

# Contact lens options for keratoconus

**COURSE CODE: C-15460 O/D/CL**

**Dr. Narendra Kumar, BAMS, PGCR, Member IACLE**

Keratoconus is a bilateral, usually asymmetrical, non-inflammatory disease of the cornea. It is characterised by progressive corneal thinning and apical protrusion (Figure 1). It presents in early adulthood and visual symptoms result from irregular astigmatism and increasing myopia.<sup>1</sup> Usually, the protrusion affects the axial and inferior nasal cornea. There is decreasing vision associated with the ensuing distortion and glare, and this does not improve in advanced cases with spectacle correction. There are several non-spectacle options available for the correction of keratoconus, from simple contact lenses to surgical approaches, an overview of which is presented in this article.

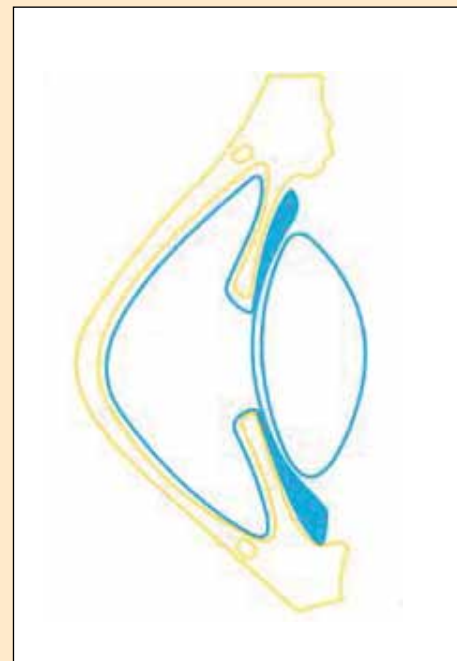
Keratoconus management options for today's practitioners include spectacles, soft contact lenses, rigid gas permeable (RGP) contact lenses, piggyback systems, hybrid contact lenses, INTACS, corneal collagen cross-linking (CXL), keratoplasty, Rose-K lenses, Nissel K2 rigid lenses, Kerasoft IC lenses, and scleral contact lenses. With such a range of options now available, for all severities of the disease, optometric practitioners need to be aware of how best to manage their patients. Indeed, spectacle correction may well provide useful vision in some mild cases of keratoconus, as may soft contact lenses, especially of the thicker lathe-cut variety and toric designs, but advanced cases will require more specialist approaches, some of which can be provided from community optometric practice.

## RGP lenses

The yesteryears' rigid contact lens was a spherical polymethyl methacrylate (PMMA) material, which was usually

fitted flat so that it would stay on the cornea. Due to the flat fit, it wasn't very comfortable for the patient but decidedly better than a soft lens in terms of providing good vision. Today's variation, the availability of RGP<sup>2</sup> as a spherical lens, is a healthier option because of better oxygen transmission to the cornea. Furthermore, technological advances mean that manufacturing of soft and RGP spherical lenses and toric lenses can make use of modern computer numerical controlled (CNC) lathes to produce custom-designed specialty contact lenses, which are a necessity for progressing cases of keratoconus.<sup>3</sup>

RGP fittings are usually done from a trial set or ordering empirically from the "K" readings (keratometer reading) along with the spectacle refraction and back vertex distance (BVD). The total lens diameter (TD) may be around 9.50mm, with the BOZR matching the flattest "K" or being "two thirds of the way towards the flattest K". Since the lens is rigid, having a sharp edge, it



**Figure 1**

Outward bulging cornea in keratoconus

needs to be handled with care so as not to traumatise the cornea at the time of its insertion in the eye. Upon removal, the technique can follow a simple 'pull and blink' method, as used in the days of PMMA lenses, which tends to work well especially with keratoconic corneas.<sup>4</sup>

RGP lenses are available in spherical designs and in an array of different materials with varying Dk values. Whilst considered an excellent modality for the management of mild to moderate keratoconus, they have unfortunately decreased in popularity, with more than 90% of contact lens fittings constituting that of soft lenses, due to their 'easy-fit-and-forget' approach (even by unqualified or under-qualified practitioners in some countries such as India<sup>5</sup>). There are not very many practitioners dealing in RGP contact lens fitting, and they may naturally enjoy the benefit of referrals from those dealing only in soft contact lens fitting.

## Piggyback system

For cases of non-tolerance to RGP

# 1 FREE CET POINT

Approved for: Optometrists ✓ Dispensing opticians ✓ CLPs ✓

Having trouble signing in to take an exam?  
View CET FAQ Go to [www.optometry.co.uk](http://www.optometry.co.uk)



**Figure 2**

Hybrid lens from SynergEyes

contact lenses, it is possible to use a piggyback system whereby a RGP lens is fitted over an underlying soft lens; the latter provides both comfort and stability. A reverse piggyback system may also be thought of in some cases, if it results in better vision. Indeed, in either case, with the availability of super-Dk silicone hydrogel and RGP lens materials, the use of the piggyback system has become better in terms of enhanced oxygen availability to the cornea and reduced risk of complication. For lens care, using a single soft lens care product usually suffices although in the case of reverse piggyback, a specific RGP lens cleaner may be advisable.

Piggybacking a RGP lens over a soft lens can convert an unsuccessful contact lens fit into a successful one, particularly in keratoconus. Choosing a soft lens power of plano to  $-0.75\text{DS}$ , which has a front surface nearly parallel to the back surface, won't dramatically alter the shape to which the base curve of the RGP lens is being fitted. In fact, when commencing the contact lens fit, the RGP lens base curve may be selected based on keratometry values taken over the soft lens worn on the cornea. Sometimes the soft lens power may be manipulated to alter the surface on which to place the RGP lens. For example, a soft lens of power  $-5.00\text{D}$  when fitted over a very steep keratoconic cornea provides a flatter, more stable surface upon which to place the RGP lens. Likewise, a soft

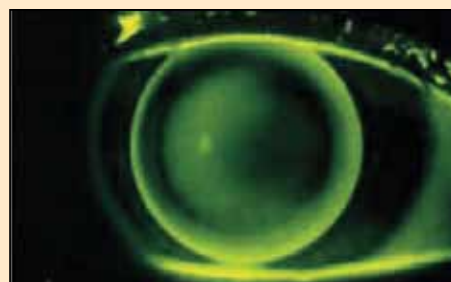
lens of power  $+5.00\text{D}$  will steepen the fitting surface over an extremely flat post-Radial Keratotomy (RK) cornea.<sup>6</sup>

## Hybrid contact lens

Hybrid contact lenses consist of a high-Dk RGP centre and a soft skirt (Figure 2); the former portion provides good vision whilst the latter provides stability and comfort on the eye. The SynergEyes KC lens is a hybrid design that has a RGP centre made of Paragon HDS 100 (Dk 145) material and a skirt made of 27% water hydrophilic material. The diameter of the rigid central portion is 8.4mm and the total diameter of the lens is 14.5mm. The curvature of the posterior portion of the RGP is described as a 'prolate ellipsoid'. The lens tends to remain stable on the eye of a patient with keratoconus, without decentering on horizontal or vertical eye movement, since the soft skirt provides stability by centring the optics of the lens over the pupil.

## Rose-K lenses

The back surface of the Rose-K contact lens for keratoconus is a series of spherical cuts that are well blended; these are produced by software-guided computerised lathe. Fitting is done using a diagnostic set. The first trial lens chosen is 0.2mm steeper than the average "K" reading. A local anaesthetic may be used to reduce tearing for quicker and accurate fluorescein



**Figure 3**

Optimum fit immediately after blink

assessment; a minimal amount of fluorescein should be instilled so as not to disrupt the tear film and also so that it doesn't lead to inaccurate assessment of the pooling patterns.

First of all, central fit is assessed for a light feather touch at the apex of the cone and the rest of the pattern as close to an alignment fit as possible (Figure 3). The peripheral fit is assessed next; the trial lenses have a standard edge lift, but an increased or decreased edge lift on the same base curve can be ordered. Lens diameter is assessed next; the standard diameter is 8.7mm, but smaller diameters of 8.1mm to 8.3mm work well on steeper corneas, and a larger diameter may be required for early cones. Assessment of power is done last by over-refraction with the contact lens in situ.<sup>7</sup>

## Nissel K2 rigid lens

Available in a wide range of base curves, diameters and edge lift options, the Nissel K2 rigid lens (Cantor & Nissel Ltd.) is manufactured from Optimum Extra (Contamac) as standard, with other materials available. The total diameter of the lens is 8.7mm as standard (other diameters being 8.1mm, 8.4mm, 9.0mm, and 9.3mm). All trial lenses are single use, removing concerns about disinfection. Corneal topographers are ideal, but if a keratometer is used then the average of the flattest and steepest "K" readings are calculated, and the first trial lens is selected as having a base curve as close as possible to 0.30mm steeper than the average "K" value. The aim is to obtain good visual acuity (VA) in a lens that is comfortable. The ideal fit exhibits good centration, having minimal clearance or light touch at the area of the cone, combined with good alignment over the cornea, with a band of edge clearance

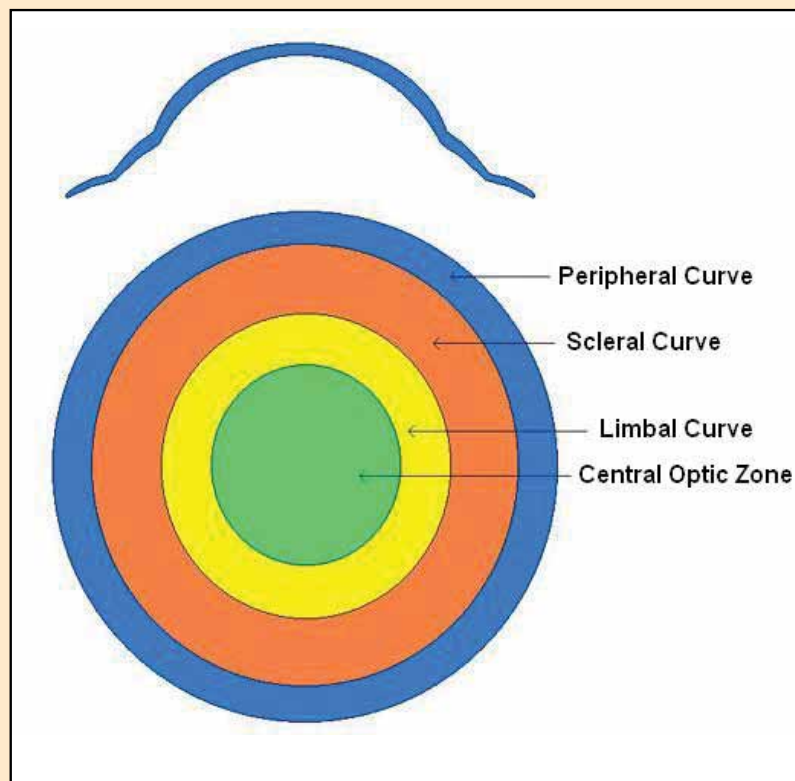
0.50mm to 0.80mm wide.

The fitting sets are supplied with each base curve having a standard value of edge lift; the axial edge lift can be increased or decreased. If the lens is riding high then it is advised that you select a smaller diameter lens, and if the lens is riding low then it is advised that you select a larger diameter lens. Full sphere / cylinder over-refraction should then be conducted to arrive at the correct contact lens power, taking account of BVD corrections.

Although the central cornea in keratoconus can indicate significant corneal toricity, the peripheral cornea is often spherical, and the best VA may usually be achieved with a spherical optic zone.<sup>8</sup>

### Kerasoft IC lenses

The term 'rigid' appears shocking to many would-be contact lens wearers and practitioners alike. Equally, the notion of a 'soft lens for keratoconus' comes as a welcome relief to such persons. The lathe-cut silicone hydrogel or non-silicone hydrogel high-water high Dk Kerasoft IC lens (Ultravision Ltd.) comes in base curves from 7.40mm to 9.40mm, diameters of 14.0mm to 15.5mm, in a front surface asphere or asphere toric prism ballasted form, with periphery options of standard, steep, steep (reverse geometry) and flat. A wide power range is available ( $\pm 30.00$  DS, cylinder  $-0.50$ D to  $-15.00$ D and axis  $1^\circ$  to  $180^\circ$ ) and fitting is done from a trial set of lenses with standard periphery and plano power, with over-refraction conducted. The Kerasoft IC lens offers Sector Management Control (SMC), which allows individual customisation of the lens periphery to enhance fit,



**Figure 4**

Scleral lens cross section

vision and comfort; until now, this was only possible with RGP lenses but can now be achieved with a silicone hydrogel material too. Consequently, the lens provides comfort, stable vision and longer wearing time even in a dry environment.<sup>9</sup>

### Scleral contact lenses

Large diameter (14.0mm to over 20.0mm) RGP lenses that completely cover the cornea and extend onto the sclera are known as scleral lenses. They are supported exclusively by the

sclera (Figure 4). The lenses trap a reservoir of fluid behind them, which protects the cornea, and because of their size they rarely dislocate from the eye. They mask corneal irregularity in keratoconus (and other conditions like keratoplasty and post-refractive surgery), and are particularly useful for patients who need visual correction but are

unable to wear other types of contact lenses.<sup>10</sup> These are so-to-say modern-day transformation (in high-Dk material) of the older-time haptic lenses that were used in 1959. An example of a scleral lens is the Boston lens, a proprietary scleral contact lens now known as PROSE (Prosthetic Replacement of Ocular Surface Ecosystem) since it is used as a prosthesis for conditions of corneal ectasia including keratoconus.<sup>11</sup>

### INTACS

INTACS are thin plastic semi-circular rings that can be inserted into the cornea.



**Figure 5**

Intacs corneal rings



**Figure 6**

Intacs imbedded in the cornea



# 1 FREE CET POINT

Approved for: Optometrists ✓ Dispensing opticians ✓ CLPs ✓

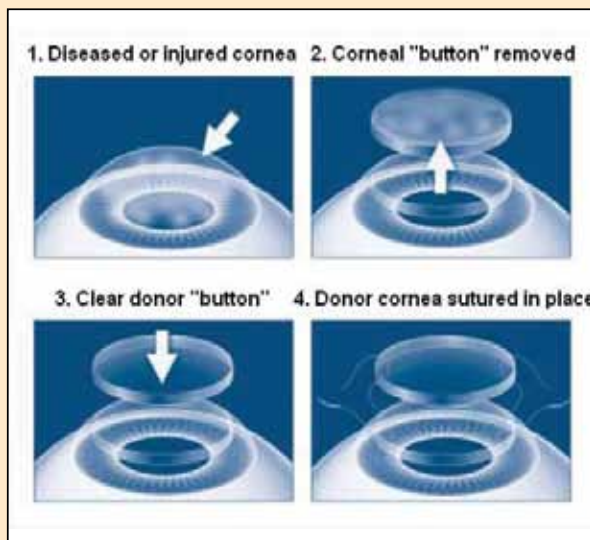
Having trouble signing in to take an exam?  
View CET FAQ Go to [www.optometry.co.uk](http://www.optometry.co.uk)

They were originally used as a form of refractive surgery for the correction of low myopia but are now used for cases of keratoconus (Figures 5 and 6). The surgical procedure using local anaesthetic drops and a clamp to hold the eye still involves the placing of inserts just beneath the surface, in the anterior stroma, in the peripheral cornea. By inserting the semi-circular rings in this manner, INTACS can flatten the cornea, changing the shape and location of the cone and eliminating some of the corneal irregularities in keratoconus. Improvement in vision is certainly notable, but spectacles or contact lenses may still be needed.

INTACS improve contact lens tolerance in patients with keratoconus, as well as improving best-corrected (and uncorrected) VA, whilst also delaying the need for surgical treatment by keratoplasty (see later). The peripheral circumferential corneal elevation above the ring segment inserts creates mechanical barriers when fitting rigid contact lenses, thus reducing RGP lens sensation; however, semi-scleral contact lenses have no corneal bearing at all and can work even better. If soft contact lenses are selected instead, there is no additional problem posed, and if astigmatism has been reduced and/or becomes more regular, makes fitting even simpler.<sup>12</sup>

## Corneal collagen cross-linking

Corneal collagen cross-linking (CXL) results in stiffening of the corneal stroma through photochemical cross-linking of the collagen fibres, resulting in a denser network of bonds and increased stability of the cornea. After epithelium ablation, Riboflavin drops are applied and the cornea is then exposed to ultraviolet (UV) light of wavelength 365nm. The



**Figure 7**  
Keratoplasty steps

procedure is performed under local anaesthesia. After the treatment a bandage contact lens is applied and a steroid-antibiotic combination drop is prescribed. Post-operative contact lens fitting becomes more tolerable and results in stable VA with minimal long-term corneal stress.<sup>13</sup>

## Keratoplasty

Perhaps as a last resort, a corneal transplant is required when the cornea becomes dangerously thin or when VA cannot be improved with contact lenses due to steepening or scarring of the cornea, or due to lens intolerance. During the day-care surgery, the diseased or injured part of the cornea (termed the "button") is removed and replaced with a clear donor tissue "button", and is fixed into place with sutures (Figure 7). A patch and shield are then applied to the eye to protect it until the surface epithelium heals, usually in 1 to 4 days. Post-operative care as per ophthalmologist's recommendation is extremely important, and includes use of steroid drops; proper care and prompt attention to any sign of rejection of the graft will need to be dealt with but

otherwise hopefully the graft remains clear and healthy.<sup>14</sup>

## Summary

New Delhi recently witnessed an excellent educational session on contact lenses for keratoconus and irregular cornea with eminent speakers including Dr. Paul Rose (Rose K lenses), Ken Pullum (Scleral lenses), Lynn White (Kerasoft IC lenses), Jyoti Dave Singh (Piggyback system) and Monica Chaudhry (Lens care solutions). The message that came out loud and clear was that there is a plethora of choices from simple

spherical soft and RGP contact lenses, to specialty contact lens options, that can be utilised by eye care practitioners for the management of keratoconus in order to provide their patients with excellent stable vision and comfort before the need for surgical intervention.

## About the author

Dr. Narendra Kumar holds a Diploma in Optometry (DROpt), degree in Ayurvedic Medicine and Surgery (BAMS), the Certificate in Rehabilitation (PGCR) and is a member of IACLE. Having served as Refractionist at Sir Ganga Ram Hospital for 30 years, he now looks after contact lens cases at his ophthalmologist son's clinic OphthaCare Eye Centre. He has been editing the quarterly journal Optometry Today (India) since 1970, is the chairman of the charitable trust Eye Care India, and the author of 'Ophthalmic Dispensing Optics' and 'Bablu goes for an eye test' books.

## References

See <http://www.optometry.co.uk/clinical/index>. Click on the article title and then download "references"

## Module questions

PLEASE NOTE There is only one correct answer. All CET is now FREE. Enter online. Please complete online by midnight on March 28 2011 - You will be unable to submit exams after this date - answers to the module will be published on [www.optometry.co.uk](http://www.optometry.co.uk). CET points for these exams will be uploaded to Vantage on April 4 2011.

### Course code: C-15687 O/D

**1. Which neurological stream should visual fields assessment primarily assess in AD and PD?**

- a) Parvo-cellular system
- b) Konio-cellular system
- c) Magno-cellular system
- d) None of the above

**2. What is the expected "awareness of practitioner" for a person with accommodative flexibility of 10cm fixating a practitioner at 3 metres?**

- a) Neck
- b) Chest
- c) Waist
- d) Hips

**3. What is the likely postural problem if a person with visual midline shift perceives a fixation rod in front of their right eye when in fact it is in front of their nose?**

- a) They have an upright posture
- b) They have a turn to their left
- c) They have a turn to their right
- d) They are leaning backwards

**4. The Motion Displacement test may prove useful for assessing AD and PD patients as it assesses:**

- a) Magno-cellular function
- b) Motion coherence processing
- c) Parvo-cellular function
- d) Static coherence processing

**5. Which of the following statements about glaucoma in patients with AD or PD is FALSE?**

- a) Patients should have more frequent visual field tests
- b) Patients should be assessed with threshold visual field methods
- c) They have a greater risk of accelerated visual field loss
- d) None of the above

**6. Which of the following statements about AD and PD is FALSE?**

- a) Retinal OCT and photography will be increasingly important in the future
- b) Cataract extraction is contraindicated
- c) Single vision spectacles should be dispensed instead of varifocals
- d) Objective tests may be more appropriate than subjective tests

### Course code: C-15460 O/D/CL

**1. What is the main characteristic feature of keratoconus?**

- a) It is a bilateral condition
- b) It is a non-inflammatory condition
- c) It presents with hypermetropia and irregular astigmatism
- d) There is central infero-nasal corneal protrusion

**2. What is a hybrid contact lens?**

- a) It is a dual material lens with a RGP centre and a soft periphery
- b) It is a dual material lens with a soft centre and a RGP periphery
- c) It is a RGP lens with plasma treatment for enhanced surface wettability and comfort
- d) It is a silicone hydrogel material combined with PMMA

**3. Which of the following is NOT an appropriate management option for keratoconus?**

- a) RGP contact lens
- b) Corneal collagen cross-linking
- c) LASIK
- d) All of the above

**4. What differentiates a corneal contact lens from a scleral contact lens?**

- a) Corneal lenses mask irregularity in keratoconus but scleral lenses do not
- b) Corneal lenses have a reservoir of tear fluid behind the lens but scleral lenses do not
- c) Scleral lenses will display central corneal touch but corneal lenses will not
- d) Scleral lenses are supported wholly by the sclera but corneal lenses are not

**5. After which keratoconic treatment may a contact lens correction still be required?**

- a) Keratoplasty
- b) INTACS
- c) Corneal collagen cross-linking
- d) All of the above

**6. Which of the following is the MOST widely used treatment for moderate cases of keratoconus?**

- a) Keratoplasty
- b) RGP contact lens
- c) Soft contact lens
- d) Corneal collagen cross-linking

I wish my practice could have:

- ✓ interactive, hands-on training
- ✓ professional advice
- ✓ tailored to our needs
- ✓ at my convenience
- ✓ in my practice

You can.  
Speak to your CIBA VISION®  
Business Development Manager.

**Practice ACADEMY**

BRINGING THE ACADEMY  
FOR EYECARE EXCELLENCE™  
TO YOUR PRACTICE.

© CIBA VISION (UK) Ltd, a Novartis company, 2011. CIBA VISION and the CIBA VISION logo are trademarks of Novartis AG.