestrini T, Mathis M, Loomas B, Burris T. A geometric model to predict the change in corneal curvature from the intrastromal corneal ring (ICR). Invest Ophthalmol Vis Sci. 1994;35:2023.
9. Giacomin NT, Mello GR, Medeiros CS, Kiliç A, Serpe CC, Almeida HG, et al. Intracorneal Ring Segments Implantation for Corneal Ectasia. J Refract Surg Thorofare NJ 1995. 2016 Dec 1;32(12):829–39.

10. Intrastromal corneal ring segments for management of keratoconus Ganesh S, Shetty R, D'Souza S, Ramachandran S, Kurian M - Indian J Ophthalmol [Internet]. [cited 2018 May 2]. Available from: http://www.ijo.in/article.asp?issn=0301-4738;year=2013;volume=61;issue=8;spage=451;epage=455;aulast=Ganesh
11. Rabinowitz YS. INTACS for Keratoconus. Int Ophthalmol Clin. 2010;50(3):63–76.
12. Peña-García P, Alió JL, Vega-Estrada A, Barraquer RI. Internal, corneal, and refractive astigmatism as prognostic factors for intrastromal corneal ring segment implantation in mild to moderate keratoconus. J Cataract Refract Surg. 2014 Oct;40(10):1633–44.
13. Vega-Estrada A, Alio JL. The use of intracorneal ring segments in keratoconus. Eye Vis [Internet]. 2016 Mar 15;3. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4791885/
14. Piñero DP, Alio JL. Intracorneal ring segments in ectatic corneal disease - a review. Clin Experiment Ophthalmol. 2010 Mar;38(2):154–67.
15. Colin J. European clinical evaluation: use of Intacs for the treatment of keratoconus. J Cataract Refract Surg. 2006 May;32(5):747–55.
16. Daxer A. Adjustable intracorneal ring in a lamellar pocket for keratoconus. J Refract Surg Thorofare NJ 1995. 2010 Mar;26(3):217–21.
17. Brenner LF, Alió JL, Vega-Estrada A, Baviera J, Beltrán J, Cobo-Soriano R. Indications for intrastromal corneal ring segments in ectasia after laser in situ keratomileusis. J Cataract Refract Surg. 2012 Dec;38(12):2117–24.
18. Yildirim A, Cakir H, Kara N, Uslu H. Long-term outcomes of intrastromal corneal ring segment implantation for post-LASIK ectasia. Contact Lens Anterior Eye. 2014 Dec 1;37(6):469–72.
19. Kymionis GD, Tsiklis NS, Pallikaris AI, Kounis G, Diakonis VF, Astyrakakis N, et al. Long-term Follow-up of Intacs for Post-LASIK Corneal Ectasia. Ophthalmology. 2006 Nov 1;113(11):1909–17.
20. Piñero DP, Alio JL, Uceda-Montanes A, El Kady B, Pascual I. Intracorneal ring segment implantation in corneas with post-laser in situ keratomileusis keratectasia. Ophthalmology. 2009 Sep;116(9):1665–74.
21. Ziaei M, Barsam A, Shamie N, Vroman D, Kim T, Donnenfeld ED, et al. Reshaping procedures for the surgical management of corneal ectasia. J Cataract Refract Surg. 2015 Apr;41(4):842–72.
22. Kubaloglu A, Sari ES, Cinar Y, Cingu K, Koytak A, Coşkun E, et al. Comparison of mechanical and femtosecond laser tunnel creation for intrastromal corneal ring segment implantation in keratoconus: Prospective randomized clinical trial. J Cataract Refract Surg. 2010 Sep 1;36(9):1556–61.
23. Rabinowitz YS, Li X, Ignacio TS, Maguen E. INTACS inserts using the femtosecond laser compared to the mechanical spreader in the treatment of keratoconus. J Refract Surg Thorofare NJ 1995. 2006 Oct;22(8):764–71.
24. Piñero DP, Alio JL, El Kady B, Coskunseven E, Morbelli H, Uceda-Montanes A, et al. Refractive and aberrometric outcomes of intracorneal ring segments for keratoconus: mechanical versus femtosecond-assisted procedures. Ophthalmology. 2009 Sep;116(9):1675–87.
25. Iovieno A, Légaré ME, Rootman DB, Yeung SN, Kim P, Rootman DS. Intracorneal ring segments implantation followed by same-day photorefractive keratectomy and corneal collagen cross-linking in keratoconus. J Refract Surg Thorofare NJ 1995. 2011 Dec;27(12):915–8.
26. Kymionis GD, Grentzelos MA, Portaliou DM, Karavitaki AE, Krasia MS, Dranidis GK, et al. Photorefractive keratectomy followed by same-day corneal collagen crosslinking after intrastromal corneal ring segment implantation for pellucid marginal degeneration. J Cataract Refract Surg. 2010 Oct;36(10):1783–5.
27. Alió JL, Toffaha BT, Piñero DP, Klonowski P, Javaloy J. Cross-linking in progressive keratoconus using an epithelial debridement or intrastromal pocket technique after previous corneal ring segment implantation. J Refract Surg Thorofare NJ 1995. 2011 Oct;27(10):737–43.
28. Al-Tuwairqi W, Sinjab MM. Intracorneal ring segments implantation followed by same-day topography-guided PRK and corneal collagen CXL in low to moderate keratoconus. J Refract Surg Thorofare NJ 1995. 2013 Jan;29(1):59–63.
29. Coşkunseven E, Sharma DP, Jankov MR, Kymionis GD, Richoz O, Hafezi F. Collagen copolymer toric phakic intraocular lens for residual myopic astigmatism after intrastromal corneal ring segment implantation and corneal collagen crosslinking in a 3-stage procedure for keratoconus. J Cataract Refract Surg. 2013 May;39(5):722–9.
30. El-Husseiny M, Tsintarakis T, Eppig T, Langenbucher A, Seitz B. [Intacsintracorneal ring segments in keratoconus]. Ophthalmol Z Dtsch Ophthalmol Ges. 2013 Sep;110(9):823–6, 828–9.
31. Barbara A, Barbara R. Intacs Intracorneal Ring Segments Complications in Patients Suffering from Keratoconus. Barbara A, editor. Int J Keratoconus Ectatic Corneal Dis. 2013;2:121–8.
32. Ertan A, Karacal H. Factors influencing flap and INTACS decentration after femtosecond laser application in normal and keratoconic eyes. J Refract Surg Thorofare NJ 1995. 2008 Oct;24(8):797–801.
33. Ertan A, Kamburoğlu G. Analysis of centration of Intacs segments implanted with a femtosecond laser. J Cataract Refract Surg. 2007 Mar;33(3):484–7.
34. Coskunseven E, Kymionis GD, Tsiklis NS, Atun S, Arslan E, Siganos CS, et al. Complications of intrastromal corneal ring segment implantation using a femtosecond laser for channel creation: a survey of 850 eyes with keratoconus. Acta Ophthalmol (Copenh). 2011 Feb;89(1):54–7.
35. Ertan A, Kamburoğlu G, Akgün U. Comparison of outcomes of 2 channel sizes for intrastromal ring segment implantation with a femtosecond laser in eyes with keratoconus. J Cataract Refract Surg. 2007 Apr;33(4):648–53.
36. Ferrer C, Alió JL, Montañés AU, Pérez-Santonja JJ, del Rio MAD, de Toledo JA, et al. Causes of intrastromal corneal ring segment explantation: clinicopathologic correlation analysis. J Cataract Refract Surg. 2010 Jun;36(6):970–7.

Optical Biometry: Recent Advances

Deepali Singhal, MD; **Rinky Agarwal**, MD;
Alisha Kishore, MD; **Prafulla Kumar Maharana**, MD

Corresponding author:

Rinky Agarwal
Senior Registrar, Department of Ophthalmology,
Dr. Rajendra Prasad Centre for Ophthalmic Sciences,
All India Institute of Medical Sciences, New Delhi-110029, India.
Email ID: rinky.1990@gmail.com

Deepali Singhal

Intraocular lens (IOL) power calculation is a crucial step to achieve optimal visual outcome in modern day cataract surgery. Various devices are currently available for accurate IOL power calculation in order to reach the target refraction. (1)

Parameters needed for measurement of IOL power include axial length (AL), anterior chamber depth (ACD), and corneal radii (K1and K2). Recently, significant developments have been made leading to improvement in the visual outcome like modifications in IOL formulas and a more predictable IOL positioning.(2)(3) Newer devices such as laser partial coherence interferometry (PCI) and the low-coherence optical reflectometry (LCOR) are now available for a more accurate result.(4)(5)

Ultrasound biometry

A-mode contact ultrasound ocular biometry is the gold standard for measurement of AL and ACD. It consists of a special piezoelectric crystal that oscillates to generate a high-frequency sound wave. This wave then penetrates the eye and is reflected back from different tissues as echoes. The distance between the echo spikes provides an indirect measurement of axial length or lens thickness (LT).(1)

Two types of ultrasound biometry include contact applanation biometry and immersion biometry. Applanation biometry being a contact procedure leads to corneal indentation and has a risk of transmitting infections. Immersion type biometry is considered to be more accurate because corneal indentation is prevented.

Optical biometry

Optical biometry allows accurate assessment of the AL as well as keratometry for IOL power calculation with the desired IOL formula. This method is increasingly becoming popular, as it is rapid, easy to use, and a non-contact method. The differences between ultrasound and optical axial length measurement are given in table 1.

Table 1: Difference between AL measurement using A scan and IOL master

	A scan	IOL Master
Signal transmission	Ultrasound waves	Laser
Measurement	From corneal apex to the internal limiting membrane. Measures the anatomic axis.	From second principal plane of the cornea to the photoreceptor layer of the fovea. Measures the visual axis.
Contact procedure	Contact	Non contact
Accuracy	Less resolution Approximately 0.10- 0.12 mm [15]	Better resolution and more accurate Approximately 0.012 mm [15]

IOL Master

Carl Zeiss Meditec first introduced IOL Master 500 in 1998. (figure-1) It measures the distance from the corneal apex to the retinal pigment epithelium.

It is based on the principle of partial coherence interferometry. It uses a 780 nm laser diode infrared

Figure-1: *IOL Master 500*

light to measure AL. It measures the time required for the infrared light to travel to the retina. The ACD is measured from the corneal epithelium to anterior lens capsule through a lateral slit-illumination, and the anterior corneal curvature is calculated at 6 reference points in a hexagonal pattern at approximately the 2.3 mm optical zone.

Recently introduced advancement of IOL master is the IOL master 700. (figure-2) This is based upon the principle of swept source optical coherence tomography (OCT) based biometry to obtain two-dimensional images of ocular structures of the anterior and posterior segments of the eye.(6) It uses a tunable laser [1055 nm]. It has the advantage of measuring LT and corneal thickness. It enables OCT imaging and visualisation across the entire length of the eye. It allows the surgeon to view the complete longitudinal section of the eye and may identify irregular eye geometries, such as lens tilt. Additionally, it provides real-time imaging of the fovea to confirm accurate fixation during measurements. (figure-3) It also uses telecentric keratometry for corneal power measurements, similar to the IOLMaster 500. It also has an integrated Barrette suite. The agreement between the two devices has been reported to be excellent but IOLMaster 700 was found to be more effective in obtaining biometric measurements in eyes with posterior subcapsular and dense nuclear cataracts.the differences between IOL master 500 and 700 are given in table 2.(7)

Figure-2: *IOL master 700*

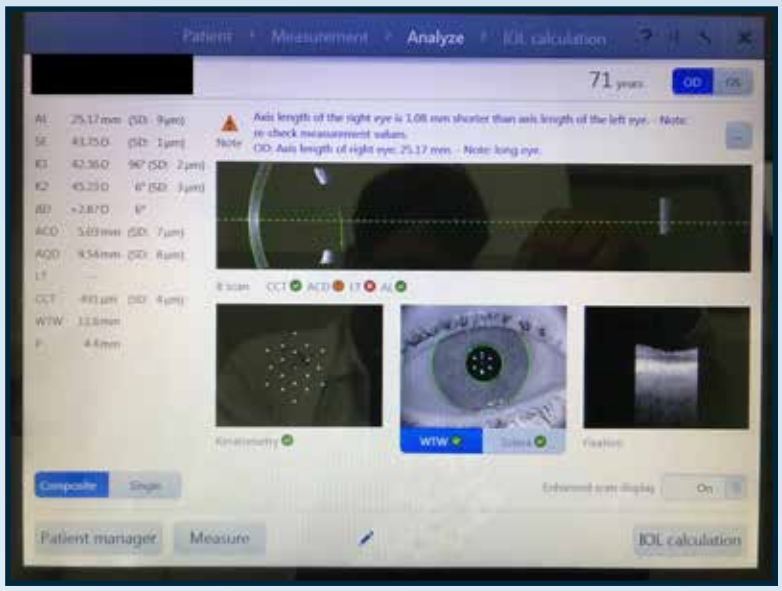


Figure-3: *IOL master 700 showing foveal image*

Table 2: IOL Master 700 vs. 500

Parameters	500	700
AL measurements	PCI	Swept source OCT
LT and central corneal thickness (CCT)	Not Available	Possible
ACD measurements	Optical section through the anterior chamber by means of a slit-illumination system	Swept source OCT images
	Not possible in Pseudophakic eyes	Possible
	Prone to error	More accurate
Identify irregular eye geometries	Not possible	Possible

Parameters	500	700
Dense PSC/dense cataracts.	Innacurate measurement	Accurate
Patients with poor fixation, irregular eye geometries	Innacurate	Useful

Various advantages of IOL master include:

1. It is an integrated device, which measures axial length, keratometry and intraocular lens power calculation with wide range of options for calculating power.
2. All measurements are done along the visual axis for accurate axial length measurement. So, it is useful even in cases of staphyloma, pseudophakics, eyes filled with silicone oil and patients with phakic lens.
3. Faster acquisition time. Both keratometry and axial length can be measured simultaneously in the dual mode. Different modes can be changed automatically and is user independent.
4. Patient comfort since the measurements are distance independent. It is therefore useful in patients with poor fixation.
5. Higher success rate compared to other devices, as there is better cataract penetration. The signal to noise values is also increased thereby increasing the reliability. It should be more than 2.0.
6. The IOL master can be integrated with CALLISTO eye for better management in the operating room. It helps in toric intraocular lens alignment without marking the cornea. It can also be connected with A scan ultrasound device for quick axial length measurement.

Lenstar

LenStar LS900 is a high-resolution non-contact, non-invasive optical biometry device. It was first introduced in 2009 by Haag-Streit manufacturer and became the first optical biometry device, which could measure crystalline lens thickness. It is based upon optical low-coherence reflectometry (OLCR) and uses an 820 nm superluminescent diode with a Gaussian-shaped spectrum, which allows a higher axial resolution.(5)

In addition to AL, it measures central corneal thickness (CCT), as well as LT leading to a longer acquisition time as compared to IOL master.(8) Lenstar measures ACD from the corneal endothelium to the anterior lens surface. It can also measure LT and retinal thickness, as well as the size and centricity of the pupil. Keratometry is considered to be more accurate since it analyzes the anterior corneal curvature at 32 reference points oriented in 2 circles at approximately 2.30 mm and 1.65 mm optical zones. The horizontal iris width (white-to-white) and pupil diameter are measured by fitting the best circle with the lowest error square to the detected.(5)

Recent advances integrated with Lenstar 900 include:

- Precise measurement technique in combination with the unique Hill- Radial Basis activation Function (RBF) method provides accurate prediction of IOL power.
- Dual zone keratometry and T-cone topography provides precise astigmatism and axis measurement. The integrated Barret Toric calculator allows for toric IOL planning.
- Barrett True-k, Shammas No-History and Masket IOL calculation methods can be used for post-refractive patients without any clinical history available.
- The Dens Cataract Measurement (DCM) Mode ensures state-of-the-art cataract penetration.
- The Automated Positioning System (APS) features dynamic eye-tracking allowing easy automated measurement acquisition with a single click.
- Allows accurate calculation of the lens position independent of the corneal status of the eye. With its unique concept of the C-Constant, the Olsen formula calculates the postoperative lens position as a fraction of the crystalline lens thickness and the ACD.

Various advantages include:

1. Dense Cataract Measurement Mode (DCM) allows penetration through dense cataract and allows biometry in aphakic, pseudophakic or silicone oil-filled eyes.
2. When planning for toric or premium IOLs, the Pro version of the LS900 can be used to measure 6-mm optical zone with the option of adding T-cone Toric Platform, a double-ring placido disk topographer, which improves refractive outcomes.

3. Lenstar Pro version has Automated Positioning System (APS) that tracks eye movement to capture reliable measurements in one click.
4. It is patient-friendly and high-speed device with each scan capturing all measurements in 30 seconds.3
5. It helps in determination of the appropriate IOL power by including the modern IOL formulae like: Barrett Universal II, Barrett True-K, Haigis, Hoffer Q, Holladay 1, SRK/T, SRK II, Masket, Modified Masket and Shammas No-history, Hill RBF methods. The option of EyeSuite IOL toric planner software also includes the Barrett Toric Calculator.
6. It has excellent intra- and intersession repeatability and good accurcay, comparable with the IOLMaster and ultrasonic biometry.
7. It uses a separate external PC, which allows good memory for storage and enables regular software updates.

IOL Master and Lenstar LS 900 are reported to be in good agreement in terms of mean AL, ACD, and K readings.(5)(8)(9)(10)(11)(12)(13) The basic differences between the two are given in table 3.

Table 3: Difference between lenstar and IOL master

	Lenstar	IOL master
Manufacturer	Zeiss	Haag- Streit
Principle	Optical low coherence reflectometry	Partial coherence interferometry
FDA approved	October 2009	March 2000
Laser used	Superlumi-nescent diode (820 nm)	Infrared diode laser (780 nm)
Measurement	Dual zone keratometer with a total of 32 marker points on two concentric rings of 1.65 mm and 2.3 mm in diameter	It measures the relative position of six spots on the cornea. These are projected in hexagonal pattern with a diameter of 2.5 mm
Pupillometry	Can be measured	Can't be measured
Lens thickness	Can be measured	Can't be measured
Central corneal thickness	Can be measured	Can't be measured

References

1. Sahin A, Hamrah P. Clinically relevant biometry. Curr Opin Ophthalmol. 2012 Jan;23(1):47–53.
2. Olsen T. Calculation of intraocular lens power: a review. Acta Ophthalmol Scand. 2007 Aug;85(5):472–85.
3. Lee AC, Qazi MA, Pepose JS. Biometry and intraocular lens power calculation. Curr Opin Ophthalmol. 2008 Jan;19(1):13–7.
4. Drexler W, Findl O, Menapace R, Rainer G, Vass C, Hitzenberger CK, et al. Partial coherence interferometry: a novel approach to biometry in cataract surgery. Am J Ophthalmol. 1998 Oct;126(4):524–34.
5. Buckhurst PJ, Wolffsohn JS, Shah S, Naroo SA, Davies LN, Berrow EJ. A new optical low coherence reflectometry device for ocular biometry in cataract patients. Br J Ophthalmol. 2009 Jul;93(7):949–53.
6. IOLMaster 700 - Optical Biometry - Cataract - Medical Technology | ZEISS International [Internet]. [cited 2018 May 8]. Available from: https://www.zeiss.com/meditec/int/products/ophthalmology-optometry/cataract/diagnostics/optical-biometry/iolmaster-700.html
7. Akman A, Asena L, Güngör SG. Evaluation and comparison of the new swept source OCT-based IOL Master 700 with the IOLMaster 500. Br J Ophthalmol. 2016 Sep;100(9):1201-5.
8. Chen Y-A, Hirnschall N, Findl O. Evaluation of 2 new optical biometry devices and comparison with the current gold standard biometer. J Cataract Refract Surg. 2011 Mar;37(3):513–7.
9. Hoffer KJ, Shammas HJ, Savini G. Comparison of 2 laser instruments for measuring axial length. J Cataract Refract Surg. 2010 Apr;36(4):644–8.
10. Salouti R, Nowroozzadeh MH, Zamani M, Ghoreyshi M, Salouti R. Comparison of the ultrasonographic method with 2 partial coherence interferometry methods for intraocular lens power calculation. Optom St Louis Mo. 2011 Mar;82(3):140–7.
11. Jasvinder S, Khang TF, Sarinder KKS, Loo VP, Subrayan V. Agreement analysis of LENSTAR with other techniques of biometry. Eye Lond Engl. 2011 Jun;25(6):717–24.
12. Rabsilber TM, Jepsen C, Auffarth GU, Holzer MP. Intraocular lens power calculation: clinical comparison of 2 optical biometry devices. J Cataract Refract Surg. 2010 Feb;36(2):230–4.
13. Rohrer K, Frueh BE, Wälti R, Clemetson IA, Tappeiner C, Goldblum D. Comparison and evaluation of ocular biometry using a new noncontact optical low-coherence reflectometer. Ophthalmology. 2009 Nov;116(11):2087–92.

Terrien's Marginal Degeneration: An overview

Manthan Chaniyara, MD; **Sridevi Nair**, MD;
Rajesh Sinha, MD

Corresponding author:

Dr. Manthan Chaniyara, MD, DNB, FICO, FAICO (Refractive)
Senior Resident,
Dr. Rajendra Prasad Centre for Ophthalmic Sciences,
AIIMS, New Delhi

Manthan Chaniyara

Introduction:

Terrien's marginal degeneration (TMD) was first described in detail by Terrien as a bilateral marginal thinning disorder of cornea. Though it is generally classified as a degenerative corneal condition, rarely it may be associated with inflammation in the form of scleritis or episcleritis. [1-2]

Epidemiology:

Terrien's marginal degeneration (TMD) is an uncommon corneal degenerative condition. All over incidence is not known. It is bilateral in 86% of cases but may be asymmetrical. It is commonly seen in males between 20 to 40 years of age with the male to female ratio of 3:1. [3-4]

Etiopathogenesis:

Even many years after its first depiction, knowledge about its etiopathogenesis, progression till remain very restricted.[1]

Clinical features:

TMD is a rare, non-inflammatory, slowly progressive, peripheral corneal degenerative condition of unknown etiology. It begins commonly at the superior limbus as perilimbal corneal opacity resembling gerontoxon that progresses very slowly over the decades. In some cases, it may take even 30 years to become significant. Classically, TMD is a non-inflammatory degenerative condition; a variant of it seen typically in young males that may be associated with ocular inflammation in the form of scleritis or episcleritis. It may be associated with pseudopterygium in about 20% of the cases that can be clinically differentiated from true primary pterygium by its oblique location other than 3 and 9 o'clock position with a flat and broad head as compared to pointed end in true primary pterygium. All over the incidence of perforation is 15% in TMD cases.[2-7]

Telltale corneal signs on slit lamp examination in a case of TMD include crescent-shaped corneal opacity, associated thinning, superficial vascularization, and lipid deposition in anterior corneal stroma near the

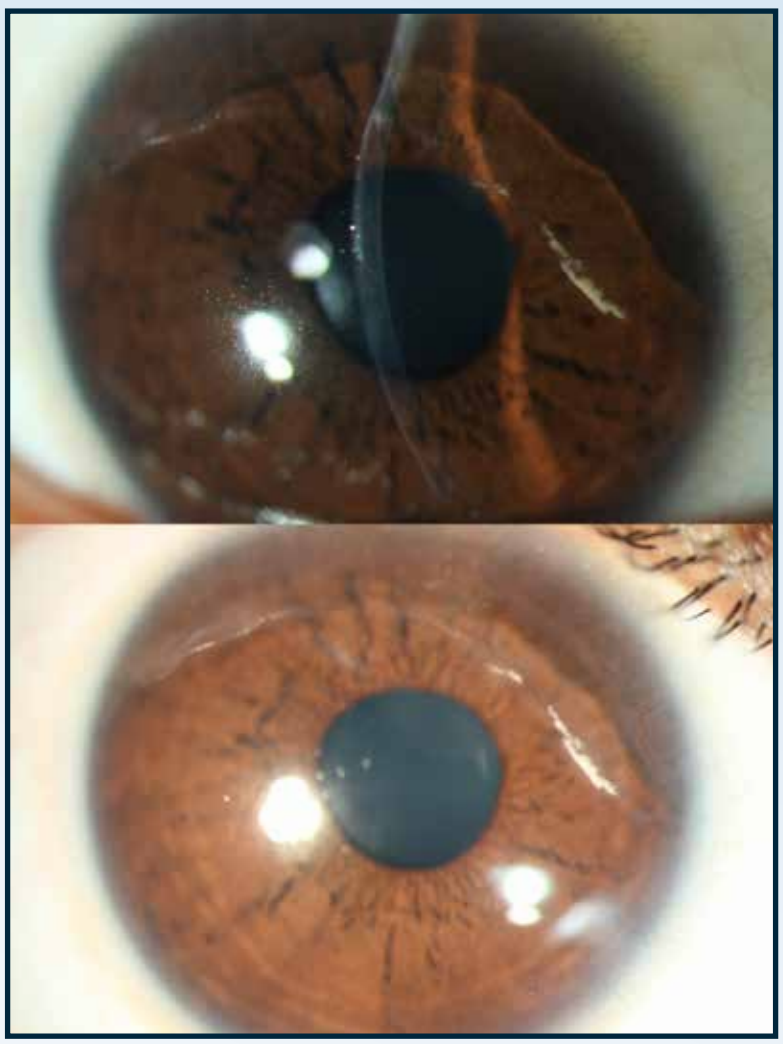


Figure 1. *Slit lamp photograph of a patient with TMD*

inner leading edge. There is often a clear corneal zone between the corneal lesion and the limbus. Corneal thinning typically starts with a gentle downward slope near the limbus and ends with a rapid steep rising at leading inner edge. Vessels travel radially across the lesion and looped back towards the limbus from the inner leading edge where lipid deposition is usually visible as a linear solid yellowish line. [3,8] (Figure 1).

Characteristic topographic features include flattening over the peripheral thin area with relative steepening at 90 degrees away from the midpoint of the peripheral thin area. As TMD usually starts at the superior limbus, against-the-rule astigmatism usually seen. [8,11]

Histology features:

Histological features include intact epithelium in all the stages of the disease, abnormal basement membrane, vascularization along with lipid deposition in anterior stroma, and normal Descemet's membrane. Though Descemet's membrane generally does not get affected in TMD, rarely it gets rupture spontaneously resulting in hydrops in TMD with intrastromal cyst formation or trabeculectomy like filtering bleb formation.[6,9,10]

Staging system:

Süveges staging system for TMD [5]

Stage 1 Marginal opacification similar to gerontoxon with peripheral vascularization.

Stage 2 In addition to the stage 1 features, initiation of the corneal thinning occurs parallel to the corneoscleral limbus.

Stage 3 Thinning of the cornea progresses but not reaching to the center of the cornea. In this stage complication like spontaneous or traumatic perforation may occur.

Stage 4 Thinning extends to the central area of the cornea.

Stage 5 Opacification of the central part of the cornea occurs. This stage is very rare because perforation occurs earlier.

A major pitfall of this staging system is that it is based on the width of the corneal involvement rather than the thickness of the cornea. In many cases, the cornea becomes to thin peripherally and gets perforated before reaching to the central part of the cornea. Hence, It may not be a good indicator of the risk of perforation and need for surgical repair.

Recently, Wang et al [12] have given a new staging system for TMD based on corneal curvatures and corneal thickness detected by optical coherence tomography. It offers an objective method for monitoring the progress of TMD.

Wang staging system for TMD

Stage	Anterior Curvature	Posterior Curvature	Thinnest corneal thickness
1	Normal	Normal	> 0.56 mm
2	Concave	Normal	> 0.41 to < 0.56 mm
3	Concave	Bowed forward	> 0.24 to < 0.41mm
4	Normal	Bowed forward	> 0.13 to < 0.24 mm
5	Bowed forward	Bowed forward	< 0.13 mm
6	Cornea perforted		= 0

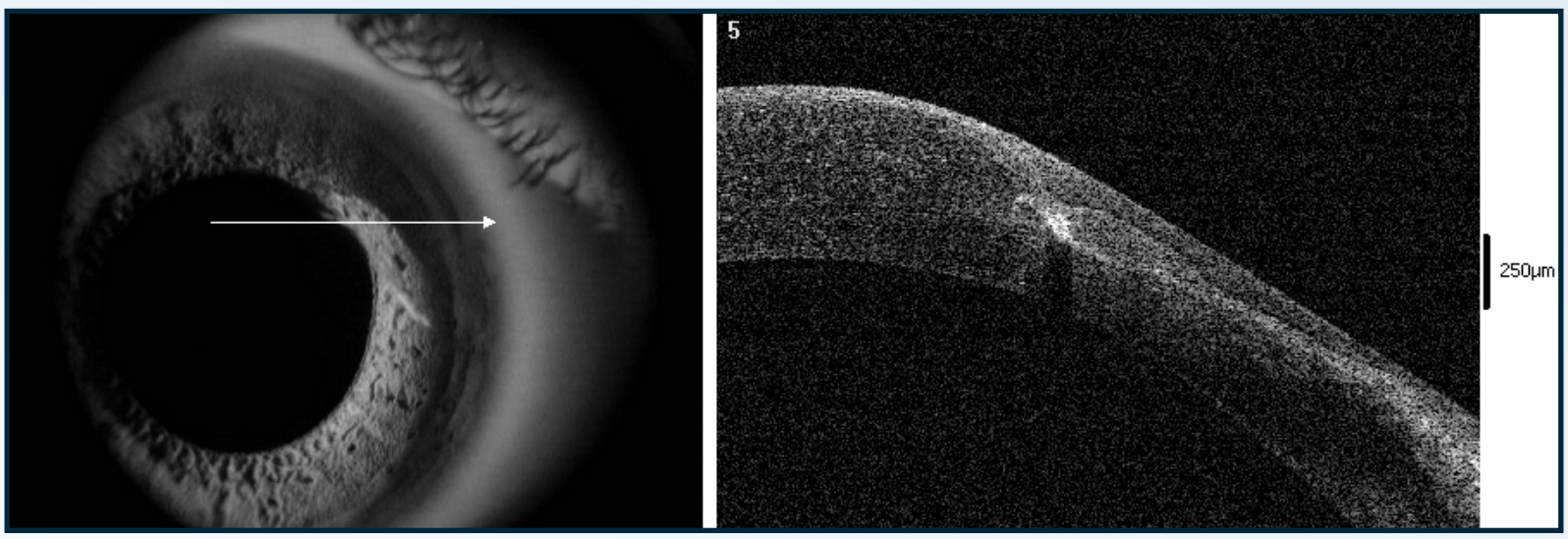


Figure 2. *ASOCT image of a patient with TMD*

Differential diagnosis:

1. Pellucid marginal degeneration
2. Marginal furrow degeneration
3. Mooren's ulcer
4. Keratoconus
5. Juvenile arcus
6. Fuchs superficial marginal keratitis
7. Staphylococcal marginal keratitis

Management

Diagnosis of TMD is based on typical slit lamp examination findings and corneal topography. Various investigations like in vivo confocal microscopy and ASOCT can be used for monitoring of the disease. Recently, ASOCT is used also for the staging of TMD. [12] (Figure 2)

As such, there is no well-established guideline for the management of TMD. In the early stage of TMD with minimal thinning and astigmatism, it can be managed conservatively with spectacles or contact lenses. Toric soft lenses and spherical and toric rigid contact lenses can be used initially to improve vision. As the condition progresses, mini-scleral or scleral contact lens designs may be beneficial. Eccentric epithelium-off corneal collagen cross-linking with standard Dresden protocol has been found to be effective in progressive TMD but it required a larger study to justify its efficacy. When conservative management fails due to very high astigmatism or if there is a risk of perforation due to extreme thinning surgery is indicated. Full thickness or lamellar crescentic graft can be used to provide tectonic support. 'Copy and Fix' technique can be used for proper matching of the crescentic graft. With keratoplasty progressive increase in astigmatism can be arrested up to 20 years. [13-17]

References

1. Pouliquen Y, Dhermy P, Renard G, et al. Terrien's disease: clinical and ultrastructural studies, five case reports. Eye 1989;3(Pt 6):791–802
2. Austin P, Brown SI. Inflammatory Terrien's marginal corneal disease. Am J Ophthalmol. 1981 Aug;92(2): 189–92.
3. Beauchamp GR. Terrien's marginal corneal degeneration. J Pediatr Ophthalmol Strabismus. 1982;19:97-99.
4. Etzine S, Friedmann A. Marginal Dystrophy of the Cornea With total ectasia. Am J Ophthalmol. 1963 Jan;55(1): 150–1.
5. Süveges J, Léval G, Alberth B. Pathology of Terrien's disease. Histochemical and electron microscopic study. Am J Ophthalmol. 1972 Dec;74(6):1191–200.
6. Pouliquen Y, Dhermy P, Renard G, Goichot-Bonnat L, Foster G, Savoldelli M. [Terrien's disease, apropos of 6 cases. Ultrastructural study]. J Fr Ophtalmol. 1989;12(8–9):503–20.
7. Goldman KN, Kaufman HE. Atypical pterygium. A clinical feature of Terrien's marginal degeneration. Arch Ophthalmol Chic Ill 1960. 1978 Jun;96(6):1027–9.
8. Ceresara G, Migliavacca L, Orzalesi N, Rossetti L. In Vivo Confocal Microscopy in Terrien Marginal Corneal Degeneration: A Case Report: Cornea. 2011 Jul;30(7):820–4.
9. Soong HK, Fitzgerald J, Boruchoff SA, et al. Corneal hydrops in Terrien's marginal degeneration. Ophthalmology. 1986;93:340–343.
10. Wong VA, Beiko G, Pavlin CJ, et al. Treatment of a spontaneous filtering bleb due to Terrien's marginal degeneration with injection of autologous blood. Can J Ophthalmol. 1995;30:377–379.
11. Wilson SE, Lin DT, Klyce SD, Insler MS. Terrien's marginal degeneration: corneal topography. Refract Corneal Surg. 1990 Feb;6(1):15–20.
12. Wang N, Wang C, Lian X, Duan S, Huang D, Zhou S. Staging of development in Terrien's degeneration based on corneal curvatures detected by optical coherence tomography. Graefes Arch Clin Exp Ophthalmol. 2015 Oct;253(10):1757–64.
13. Hafezi F, Gatzioufas Z, Seiler TG, Seiler T. Corneal Collagen Cross-linking for Terrien Marginal Degeneration. J Refract Surg. 2014 Jul 1;30(7):498–500.
14. Brown AC, Rao GN, Aquavella JV. Peripheral corneal grafts in Terrien's marginal degeneration. Ophthalmic Surg. 1983 Nov;14(11):931–4.
15. Caldwell DR, Insler MS, Boutros G, Hawk T. Primary surgical repair of severe peripheral marginal ectasia in Terrien's marginal degeneration. Am J Ophthalmol. 1984 Mar;97(3):332–6.
16. Pettit TH. Corneoscleral freehand lamellar keratoplasty in Terrien's marginal degeneration of the cornea--long-term results. Refract Corneal Surg. 1991 Feb;7(1):28–32.
17. Samarawickrama C, Goh R, Vajpayee RB. "Copy and Fix": A New Technique of Harvesting Freehand and Horseshoe Tectonic Grafts. Cornea. 2015 Nov;34(11):1519–22.
18. Mahadevan R, Fathima A, Rajan R, et al. An ocular surface prosthesis for keratoglobus and Terrien's marginal degeneration. Optom Vis Sci. 2014;91(4 Suppl 1):S34-9.

Tests for Dry Eye

Nawazish Sheikh, MD; **Sridevi Nair**, MD
Cornea & Ocular Surface Services, Dr Rajendra Prasad Centre for Ophthalmic Sciences, AIIMS, New Delhi - 110029, India

Corresponding author:
Rajesh Sinha, MD, DNB, FRCS
Professor, Cornea, Lens & Refractive Surgery Services,
Dr Rajendra Prasad Centre for Ophthalmic Sciences,
All India Institute of Medical Sciences, New Delhi - 110029, India


Nawazish Sheikh

Definition of dry eye

According to TFOS (Tear Film & Ocular Surface Society) DEWS II, dry eye is a multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film, and accompanied by ocular symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities play etiological roles.[1]

Diagnosis

The tests can be broadly classified into. Table 1 highlights the various tests that can be used to assess the different aspects of the tear film.

1. Quantitative tests
2. Qualitative tests

Quantitative tests

A) **Tear break-up Time test (TBUT)**[2]

It only establishes the tear film instability.

Method: After instilling 2% Fluorescein stain into the inferior fornix, the patient is asked to blink a few times and observed under the cobalt blue filter of the slit lamp. The time interval between the last blink and the appearance of the first randomly distributed discontinuity in the stain is taken as the Tear break-up Time (TBUT).

Any value less than 10 seconds is considered abnormal. Recurrent break-up of the tear film in the same area may indicate localised surface abnormalities.

Interpretation: Decreased Tear break-up time is seen in aqueous tear deficiency as well as in patients with Meibomian gland dysfunction.

Other Modalities:

i) Non-fluorescein noninvasive[3] tests for tear break-up time utilise reflective devices via which a grid is projected onto the cornea. Time duration for the distortion of the grid is measured and the values are slightly higher. Intruments such as Tearscope-Plus can be used for the same.

ii) Quantified amount of 1% Sodium Fluorescein is instilled into the conjunctival sac and video recording is done for the first randomly distributed corneal dry spot. Values less than 7 seconds are considered abnormal.

iii) Ocular Protection Index: It is the ratio of the tear film break up time over the inter-blink interval. Values below 1 are indicative of tear film instability and dry eye disease.

B) **Schirmer's Test:** Uses Whatmann Filter Paper No:41 and has the following test variations :

i) **Schirmer's test I**

Method: No local Anaesthesia is used. Whatmann filter paper no: 41 is placed at the junction of the medial 2/3rd and the lateral 1/3rd of the lower fornix, such that it doesn't touch the cornea. The patient is asked to sit patiently with normal blinking (Schirmer's described the open eye technique). The wetting of the filter paper is measured at the end of 5 minutes. Measures the total tear production (basal and reflex tear production)

Interpretation: The wetting of the filter paper is measured in millimetres at the end

of 5 minutes or if there is complete wetting, then the time taken for total wetting of the filter paper is taken into consideration. A value less than 10mm at the end of 5 minutes is considered abnormal.

Limitations: High variability and Poor reproducibility along with long duration of the test.

Modification of Schirmer's I

Method: Instillation of 0.5% Proparacaine Hydrochloride followed by blotting of excess local anaesthetic from the cul-de-sac before placing the filter paper strips. It measures the basal tear secretion.

Interpretation: Values less than 10mm at the end of 5 minutes are considered abnormal.

ii) **Schirmer's Test II**

Method: Tear secretion is measured using the strip following nasal stimulation.

Interpretation: It measures the reflex tear secretion and a wetting of the strip less than 10 mm at the end of 5 minutes is considered abnormal.

C) **Phenol red thread test**[4]

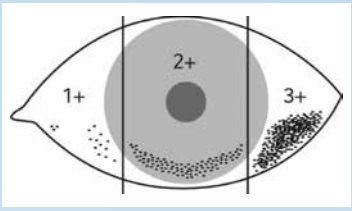
Method: 75mm thread impregnated with phenol red is placed in the lateral 1/3rd of the lower lid for 15 seconds. Due to alkalinity of the tears, there is a colour change from white to red. The red portion of the thread is measured.

Interpretation: Values less than 10mm are abnormal. Phenol red thread test is equally sensitive for diagnosis of dry eye when compared to Schirmer's but has the advantage of being simpler, less reflex tearing and shorter duration of the test.

D) **Staining of the ocular surface using vital stains**

Most commonly Fluorescein stain (2%) is used. It stains the denuded corneal epithelium. Other stains used are Rose Bengal which stains dead and devitalized epithelial cells and areas devoid of mucin. RB stain can produce stinging and is known to be epitheliotoxic. Lissamine green stains healthy epithelial cells devoid of mucin and also dead and degenerated epithelial cells. The following grading schemes maybe used to grade the ocular surface staining.

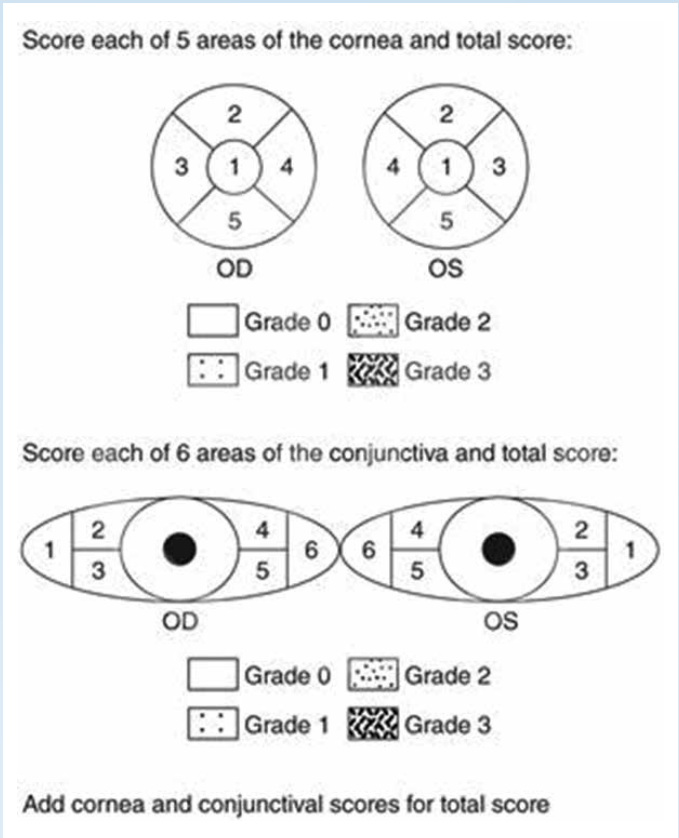
1) Van Bijstervald scoring system divides the ocular surface into three zones
   a) Nasal bulbar conjunctiva
   b) Cornea
   c) Temporal bulbar conjunctiva



   Each zone is scored for severity ranging from 0 (no stain) to 3 (confluent staining)

   A score of >3.5 is considered abnormal.

2) National Eye Institute workshop grading



3) Objective assessment of corneal staining using digital image analysis.[5] It involves analysis using colour extraction and the occupied area by staining. It was found to have excellent correlation with oxford and NEI staging with excellent repeatability

E) **Fluorescein Clearance Test**[6]

Aliquot of 5 microlitre of Fluorescein (0.25%) is instilled on the conjunctiva and residual dye in the schirmer's strip is measured at intervals if 1 minute, 5 minutes, 10 minutes, 20 minutes and 30 minutes. A value of 3mm or greater at the first 10 min interval is normal. Delayed clearance of more than 20 minutes is seen in patients with dry eye. It can also help determine the efficacy of punctal occlusion. It tests both the tear secretion and drainage.

F) **Tear function index**

The tear finction index is determined by dividing Schirmer test with anesthesia by the clearance rate. A score of less than 96 indicates dry eyes and an index score less than 34 points to Sjogren's syndrome. However the test is time consuming and the index fails to account for the tear loss due to evaporation

G) **Tear Meniscus height**

Can be subjectively measured using the slit lamp, using one capable of measuring micrometers. Objective measurement of the tear miniscus height can be made using instruments such as Tearscope-Plus. The normal values range from 0.2-0. Mm while values less than 0.2 mm are suggestive of dry eye.

Qualitative tests

1) **Tear Osmolarity** [7,8]

Normal value is around 302 +/- 8 miliosmole/litre. In patients with dry eye disease, hyperosmolarity, i.e values higher than 318 mOsm/L is seen. It has a sensitivity of 73% and a specificity of 92% for dry eye disease. The TearLab osmoloarity can used to to quantify the tear osmolarity values.

2) **Assessment of tear proteins**

a) Lyzozyme is decreased in patients with aqueous tear deficiency dry eye disease and is also seen in inflammatory conditions. Values are measured using the lysis of culture of Micrococcus Lysodeikticus

b) Lactoferrin is measured using radioimmunoassay. Decreased levels are found in aqueous deficient dry eye disease.

c) Raised levels of inflammatory biomarkers such as MMP-9 can also help detecting dry eye disease early. InflammaDry Detector (Rapid Pathogen Screening Inc, Sarasota, FL, USA) has been found to have good sensitivity and specificity for the same.

3) **Tear ferning** [9]

Tear samples are dried on a clean glass slide and measured under the microscope. Ferning patterns range from uniform arborisation to amorphous pattern. Basically act as a qualitative test to measure the composition of the tears (electrolyte composition).

4) **Presence of Meibomian Gland dysfunction**

Objectively using either a contact or a non-contact meibography. Meibography implies the invivo assessment of the meibomina gland morphology. The older contact meibography test was done using probe to illuminate the skin side of the lower lids and then observing the silhouettes of the glands. The newer non contact meibography a slitlamp biomicroscope, video camera and infrared filter to study the gland morphology. Meiboscore, introduced by Arita et al in 2008 is a scoring system in which each eyelid is examined for meibomian gland loss and scored from grade 0 (no loss of meibomian glands) through grade 3 (the area of loss more than two thirds of the total meibomian gland area).

5) **Lid-Parallel Conjunctival folds** [10]

Temporal conjunctival folds are analysed and graded from degree 0 to degree 3 according to Hoh et al and is comprised of measuring the size of the conjunctival fold with the tear meniscus height and also the number of individual conjunctival folds present.

Degree 0: No permanently present fold

Degree 1: Single small fold in the primary eye position which appears smaller than the normal tear meniscus height

Degree 2: Multiple conjunctival folds upto the height of the normal tear meniscus

Degree 3: Multiple conjunctival folds higher than the normal tear meniscus

6) **Interferometry**

Interferometry is used to analyse the lipid layer of the tear film. Its is based on the principle of a light source being projected on to the tear lipid layer and the intereferenrce images so obtained are studied to asses the quality of th elipid layer. Instruments such as Tearscope and LipiView can be used for the same. An abnormal lipid layer is considered to indicative of meibomiain gland dysfunction.

Table 1.
Tests for assessing the ocular tear film

Tests for TearFilm stability
• Tear film break up time
– Invasive
– Noninvasive
• Tear film interterferometry
Tear secretion assessment tests
• Schirmer
– With anesthesia
– Without anesthesia
Tear clearance assessment
• Fluorescein clearance test
• Tear function index
• Fluorophotometry
Ocular surface damage assessment
• Corneal and conjunctival staining
• Corneal and conjunctival cytology
Lipid layer assessment
• Precorneal/meibomian grading
Others
• Tear osmolarity test
• Patient subjective symptom questionnaires

References

1. Craig JP, et al., TFOS DEWS II Report Executive Summary, The Ocular Surface (2017), http://dx.doi.org/10.1016/j.jtos.2017.08.003
2. Pflugfelder SC, Tseng SC, Sanabria O, et al. Evaluation of subjective assessments and objective diagnostic tests for diagnosing tear-film disorders known to cause ocular irritation. Cornea 1998; 17: 38-56.
3. Mengher LS, Bron AJ, Tonge SR, et al. A non invasive instrument for clinical assessment of the pre-corneal tear film stability. Curr Eye Res. 1985: 4:1-7.
4. Vashisht, S. & Singh, S. Evaluation of Phenol Red Thread test versus Schirmer test in dry eyes: A comparative study. Int. J. Appl. Basic Med. Res. 1, 40–42 (2011).
5. Chun YS, Yoon WB, Kim KG, Park IK. Objective assessment of corneal staining using digital image analysis. Investigative ophthalmology & visual science. 2014 Dec 1;55(12):7896-903.
6. Zappia RJ, Milder B. Lacrimal drainage function. 2. The fluorescein dye dispearance test. Am J Ophthalmol. 1972;74:160-162
7. Jacobi C, Jacobi A, Kruse FE, Cursiefen C. Cornea. 2011 Dec; 30(12):1289-92
8. Lemp, M. A. et al. Tear Osmolarity in the diagnosis and management of dry eye disease. Am. J. Ophthalmol. 151, 792-798.e1 (2011).
9. Norn M. Quantitative tear ferning. Clinical investigations. Acta Ophthalmol (Copenh) 1994;72(3):369-72.
10. Németh J, Fodor E, Lang Z, Kosina-Hagyó K, Berta A, Komár T, Petricek I, Higazy M, Prost M, Grupcheva C, Kemer OE. Lid-parallel conjunctival folds (LIPCOF) and dry eye: a multicentre study. British Journal of Ophthalmology. 2012 Nov 1;96(11):1380-5.

Rare causes of Explantation of Implantable Collamer Lens

Jeewan S. Titiyal, MD;
Manpreet Kaur, MD

Dr. Rajendra Prasad Centre for Ophthalmic Sciences,
All India Institute of Medical Sciences, New Delhi, India

xxx

Phakic IOL implantation has been found to be safer than excimer laser surgical correction in cases with moderate to high myopia, with better contrast sensitivity as well as better patient satisfaction and preference.[1] It also carries a lesser chance of loss of best spectacle corrected visual acuity as compared to excimer laser ablation.[1] Implantable collamer lens (ICL) (Visian, STAAR Surgical Co., CA, USA) is a posterior chamber phakic intraocular lens (pIOL) that received FDA approval in 2005 for the correction of moderate to high myopia.[2]

Safety and success of ICL implantation depends on adequate vaulting, and extremes of vaulting are associated with an increase in the incidence of complications such as anterior subcapsular cataract and glaucoma.[3-6] These complications may lead to the need for explantation of the ICL which may be severely debilitating for the patient.

We herein report a few rare indications of ICL explant in our institution and their visual and anatomical outcomes.

Surgical technique for ICL explant

A 2.2 mm temporal corneal incision was created using a keratome along with two 1.1 mm entries at 90° and 240°. A cohesive OVD (Healon, AMO Inc., California) was injected both above and beneath the ICL to maintain the anterior chamber (AC) and protect the anterior lens capsule. The ICL haptics were manipulated in to the AC. The ICL was grasped at its temporal edge with the ICL holding forceps and pulled out from the 2.2 mm corneal incision. In cases that required a concomitant phacoemulsification, a coaxial phacoemulsification with IOL implantation was performed through the 2.2 mm corneal incision after ICL explant in the same sitting. The corneal wounds were hydrated with balanced salt solution.

Chipped Haptic

One case had a chipped haptic of the ICL during insertion. The trailing haptic was stuck in the cartridge leading to damage during insertion. The ICL was explanted immediately after insertion on noticing the chipped haptic. A new ICL was subsequently implanted after one week, due to unavailability of a replacement lens at the time of the first surgery. The postoperative course was uneventful with a UDVA of 20/20 and vaulting of 545 microns. The lens was crystalline and there was no evidence of cataract till the last follow up.[7]

Inverse ICL with rhegmatogenous retinal detachment and cataract

One case presented with inverse ICL implantation and anterior subcapsular cataract. The central vault was 22 microns. On fundus examination, an inferior rhegmatogenous retinal detachment involving the macula was observed. The ICL was explanted along with phacoemulsification and IOL implantation in the first stage. Subsequently, vitreoretinal surgery with silicon oil injection was performed after one week and the patient regained a CDVA of 20/70.[7]

Post-traumatic ICL dislocation with anterior subcapsular cataract

A 40 year male presented with post-traumatic ICL dislocation and anterior subcapsular cataract. The patient had sustained blunt trauma with a bottle leading to anterior chamber hyphema, anterior dislocation of the ICL and anterior subcapsular cataract. The retina was attached on B-scan ultrasonography. ICL was explanted and phacoemulsification with IOL implantation was done. After one month, the CDVA was 20/20.[7]

Shallow vault and recurrent uveitis

A 28 year old female presented with a shallow vault and recurrent uveitis. The patient had undergone

bilateral ICL implantation one year back. She presented with recurrent episodes of pain, redness and blurred vision in the left eye. On examination, the right eye had a vault of 100 microns with ICL in situ and crystalline lens. The left eye had circumciliary congestion and fine keratic precipitates were present on the corneal endothelium. Anterior segment inflammation with 2+ cells and flare was noted. The ICL was in situ with a vault of 72 microns. Mild anterior subcapsular cataract was present. The initial episodes of inflammation were treated conservatively with steroids and cycloplegics, however a decision was made to explant the ICL because of increasing severity and frequency of the inflammatory episodes. Minimal anterior subcapsular cataract was present; hence concomitant phacoemulsification was not done. The postoperative CDVA was 20/20. Since the fellow eye had ICL in situ, a contact lens was prescribed for the visual rehabilitation of the left eye.[7]

Acute postoperative endophthalmitis

A 29 year old male presented with acute postoperative endophthalmitis in the right eye five days after implantation of implantable collamer lens (ICL). Intravitreal antibiotics (vancomycin 1mg/0.1ml + piperacillin-tazobactam 225 μg/0.1ml) were administered. There was minimal improvement after 48 hours; hence the ICL was explanted and repeat injection of intravitreal antibiotics was administered. Following this, the endophthalmitis resolved and the patient achieved a CDVA of 20/25 after one month. A repeat implantation of ICL was done nine months after the first surgery following which the patient regained UDVA of 20/20.[8]

Discussion

Phakic IOL implantation is a safe and effective method of refractive correction in cases with moderate to high myopia. An ICL explantation may rarely be needed in the event of complications. Surgical expertise is essential in this refractive surgery to prevent undue complications. Our series had one case of chipped haptic and one case with inverse ICL implantation, both of which are avoidable surgical complications. Endophthalmitis after pIOL implantation is a rare but debilitating complication, with an incidence of 1 case per 6000.[9] Timely intervention is the key to minimise damage, and intravitreal antibiotics along with ICL explantation helped in successful resolution of the endophthalmitis in our case with preservation of the CDVA.

As per the current literature, the indications for ICL explantation have been related to inappropriate vaulting and its consequences.[10-12] A low vault predisposes to cataract formation whereas an excessively high vault leads to raised IOP. Both these scenarios may necessitate ICL explantation with or without concomitant cataract surgery. We have herein reported few rare indications for ICL explant and optimal visual and anatomical outcome may be achieved in these cases.

References

1. Barsam A, Allan BD. (2014) Excimer laser refractive surgery versus phakic intraocular lenses for the correction of moderate to high myopia. Cochrane Database Syst Rev.; 6:CD007679. doi: 10.1002/14651858.CD007679.pub4
2. Sanders DR, Doney K, Poco M. (2004) ICL in Treatment of Myopia Study Group. United States Food and Drug Administration clinical trial of the Implantable Collamer Lens (ICL) for moderate to high myopia: three-year follow-up. Ophthalmology. ;111(9):1683-92
3. Kojima T, Maeda M, Yoshida Y, Ito M, Nakamura T, Hara S, Ichikawa K. (2010) Posterior chamber phakic implantable Collamer lens:changes in vault during 1 year. J Refract Surg.; 26(5): 327–332.
4. Choi KH, Chung SE, Chung TY, Chung ES. (2007) Ultrasound biomicroscopy for determining Visian implantable contact lens length in phakic IOL implantation. J Refract Surg. ; 23(4): 362–367.
5. Guell JL, Morral M, Kook D, Kohnen T. (2010) Phakic intraocular lenses part 1: historical overview, current models, selection criteria, and surgical techniques. J Cataract Refract Surg.; 36(11): 1976–1993.
6. Kaur M, Sahu S, Sharma N, Titiyal JS. (2016) Femtosecond Laser-Assisted Cataract Surgery in Phakic Intraocular Lens With Cataract. J Refract Surg.;32(2):131-4.
7. Kaur M, Titiyal JS, Falera R, Sinha R, Sharma N. (2018) Indications for explant of implantable collamer lens. Eye (Lond). Jan 12. [Epub ahead of print]
8. Kaur M, Titiyal JS, Sharma N, Chawla R. (2015) Successful re-implantation of implantable collamer lens after management of post-ICL methicillin-resistant Staphylococcus epidermidis endophthalmitis. BMJ Case Rep. pii: bcr2015212708. doi: 10.1136/bcr-2015-212708.
9. Allan BD, Argeles-Sabate I, Mamalis N. (2009) Endophthalmitis rates after implantation of the intraocular Collamer lens: survey of users between 1998 and 2006. J Cataract Refract Surg.; 35(4):766-9
10. Zeng QY, Xie XL, Chen Q. (2015) Prevention and management of collagen copolymer phakic intraocular lens exchange: Causes and surgical techniques. J Cataract Refract Surg.;41(3):576-84
11. Fernandes P, González-Méijome JM, Madrid-Costa D, Ferrer-Blasco T, Jorge J, Montés-Micó R. (2011) Implantable collamer posterior chamber intraocular lenses: a review of potential complications. J Refract Surg. ;27 (10):765-76
12. Alió JL, Toffaha BT, Peña-Garcia P, Sádaba LM, Barraquer RI. (2015) Phakic intraocular lens explantation: causes in 240 cases. J Refract Surg.;31(1):30-5

ISCKRS Meet 2018

Annual Conference of Indian Society of Cornea & Keratorefractive Surgeons

"Evolving Trendz"

04TH & 05TH AUGUST 2018

Le Meridien, New Delhi

For more information, please visit www.isckrs.com

isckrs@gmail.com

+91-9650268007

Registration & Abstract Submission Starting Soon

Prof. Jeewan S Titiyal
President, ISCKRS

Prof. Rajesh Sinha
Secretary, ISCKRS

Cipla

In Moderate to Severe Dry eye condition,

START EARLY START RIGHT

IMUDROPS preservative free Singules

Cyclosporine Eye Drops 0.05%

Treat beyond the surface

World's 1st Micro-emulsion Technology

- Ensures particle size of less than 1 micron

Reference: Cipla Data on file

In VKC,*

IMUDROPS preservative free DS

Cyclosporine 0.1%

*Vernal Keratoconjunctivitis

"For any further information, please contact"

Cipla

Cipla Ltd. Regd, Office:

Cipla House, Peninsula Business Park, Ganpatrao Kadam Marg,
Lower Parel, Mumbai 400 013, INDIA
Website: www.cipla.com

Cipla FORESIGHT™ vision becomes reality

For the use of a Registered Medical Practitioner or a Hospital or a Laboratory only.

INDIAN SOCIETY OF CORNEA
AND KERATOREFRACTIVE SURGEONS

INDIAN SOCIETY OF CORNEA AND KERATOREFRACTIVE SURGEONS

(LIFE MEMBERSHIP APPLICATION FORM)

Name (BLOCK LETTERS).....

S/D/W/of.....DOB(dd/mm/yy).....

Qualifications.....

ADDRESS

Correspondence.....

.....Phone.....

Hospital / Clinc.....

.....Phone.....

Mobile.....FAX.....

Nationality ..... Email.....

Paste one recent Photo and SUBMIT one Additional

I wish to become a Life Member of the 'Indian Society of Cornea and Keratorefractive Surgeons' and shall abide by the Constitution and Rules & Regulations of the Society.

Please Find enclosed my membership Fees of Rs. _____(in words) Rs._____ By Cash/Cheque/DD No. _____ dt._____ drawn on _____.

Also enclosed is a brief C.V. (max 2 pgs) highlighting my training and experience in Cornea specialty&/or Keratorefractive surgery & degree Certificate.

I declare that the information provided by me as above is correct

(Signature of Applicant)

FOR OFFICIAL USE

Dr. _____has been admitted as a Life Member of the Indian Society of Cornea and Keratorefractive Surgeons in the Governing Body Meeting held on _____ His/Her membership no. is _____ ,Membership Fee received by Cash/Chq/DD no. _____ dated _____ drawn on _____

Address: ISCKRS Secretariat - Dr. Rajesh Sinha, 474, 4th Floor, R.P. Centre for Opthalmic Sciences AIIMS

Life Membership fee is Rs. 3,000/- payable by local (Delhi) Cheque or by Demand Draft payable at Delhi in favour of "Indian Society of Cornea and Keratorefractive Surgeons".

JOIN ISCKRS

The Indian Society of Cornea & Kerato-refractive Surgeons (ISCKRS) has been active, dedicated and committed to the advancement of the understanding of diseases of the Cornea, External Eye & Refractive Surgery. All admitted members of ISCKRS shall be "Life Time Members" of the society, enjoying benefits, bound by terms laid in the Constitution & By Laws of ISCKRS.

To Become Member, please visit http://www.isckrs.org/membership.aspx

BENEFITS

All admitted members of the society shall be Life Time Members of the society, enjoying benefits, bound by terms laid down in the Constitution & By-Laws of ISCKRS. All Life Member of ISCKRS shall enjoy the following benefits

1. ISCKRS Newsletter
2. Hands on Training Courses
3. Skill Transfer Courses
4. Certification of Training
5. Clinical Recommendations and Guidelines: Management Protocols
6. Online Journal Access
7. Online Photo Gallery
8. Online Video Gallery

Cipla

OSMODROPS

CMC 0.5% + Glycerine 0.9%

EDGE OVER HYDRATION

WHEN DRY EYE PROGRESSES

CHOOSE OSMODROPS

TO PROVIDE AN EDGE OVER HYDRATION

- Formulated with CMC 0.5%, Glycerine 0.9%, L-carnitine and Erythritol for osmoprotection
- Mixture of 2 grades of BLANOSE CMC to provide the best hydration and retention time.
- 3-piece Metered-Dose Dropper to prevent wastage of drops and provide cost-effective therapy.

"For any further information, please contact"

Cipla

Cipla Ltd. Regd, Office:
Cipla House, Peninsula Business Park, Ganpatrao Kadam Marg,
Lower Parel, Mumbai 400 013, INDIA
Website: www.cipla.com

Cipla FORESIGHT™ vision becomes reality

Reference: Cipla Data On File *CMC-Carboxymethy Cellulose*

Cipla

Introducing

QUEEN of QUINOLONES

Gatiquin HS

Gatifloxacin 0.5% EYE DROPS

The Future of Infection Control

Gatifloxacin Higher Strength Benefits

- Improved efficacy[1]
- Helps prevent development of resistance[2]
- Maintains the safety of the 0.3% formulation[2]
- Allows for a less frequent dosing regimen[2]

References:

1. *http://optometrytimes.modernmedicine.com/print/147790 Last accessed on 2nd January 2016*
2. *Heller W., Cruz M., Bhagat YR., Leon JM., Felix C., Villanueva L., et al. Gatifloxacin 0.5% administered twice daily for the treatment of acute bacterial conjunctivitis in patients one year of age or older. Journal Of Ocular Pharmacology And Therapeutics 2014: 1-8*

For the use of a Registered Medical Practitioner or a Hospital or a Laboratory only.

Cipla FORESIGHT™ vision becomes reality

"For any further information, please contact"

Cipla

Cipla Ltd. Regd, Office:

Cipla House, Peninsula Business Park, Ganpatrao Kadam Marg,
Lower Parel, Mumbai 400 013, INDIA
Website: www.cipla.com