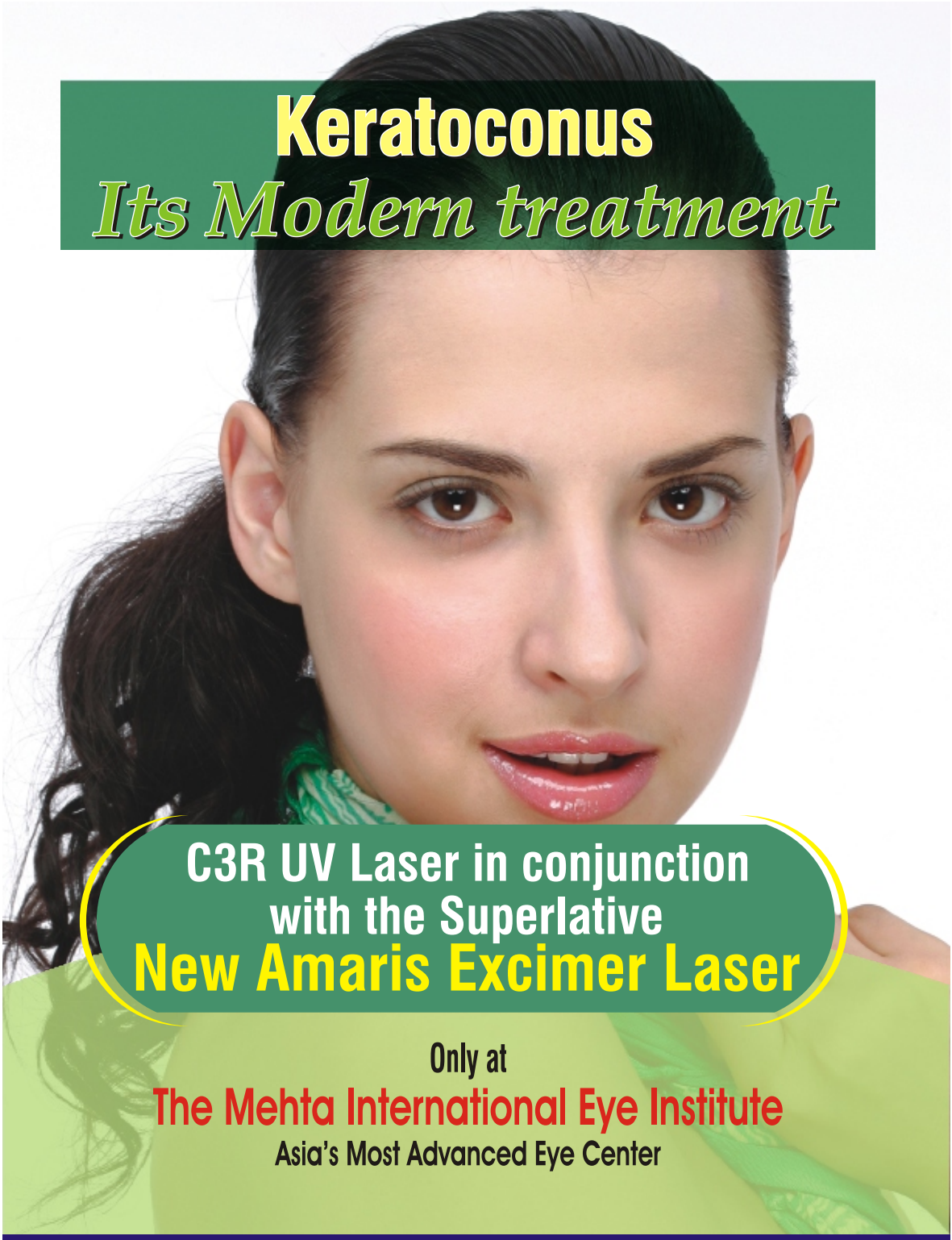
Keratoconus
Its Modern treatment
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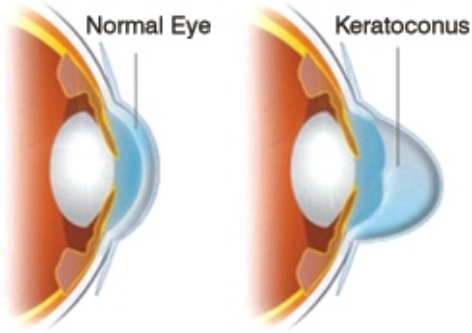
What is Keratoconus ?

Keratoconus is an eye condition in which the shape of the cornea becomes progressively distorted and in addition thins. The cornea is a clear structure that covers the front of the eye and allows light to enter the eye. In a healthy eye, the cornea curves like a dome. In an eye with keratoconus, the center of the cornea slowly thins and bulges, so that it sags and has a cone shape.

In keratoconus, the posterior layer may give way and develop fine tears. When this happens, the cornea may suddenly become swollen with water (termed hydrops) with sudden fall in vision. Wrinkles and scars may also form on a keratoconus cornea.



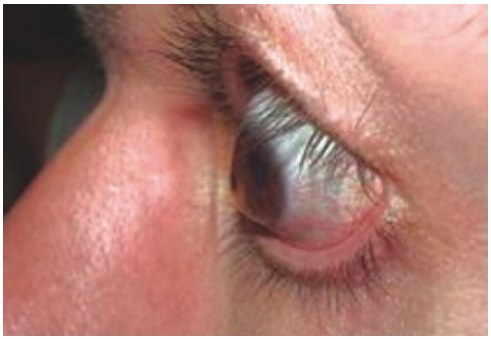
Q How does keratoconus interfere with vision?

People with keratoconus may lose vision in two ways:

1. From the induced distortion of the cornea: Seeing through a irregular distorted cornea is like taking pictures with a camera whose lens has an irregular (not smooth) surface. Parts of the picture or field of vision are in focus and parts are out of focus. This visual problem is called irregular astigmatism.
2. From scarring or swelling of the cornea: Seeing through a scarred or swollen cornea is like taking pictures with a camera with a dirty or cloudy lens. The picture or vision is blurred.

Q How common is keratoconus?

Keratoconus is not uncommon, occurring in 50 to 230 per 100,000 population.



Q Who can get keratoconus?

Keratoconus has been found in all races and in both sexes but affects women more often. Its frequency is more in patients with Down's syndrome, patients with retinitis pigmentosa, those with collagen disorders and gross allergies or congenital amaurosis (a rare form of blindness at birth). Keratoconus may also develop in persons who have worn contact lenses for a long time and who often rub their eyes with too much force.

Q When does keratoconus start, what causes it ?

Keratoconus affects both eyes, though it usually develops first in one eye, and this eye often continues to be worse than the second eye. Symptoms normally start between 16 and 25 years of age. Keratoconus usually start in puberty (in the teens) and may progress for the next 10 to 20 years. It normally stabilizes by the age of 40, but not always. The cause of keratoconus are not fully known.

Q Is keratoconus hereditary?

While most patients with keratoconus have no relatives suffering from the disorder, many have relatives with high astigmatism and this may be a very mild form of keratoconus. Only about one in ten patients has a relative who is suffering from keratoconus.

What are the symptoms of keratoconus ?

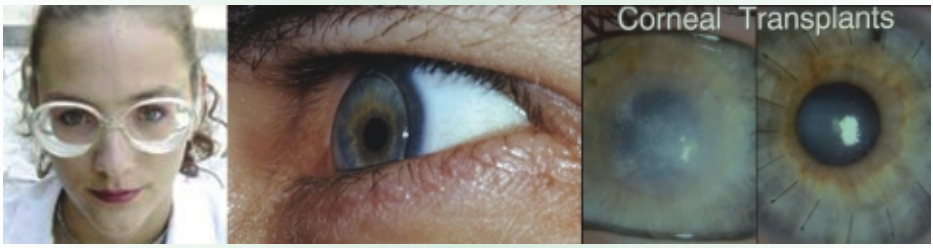
- One of the first indications patients may be developing keratoconus is that they are never satisfied with their spectacle prescription. They visit a number of practitioners and have many pairs of spectacles. They may also report many changes in their spectacle prescription over a relatively short amount of time, such as 12-18 months, and typically will note that there is a significant change in their astigmatism correction, both in the power and even the axis changes.
- Typically patients may report that their eyes itch, that they have allergies, and they often rub their eyes , often quite forcefully.
- In addition to a fall in vision, patients with keratoconus often complain of visual discomfort similar to a patient with uncorrected astigmatism. They will report "squinting" in order to see well.
- They are more sensitive to light than the normal patient. They report flare or halos around lights, particularly when driving at night. Many will even avoid night driving. Ghost images, seeing double with one eye covered (monocular diplopia), and multiple images are common complaints.
- Due to the distortion, there may be many areas of the cornea with different refracting powers creating multiple confusing images. Sometimes keratoconus is diagnosed when sudden swelling (hydrops) develops which lead to pain.


The images entering through the KC corneal surface create distortion and blurring

How is Keratoconus diagnosed ?

Keratoconus usually is discovered when a patient sees an ophthalmologist because of decreased vision. The diagnosis can be made through an ophthalmologist's examination of the eye, often involving computerized mapping of the corneal shape using a device termed as Computerized Corneal Topography. This is much like the topographic maps created of land. It shows how steep the cornea is and how quickly the steepness changes by using color-coded printouts. Advantages of corneal topographers are that they allow you to see a cone, even if it is off-center. Changes in the cornea over time are easy to quantify

Another important device to detect keratoconus is the biomicroscope, commonly called the 'slit lamp', which is a special microscope fitted with chin and headrests which allows the eye-care practitioner to view the eye under high magnification. The slit lamp also contains special colored filters which can enhance the doctor's view.



Keratoconus treatment

The treatment approach to keratoconus follows an orderly progression from glasses to contact lenses to corneal transplantation.

- Specially designed glasses are an effective means of correction mild keratoconus. As the cornea steepens and becomes more irregular, glasses are no longer capable of providing adequate visual improvement. And contact lenses are needed.
- A gas permeable contact lens is the most highly effective way to manage keratoconus and 90% of all cases can be managed this way indefinitely. If the cornea becomes too scarred or painful, a corneal transplant may be necessary. In more advanced cases the cornea becomes more distorted and specifically designed keratoconic contact lenses become necessary. Even though Keratoconus does not cause blindness most patients go on to needing contact lenses. Less than 10% of patients will require a corneal transplant.
- Corneal transplant surgery is indicated when a patient cannot wear contact lenses for an acceptable period of time or when the vision, even with contacts, is unsatisfactory. Over 90% of corneal transplants are successful with the majority of patients obtaining vision of 20/40 or better afterwards with either glasses or contact lenses.

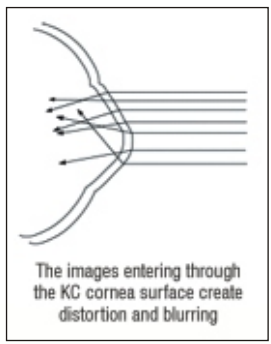
Keratoconus Contact lenses

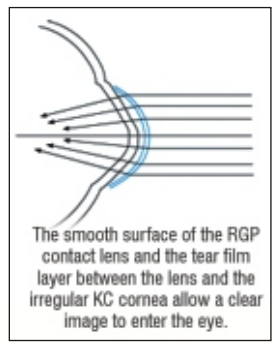
Rose K Keratoconic lens: The Rose K lens is probably the most widely fitted keratoconus lens worldwide and achieves an 85% first fit success in the UK. The Rose K lens design is a fully flexible lens that works well on early to advanced keratoconus patients. Complex lens geometry, combined with the enhanced material benefits of Boston ES™, makes the Rose K lens the good fit enhancing patient comfort and visual acuity. Multiple parameters make fitting the Rose K lens possible for most keratoconic eyes.

McGuire lens system: This is an aspheric lens design specifically set up to put minimal pressure on the central cone by vaulting it and distributing the bearing pressure to the more healthy peripheral cornea.

Tricurve Keratoconus lens: This lens is a soft contact lens designed with a thick center that creates more rigidity to maintain visual acuity.

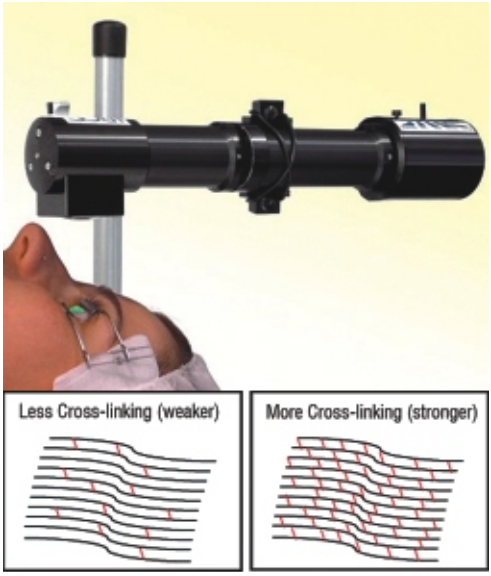
Piggyback Lens System: This lens is a two lens system: a soft lens that rests on the cornea, with a center area hollowed out to accommodate a small gas perm lens. This design is an attempt to ensure centration of the rigid lens over the central cornea and maintain a comfort level similar to a soft lens.


The images entering through the KC cornea surface create distortion and blurring


The smooth surface of the RGP contact lens and the tear film layer between the lens and the irregular KC cornea allow a clear image to enter the eye.

(CAST) Computer Assisted Shaped Topography contact lens: These designs are available from some laboratories. Because they are designed from corneal topography, and the keratoconic cornea can have changes in curvature that are too detailed for the corneal map to reveal, this type of design may work when the keratoconus is advanced or the eye has multiple zones which no regular contact lens can fit.

Corneal collagen crosslinking (C3R or UVX) for Keratoconus and weak corneas. Frequently Asked Questions (FAQ's)



Q What is Corneal collagen crosslinking (C3R or UVX)

It is a line of treatment to stabilize a advancing "coning" cornea with progressively thinning, by stiffening it, utilizing a combination of photosensitized Riboflavin eye drops which are applied on the eye followed by carefully gradated amounts of ultra-violet light which in combination, stiffens the cornea.

The UV irradiator is specially designed by IROC Switzerland, with a fixed wavelength. It is applied for a 20- 30 minutes which 'fixes' the Riboflavin dye, effectively stiffening the cornea.

Q How does it work?

This combination procedure, by binding together the fibres of the cornea naturally stiffens the cornea and stops it sagging and in a fair majority even reverses the sagging , thereby improving the vision.

Q How safe is it?

It is very safe. There are no cuts on the surface of the eye, simply surface epithelial cell removal, and that too with the laser, which grows back in 2 days. Lets look at the alternatives. In comparison, it is far, far safer than a corneal graft. The transplant carries risks such as infection, rejection and astigmatism

IROC Swiss, UV irradiation system is CE approved from January 2007 and many hundreds of thousand cases have been done since then.

Q What else is C3R used for?

Post traumatic Keratoconus and in cases of Pellucid Marginal Degeneration, post-surgical ectasia and regression Interestingly it is also used to treat some surface corneal infections (ultra-violet light kills bacteria) and other rarer conditions.

It may also be used to stiffen corneas before corneal transplant surgery so making the surgery easier, and it has been suggested that it could be used as a safety treatment, especially in high myopes with borderline corneal thickness before LASIK so that corneal ectasia (bulging) does not occur afterwards and to correct Radial Keratotomy patients who have over corrected with time and have gone long-sighted.

Q Who is suitable and who is not?

The patient should have a cornea with over 0.400 mm thickness. It can be done on thinner corneas but they need to be pretreated with distilled water. The distilled water application on an abraded cornea will lead to a 0.240 mm corena to swell to 0.400 mm. It is essential that the keratometry readings should be less than 70D, with no severe central scarring. There should be no history of herpes simplex or zoster eye infections or scars, and not pregnant (because of variable healing).

Q Are there any age limits?

No. Keratoconus develops at puberty at the earliest which produces a natural age limit. There is no upper age limit. For treating other eye conditions such as Pellucid Marginal Degeneration, Laser Eye Surgery regression, and prolonging the Effect of Conductive Keratoplasty in the over 40's naturally no age group applies

Q How is it done?

Drops are applied to shrink the pupil to reduce light reaching the back of the eye followed by drops to numb the eye

Using an excimer laser, the surface epithelium is removed, which gives a polished surface. These epithelial cells will grow back in 2 days. A spring keeps the lid open so that the Riboflavin dye can be applied for 15 minutes at 5 minute intervals with

saline to keep the eye wet in between, and the ultra-violet is applied for 30 minutes with the Riboflavin drops still being applied every few minutes. Subsequently, a bandage contact lens is applied for 4 days to reduce discomfort with antibiotic drops to eliminate any risk of infection.

Q What are the possible complications and side effects?

Pain in the first day, with a little irritation for the next 2 days and sensitivity to light for a week are the usual complaints. The application causes a little haze which slightly blurs the vision (some describe it as making the vision a bit 'milky').

Q How am I sure that I am getting the right amount of treatment?

There is only one treatment protocol level at present: 30 mins of 3.0mW/cm2. This was found to be optimal for effect and safety and IROC machines cannot now be adjusted to prevent the risk of errors. All systems use the same protocol.

Q Do we need to do it in both eyes, even if there is no overt keratoconus in the second eye?

At least 90% of people with Keratoconus in one eye will develop it in the other eye and hence in many parts of the world, surgeons now treat both eyes regardless once it has been diagnosed in one eye. This is because the risks are so low and it is much easier to prevent progression than to restore an eye to normal after it has become abnormal.

Q Can it be redone if needed?

Yes, but it is needed only in severe cases and that too if the conus shows in stability or an increase. About 17% of cases may need a second dose. The second dose is given after 6 months and never repeated again. The collagen cells have a very slow turnover rate so no new treatments are required. The age of 40 can be thought of as a rough finishing line. By the natural crosslinking associated with age, should stop further progression.

Q Can I wear contact lenses after treatment if I need?

Yes, that is one of the big advantages. Rigid gas permeable lenses are good for vision in Keratoconus, but can cause central scarring in some cases and are often very uncomfortable to wear. By making a cornea more regular, now a soft contact lens can be used; for example a soft toric one. Though it can be worn a month or so after surgery, but it is best to delay for 2 months as it may possibly affect healing.

Q How soon does the vision fully recover and stabilize

The results are slow and vary a lot in the first few weeks, patients often feel that the vision fluctuates between morning and evening. It is quite normal and gradually stabilizes as the cornea stiffens

Q Are there any limitations in what I can do after surgery?

There are virtually no limitations as there are no cuts. However prudence dictates that you should avoid getting the eye wet for a week afterwards and delay , unless unavoidable wearing a contact lens , for the full day as it may possibly affect healing. The blurring mentioned before may affect some people, especially in the first few days, which may limit work and driving.

Q How many have been done?

More than a hundred thousand treatments have been completed worldwide and by the end of this year, it will be many more as so many doctors are convinced of its benefits.

Q How long ago was the first one done?

The first human eyes were treated in 1998. The very first eyes were blind, so that if anything unexpected occurred there would be no serious damage caused. The Germans and Swiss are very cautious! These have all been carefully followed and none has worsened since. It is now the most frequently carried out treatment for keratoconus worldwide.

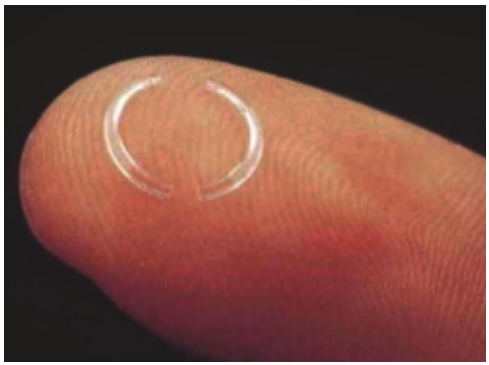
Q Has it been fully approved?

It was fully approved for use in the EU in January 2007 and has now been approved by the FDA in USA.

Q Can both eyes be done at the same time?

Ideally yes. It makes no sense to do it at two separate times. Agreed that the vision is a bit blurred for a few days but that is a very small price to pay for life long good vision. And since it is totally safe, bilateral is the way to go.

Do Intacs have any role to play in Keratoconus management ?



Intacs are specially designed small crescent shaped rings which are designed to be implanted in the substance of the clear cornea of the eye. Intacs is far less an invasive procedure than a corneal transplant or many other surgical procedures of the eye and the Intacs success rate is high.

However, there must be adequate thickness of the cornea for Intacs to work. Unfortunately it is often not the case with keratoconus. Intacs reshape the curvature of the cornea from within, enhancing the natural shape of the eye to correct mild nearsightedness. Because no tissue is removed, natural optics are enhanced and adds to the structural integrity of the cornea.

A curved glide creates a channel in the periphery of the cornea by gently separating the tissue layers. The two tiny plastic segments are placed in the channel much like placing a pencil in between the pages of a book. This causes the cornea to flatten which help to achieve more clear vision. Intacs improve the irregular corneal shape. The placement of Intacs inserts remodel and reinforce your cornea, eliminating some or all of the irregularities caused by keratoconus in order to provide you with improved vision This typically translates into improved vision with less distortions, glare, and streaking of lights. Intacs can be exchanged or removed if needed

How is the procedure done.

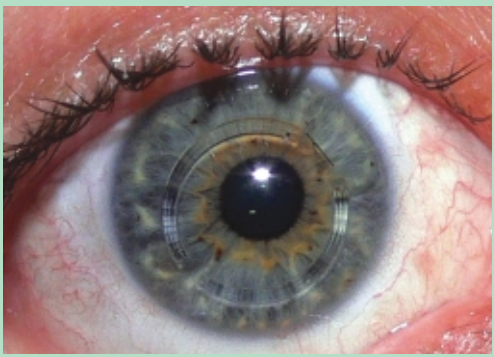
Anesthetic drops are used to numb the eye, which is held open throughout the procedure to prevent blinking.

A single, small incision is made in the surface of the cornea.

A special centering guide is placed on the surface of your eye. During this time, inner layers of the cornea are gently separated in a narrow circular area to allow for Intacs placement. After both the Intacs have been inserted the small opening in the cornea is closed.

Follow-up visits will be required to monitor the healing process and evaluate the visual benefits of the procedure. Even after a successful procedure, glasses or contacts still may be required to provide you with good vision.

As with any surgical procedure, there are some risks, including infection. Some patients experience visual symptoms including difficulty with night vision, glare, halos, blurry and fluctuating vision.



Know Your Surgeon

Prof. Dr. Keiki R. Mehta

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Chief Surgical & Medical Director,
Mehta International Eye Institute.

Dr. Keiki R. Mehta, receiving the Padmashree Award by the President of India, Smt. Pratibha Patil for his exemplary surgical skills and his outstanding contribution to Ophthalmology

- **Prof. Dr. Keiki R. Mehta is India's foremost Consultant Ophthalmic Surgeon, and is The Surgical Chief & Medical Director of The Mehta International Eye Institute**, Colaba, Mumbai, considered to be Asia's most advanced and foremost Ophthalmic Institute, and specializes in **Cataract, LASIK, Glaucoma, Squint, Lazy Eyes, Keratoconus, Retinal surgeries and treatment**. An outstanding researcher and clinician, he has extensive experience of Excimer Laser, PRK and LASIK techniques which **he has done on over 11000 patients over the last 15 years**
- **He has pioneered, in India, the commencement of Intraocular Implants, Phacoemulsification Cataract surgery.**
- **He is the winner of 11 Gold Medals in India, having received virtually all the Honors possible, has been the President of the All India Ophthalmologists Association and President of the Intraocular Implant and Refractive Society** among many others. **Chairman and Organizing Secretary of the very successful Eye Advance Congresses** for the last 12 years 1996- 2008. These have now reached an iconic status and are recognized worldwide
- **The American Implant Society awarded him its Appreciation Award, at San Francisco for pioneering Soft Intraocular implants for the first time in the world. He has received Grand Honors Award from the National Eye Research Foundation, Chicago, USA, the only Indian to be ever awarded. Presented the prestigious Lim International Award from the Asia Pacific Intraocular Implant Association for outstanding work in Ophthalmology in the Asia Pacific Region, the only India to be presented this award. Awarded the Triple Ribbon Award of the American Society for Cataract and Refractive Surgery, USA, for Outstanding Research presentations in Ophthalmology. Presented the Outstanding Recognition Award by International Council of Cataract Surgeons for Outstanding Research & Development in Cataract Surgery, award presented at Barcelona, Spain**
- **He is the only Indian to be elected a Member of the Legion d' Honor of the Instituto Barraquer, Barcelona, Spain**
- **Prof. Dr. Keiki Mehta is the only distinguished Indian Ophthalmic surgeon to be ever invited to Operate Live at Video Cataracta in Milan, Italy, where only the best of the best are invited, at Europe's biggest Live Surgery Conference**
- **Presented advanced research papers on Lasik Internationally and won the Outstanding Presentation Award at San Diego, USA**
- **Prof. Dr. Keiki R. Mehta is considered India's foremost Ophthalmic surgeon, and has conducted Live Surgical workshops in every major city in India, and has trained thousands of doctors in Intraocular implant surgery and Phacoemulsification and Laser refractive surgery including Lasik**
- **He is Honorary Visiting Professor at ONO Eye Hospital in Geneva, Switzerland and St. Luke's Institute, Texas, USA**
- **He is the Consultant Ophthalmic Surgeon to the Governor of Maharashtra, to the Armed Forces, Government of India and to the Maharashtra Police.**

Awarded *PadmaShree* by the President of India in 2008 for his exemplary surgical skills and his outstanding achievements and research in Ophthalmology

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