Clinical Policy Bulletin: Corneal Remodeling

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Policy

I. Post-Cataract Post-Transplant Corneal Surgery

Aetna considers correction of surgically induced astigmatism with a corneal relaxing incision (including limbus corneal wedge resection) medically necessary if the member had previous penetrating keratoplasty (corneal 60 months or cataract surgery within the last 36 months and both of the following criteria are met:

A. The degree of astigmatism must be 3.00 diopters or greater; and
B. The member must be intolerant of glasses or contact lenses.

Note: Correction of surgically induced astigmatism with a corneal relaxing incision (including limbal relaxing wedge resection) is covered even if the member's plan excludes re...

II. Phototherapeutic Keratectomy

Aetna considers phototherapeutic keratectomy (PTK) medically necessary for members with any of the following:

A. Corneal scars and opacities (including post-traumatic, post-infectious, post-surgical, and secondary trauma);
B. Epithelial membrane dystrophy; or
C. Irregular corneal surfaces due to Salzmann's nodular degeneration or keratoconus nodules; or
D. Recurrent corneal erosions when more conservative measures (e.g., lubricants, hypertonic saline, partial-thickness applications, gentle debridement of severely aberrant epithelium) have failed to halt the erosions; or
E. Superficial corneal dystrophy (including granular, lattice, and Reis-Bückler's dystrophy).

Aetna considers PTK experimental and investigational for the treatment of infectious keratitis and all other indications not been shown to be safe and effective for these indications.

Note: Phototherapeutic keratectomy (PTK) should not be confused with photorefractive keratectomy (PRK). The same procedure, PTK is used for the correction of particular corneal diseases, whereas PRK involves use of correction of refractive errors (e.g., myopia, hyperopia, astigmatism, and presbyopia) in persons with other...}

III. Refractive Surgery

Note: Aetna's standard HMO benefit plan excludes coverage of "radial keratotomy, including related procedures to correct refractive errors". Traditional benefit plans generally exclude coverage for services "for or related to..."
correct refractive errors”. These exclusions apply to radial keratotomy (RK), astigmatic keratotomy, PRK, ph (PARK), laser-in-situ keratomileusis (LASIK), keratomileusis, epikeratophakia, implantation of intrastromal c other refractive surgical procedures.

For plans that do not have a specific contractual exclusion of refractive surgery, refractive surgery is conside investigational or not medically necessary, as is outlined below.

For the U.S. Food and Drug Administration (FDA)-approved indications and indications accepted by the Am Ophthalmology (AAO), refractive surgical procedures are considered not medically necessary, because spe have been shown to provide more accurate corrections of refractive errors than refractive surgery.

- **Radial keratotomy (RK)** is not considered medically necessary for the treatment of myopia ranging because this refractive error can be corrected satisfactorily with eyeglasses or contact lenses. Radia investigational for treatment of myopia greater than -8.00 diopters and all other refractive errors beca these indications has not been established.

- **Minimally invasive radial keratotomy (Mini-RK)** is considered experimental and investigational for t and other indications.

- **Astigmatic keratotomy (AK)** (arcuate incision, corneal wedge resection) is considered medically ne for the correction of surgically induced astigmatism following medically indicated cataract removal or surgery. Astigmatic keratotomy is considered investigational for treatment of all other refractive error for these indications has not been established.

- **Hexagonal Keratotomy (HK)** is considered experimental and investigational the treatment of hypero following radial keratotomy because its effectiveness for these indications has not been established.

- **Laser-in-situ keratomileusis (LASIK)** is considered not medically necessary for treatment of myopi diopters, with or without astigmatism up to 5.0 diopters, because this can be corrected satisfactorily lenses. Laser-in-situ keratomileusis is also considered not medically necessary for treatment of hype with or without astigmatism up to 5 diopters. Laser-in-situ keratomileusis is considered investigation greater than -15.0 diopters or hyperopia greater than + 6.0 diopters, for treatment of persons with ast diopters, and for all other refractive errors. This clinical policy is based on the FDA-approved indicati

- **Standard keratomileusis (ALK)** is considered investigational for treatment of all refractive errors be treatment of refractive errors has not been proven.

- **Epikeratoplasty (or epikeratophakia)** is considered medically necessary for the following indication childhood aphakia since contact lenses are difficult for children to use and intraocular lens implants m complications in children; (ii) for the treatment of scarred corneas and corneas affected with endothe treatment of adult aphakia in circumstances where secondary implantation of an intra-ocular lens is n reentering the eye could affect outcome (e.g., vitreous in the anterior chamber, history of uveitis, diso that cannot support an intraocular lens, significant corneal endothelial disease, or gross corneal irreg procedure is considered investigational for correction of refractive errors and for all other cases of ad

- **Keratophakia** is considered investigational for correction of refractive errors because its effectivene refractive errors has not been proven.

- **Lamellar keratoplasty (non-penetrating keratoplasty)** is considered medically necessary for treatm including scarring, edema, thinning, distortion, dystrophies, degenerations, and keratoconus. It is co pterygium and when performed solely to correct astigmatism and other refractive errors because its indications has not been established.
■ Penetrating keratoplasty (PK) (corneal transplantation, perforating keratoplasty) is considered treatment of corneal diseases, including: (i) to improve poor visual acuity caused by an opaque corneal disease, such as persistent severe bacterial, fungal, or amebic inflammation of the cornea (k antibiotic therapy; (ii) to restore altered corneal structure or to prevent loss of the globe that has been compromised by corneal diseases, including bulbar keratopathy, keratoconus, corneal scar with opacity, keratitis, corneal dystrophies, Fuch's dystrophy, corneal degeneration, other corneal dystrophies, corneal edema, and herpes simplex keratopathy is considered investigational when performed solely to correct astigmatism or other refractive errors. Tissue procurement, preservation, storage associated with medically necessary corneal transplantation are also considered medically necessary.

■ Photorefractive keratectomy (PRK) and Photoastigmatic keratectomy (PARK or PRK-A) are considered investigational for individuals with hyperopia of up to 6.0 diopters and myopia of up to -10.0 diopters, with to 4.0 diopters, because the refractive corrections achieved with PRK and PARK are less precise than eyeglasses or contact lenses. Photorefractive keratectomy and PARK are considered investigational for hyperopia greater than 6.0 diopters, myopia greater than -10.0 diopters, astigmatism greater than 4.0 diopters, keratoconus or pellucid marginal degeneration, and for hyperopia greater than 6.0 diopters, myopia greater than -10.0 diopters, astigmatism greater than 4.0 diopters, keratoconus or pellucid marginal degeneration, INTACS are not excluded from coverage under plan descriptions.

■ Intrastromal corneal ring segments (INTACS) (Addition Technology, Sunnyvale, CA) are considered investigational for adults with mild myopia (from -1.0 to -3.0 diopters) that have less than 1 diopter of astigmatism. Intrastromal corneal ring segments experimental and investigational for children, for persons with more than 1 diopter of astigmatism, and for hyperopia greater than -3.0 diopters, myopia greater than -10.0 diopters, astigmatism greater than 4.0 diopters, keratoconus or pellucid marginal degeneration, INTACS are considered ineffective for these indications has not been established. Intrastromal corneal ring segments are considered investigational for keratoconus or pellucid marginal degeneration, INTACS are not excluded from coverage under plan descriptions.

■ Conductive Keratoplasty is considered not medically necessary for the treatment of individuals who have mild-to-moderate hyperopia (0.75 D to 3.25 D), who have 0.75 D or less astigmatism changed very little over the previous 12 months (as demonstrated by a change of less than 0.50 D in keratoplasty is considered experimental and investigational for keratoconus and all other indications for these indications has not been established.

■ Methods of thermokeratoplasty other than conductive keratoplasty (see above), such as the super and Kaufman for keratoconus, holmium:YAG laser thermokeratoplasty (laser thermokeratoplasty or Fyodorov, are considered experimental and investigational for treatment of refractive errors, keratoceratoconus indications because their effectiveness for these indications has not been established.

■ Orthokeratology is considered investigational for correction of refractive errors and all other indications for these indications has not been established.

■ Scleral Expansion Surgery is considered experimental and investigational for presbyopia and all other indications for these indications has not been established.

■ Intraocular lens implants (clear lens extraction) (aphakic intra-ocular lenses (IOLs)) are considered investigational for correction of presbyopia, hyperopia, and myopia because these refractive errors can be corrected with eyeglasses or contact lenses. Intra-ocular lens implants are considered medically necessary for per (see CPB 0508 - Cataract Removal Surgery).
- **Implantable contact lenses (without lens extraction)** (phakic IOLs) (e.g., the Artisan [model 204 a known as the Verisye [e.g., VRSM5US and VRSM6US] phakic IOL, and the Collamer lens [e.g., Visi medically necessary for severe myopia because these refractive errors can be corrected satisfactorily contact lenses. The Artisan (model 204 and 206) phakic IOL is considered not medically necessary elimination of myopia in adults with myopia ranging from -5 to -20 diopters with less than or equal to at the spectacle plane and whose eyes have an anterior chamber depth (acd) greater than or equal t (ii) individuals with documented stability of refraction for the prior 6 months, as demonstrated by sph less than or equal to 0.50 diopters. The Visian ICL is considered not medically necessary for adults 2 correct myopia ranging from -3.0 diopters to less than or equal to -15.0 diopters with less than or equ astigmatism at the spectacle plane; (ii) to reduce myopia ranging from greater than -15.0 diopters to than or equal to 2.5 diopters of astigmatism at the spectacle plane; and (iii) with an anterior chamber greater, and a stable refractive history within 0.5 diopter for 1 year prior to implantation. Phakic IOLs experimental and investigational for all other indications because their effectiveness for indications ot above has not been established.

IV. **Coverage of Corneal Remodeling Surgery to Correct Refractive Errors in Plans that Explicitly Cover Refract**

Note: For members whose policies specifically include coverage for refractive surgery, refractive surgical pro their FDA-approved indications and indications accepted by the AAO, without regard to medical necessity. indications for refractive surgical procedures are listed in section III above). Also, RK (which does not requi covered for indications recognized by the AAO as established -- mild to moderate myopia of -8.00 diopters established indications for RK in section III above). Aetna's payment for these services does not constitute Aetna that those services are medically necessary.

V. **Keratoprosthesis (Artificial Cornea):**

The Boston Keratoprosthesis (Boston KPro) may be considered medically necessary for corneal blindness i following medical necessity criteria:

- A. The cornea is severely opaque and vascularized, with vision less than 20/400 in the affected eye and in the opposite eye; and
- B. The member has had 2 or more prior failed penetrating keratoplasties (corneal transplants), with poo grafting; and
- C. The member does not have end-stage glaucoma or retinal detachment.

Aetna considers the Boston KPro keratoprostheses experimental and investigational for all other indications effectiveness for indactions other than the one listed above has not been established.

Aetna considers the AlphaCor keratoprosthesis experimental and investigational because of insufficient evi

VI. **Endothelial Keratoplasty:**

Aetna considers endothelial keratoplasty (Descemet's stripping endothelial keratoplasty (DSEK), Descemet endothelial keratoplasty (DASERK), and Descemet's membrane endothelial keratoplasty (DLEK) medically ne indications in persons with endothelial failure and otherwise healthy corneas:

- A. Bullous keratopathy;
- B. Corneal edema;
- C. Endothelial corneal dystrophy and other posterior corneal dystropies;
- D. Mechanical complications due to corneal graft or ocular lens prostheses;
- E. Rupture of Descemet's membrane.
Aetna considers endothelial keratoplasty procedures experimental and investigational for conditions with co
disease and anterior corneal disease, including anterior corneal dystrophies, anterior corneal scars from tra
ectatic conditions of the cornea such as keratoconus, pellucid marginal degeneration and ectasia after previ
surgery, and for all other indications (e.g., iris atrophy) because their effectiveness for these indications has

VII. Collagen Cross-Linking for Keratoconus

Aetna considers epithelium-off photochemical collagen cross-linkage using riboflavin and ultraviolet A medi
keratoconus and keratectasia. Photochemical collagen cross-linkage is considered experimental and invest
indications because its effectiveness for other indications has not been established. Epithelium-on (transep
linkage is considered experimental and investigational for keratoconus, keratectasia, and all other indication
photochemical collagen cross-linkage in combination with other procedures (CXL-plus) (e.g., intrastromal c
or phakic intra-ocular lens implantation) is considered experimental and investigational.

Background

Refractive surgical procedures are considered by Aetna to be not medically necessary, because spectacles or con
shown to provide more accurate corrections of refractive errors than refractive surgery. Although the efficacy of re
improving, the accuracy and precision of the refractive corrections achieved is substantially less than that which ca
spectacle correction. In a randomized prospective study of laser in situ keratomileusis (LASIK) and photorefractive
myopia, Hersh et al (1998) reported that 29.4 % of PRK patients and 27.1 % of LASIK patients had refractive corre
attempted correction at six months after surgery. In comparison, over 99 % of patients who are corrected with glas
achieve refractive corrections within 0.5 diopters of normal vision (Waring, 1990).

Although the safety of refractive surgical procedures is improving, these procedures are associated with significant
best corrected visual acuity, as well as glare, induced regular or irregular astigmatism, regression of effect, visual a
transient or permanent glare or starburst/halo effect), and decreased contrast sensitivity. These optical complicatio
discussed in a 1997 American Academy of Ophthalmology (AAO) Preferred Practice Pattern on Refractive Errors
Ophthalmic Procedures Assessment on PRK. According to the AAO Preferred Practice Pattern on Refractive Erro
simplest and safest means of correcting a refractive error”.

Radial keratotomy (RK) involves the use of radial incisions in the cornea to correct mild to moderate myopia. Acco
AAO, radial keratotomy has been shown to be effective for treatment of myopia ranging from -2.00 to -8.00 diopters
not been proven to be effective for treatment of myopia greater than -8.00 diopters or for other refractive errors. T
for radial keratotomy were based on the 1992 AAO Ophthalmic Procedures Assessment of Radial Keratotomy for M
position on RK was reaffirmed in the 1997 AAO Preferred Practice Pattern on Refractive Errors, which restated tha
to moderate myopia”.

Lindstrom (1995) stated that radial keratotomy (RK) is a common surgical technique for correcting myopia. The RK
incisions, permanently weaken the cornea and this structural weakening can cause several complications and side
fluctuation, progressive hyperopic shift, and the potential for traumatic rupture of the keratotomy scars. This resea
technique -- minimally invasive RK (mini-RK) -- that reduces the millimeters of cornea incised and presented prelim
clinical results. In a cadaver eye study, 8 short, deep incisions extending from the 3.0 mm optical zone to the 7.0 m
92 % of the efficacy of full-length incisions to the 11.0 mm optical zone. This finding was confirmed by intra-operat
6 patients in whom a 1 % increase in central corneal flattening was achieved when incisions were extended from th
to full length. In a retrospective evaluation of 100 patients with -1.0 to -6.0 diopters (D) of myopia, 92 % of eyes we
emetropia and 94 % had 20/40 or BCVA. No significant complications were encountered. The author concluded
useful alternative to reduce the invasiveness of RK but retain its efficacy in eyes with low to moderate myopia.
Shoji et al (2003) reported a case of central corneal haze induced by mini-RK after PRK and subsequent deep lamellar keratoplasty. Investigators reported a case (1 eye of 1 patient) of central corneal haze that worsened after mini-RK was performed. Four years later, a second PRK was done, myopic regression was subsequently observed, and corneal haze persisted. Keratoplasty was performed and a corneal graft was taken, which was examined by light and electron microscopy. Irregularity of the basal membrane and hypertrophy of the corneal epithelium were observed. In the stromal layer, disorder in the disposition of keratocytes was observed. Aggregated activated keratocytes were observed. An epithelial plug filling the gap of tissue was present for 6 years after the mini-RK. The RK incision was easily divided when deep lamellar keratoplasty was performed. The authors concluded that it is possible that mini-RK enhancement after PRK induced central corneal haze.

**Astigmatic keratotomy (AK)** (arcuate incision, corneal wedge resection) is a refractive surgical procedure similar to radial keratotomy. Instead of radial incisions, a curvilinear pattern is used to smooth the areas of the cornea that are too steep or too flat. Surgeries have combined RK with AK in patients with myopia with astigmatism. Variations of astigmatic keratotomy include the Ruiz Procedure and the Troutman Wedge Resection. Astigmatic keratotomy may be indicated for the correction of astigmatism following medically indicated cataract removal or corneal transplant surgery. Astigmatic keratotomy has been used to treat other refractive errors. The 1997 American Academy of Ophthalmology Preferred Practice Pattern on Refractive Errors states: "[T]here are no prospective clinical studies available on the procedure to date, performed either individually or in connection with other procedures".

**Laser-in-situ keratomileusis (LASIK)** is a type of laser surgery of the cornea to correct refractive errors, in which a thin, light-reflective flap is created, shaped to the desired curvature with an excimer laser, and then sutured back to the remaining cornea. LASIK is approved by the Food and Drug Administration (FDA) for treatment of myopia between -1.0 and -6.0 diopters, without astigmatism up to 5.0 diopters. Laser-in-situ keratomileusis has also been approved by the FDA for treatment of hyperopia greater than +6.0 diopters with or without astigmatism up to 5 diopters. Laser-in-situ keratomileusis has not been proven to be effective for myopia greater than -15.0 diopters or hyperopia greater than +6.0 diopters, for treatment of persons with astigmatism greater than 6.0 diopters, and for other refractive errors.

**Standard keratomileusis (ALK)** is a variation of LASIK, where the cornea is shaped with a microkeratome rather than with a laser, has not been proven to be effective for treatment of refractive errors. The 1997 American Academy of Ophthalmology Preferred Practice Pattern on Refractive Errors states: "In its current clinical practice, ALK is being replaced by laser in situ keratomileusis".

**Epikeratophakia (or epikeratophakia)** is a refractive surgical procedure that involves placement of a pre-carved donor corneal button on the surface of a patient's eye. Epikeratophakia may be indicated for the treatment of childhood aphakia since contact lenses may be difficult to use and intraocular lens implants may result in long-term complications in children. This procedure may be indicated for the treatment of childhood aphakia, where there are circumstances where reentering the eye could affect outcome (e.g., vitreous history of uveitis, disorganized anterior chamber that cannot support an intraocular lens, significant corneal endothelial irregularity after trauma); in these cases of adult aphakia, epikeratophakia may be considered acceptable. This procedure has been proven to be effective for the correction of refractive errors and for all other cases of adult aphakia. The 1997 American Academy of Ophthalmology Preferred Practice Pattern on Refractive Errors states: "[T]he results have been widely variable, and there have been significant concerns regarding the technique and its potential complications. Keratophakia alone is not recommended for correction of myopic refractive errors, except in very unusual circumstances".

**Keratophakia** involves implantation of a donor cornea within the corneal stroma to modify its refractive power. Keratophakia was not addressed in the 1997 American Academy of Ophthalmology Preferred Practice Pattern on Refractive Errors. However, an August 1992 American Academy of Ophthalmology Preferred Practice Pattern Assessment of keratophakia concluded "handful of reports" in peer-reviewed medical journals regarding keratophakia for correction of refractive errors, and "no additional clinical studies of keratophakia for refractive errors have been published, so the question of its effectiveness remains unanswered."
Lamellar keratoplasty (non-penetrating keratoplasty) is a corneal transplant procedure in which a partial thickness of the cornea and the diseased tissue is replaced with a partial-thickness donor cornea. The donor eye is prepared by making a incision in the cornea and dissecting free the lamellar button. This procedure may be indicated for a number of conditions, including corneal scarring, edema, thinning, distortion, dystrophies, degenerations, and keratoconus. It is not known to be effective for astigmatism and other refractive errors.

Penetrating keratoplasty (PK) (corneal transplantation, perforating keratoplasty) is a corneal transplant procedure in which the full thickness of the cornea with donor cornea, but retaining the peripheral cornea. As with lamellar keratoplasty, it is also used to replace active corneal disease, such as persistent severe bacterial, fungal, or cornea (keratitis) after appropriate antibiotic therapy. Penetrating keratoplasty has also been performed to restore vision to patients who have lost the use of their globe. The most common indications for PK are bullous keratopathy, keratitis, corneal transplant rejection, Fuch's dystrophy, corneal degeneration, other corneal dystrophies and herpes simplex keratitis. Penetrating keratoplasty has not been proven to be effective for correcting astigmatism and other refractive errors.

Photorefractive keratectomy (PRK) is a refractive surgical procedure involving the reshaping of the surface of the cornea using a laser to correct mild-to-moderate myopia. Photorefractive keratectomy (PARK or PRK-A) is a refractive surgical procedure with astigmatism. These procedures have been approved by the FDA for treatment of hyperopia up to 6.0 diopters, with or without astigmatism up to 4.0 diopters. Photorefractive keratectomy and PARK have not been approved for correction of hyperopia greater than 6.0 diopters, myopia greater than -10.0 diopters, astigmatism greater than 4.0 diopters, or other refractive errors. A 1999 AAO Ophthalmic Procedures Assessment on PRK and PARK concluded that it "appears to be the most promising procedure for the treatment of low to moderate degrees of myopia and astigmatism. Results for high degrees of myopia and astigmatism are not as predictable and may require retreatment." Phototherapeutic Keratectomy (PTK) is the same surgical procedure as PRK, but is now used for the treatment of corneal diseases.

Intrastromal corneal ring segments (INTACS) (Addition Technology, Sunnyvale, CA) have been approved by the FDA for the treatment of mild-to-moderate myopia (from -1.0 to -3.0 diopters) that have less than 1 diopter of astigmatism. Intrastromal corneal ring segment be effective in children, and for correction of moderate to severe myopia (greater than -3.0 diopters), for correction of hyperopia (greater than 10.0 diopters), and for correction of astigmatism in persons with keratoconus who are no longer able to use contact lenses or spectacles and for whom corneal transplants are not an option. INTACS involves the use of small rings that are inserted under the surface of the cornea to elevate the edge of the cornea. This effectively flattens the front of the eye, and improves vision. Different size rings are used to correct different amounts of myopia and astigmatism.

INTACS was approved by FDA for use in keratoconus under a Humanitarian Device Exemption (HDE), as that INTACS are a medical device intended to treat a condition that affects fewer than 4,000 individuals per year in the United States. INTACS are approved for the reduction or elimination of myopia or astigmatism in persons with keratoconus, Colin et al (2000) reported a 70 % improvement in uncorrected visual acuity and a 50 % improvement in corrected visual acuity. INTACS was approved by FDA for use in keratoconus under a Humanitarian Device Exemption (HDE), as that INTACS are a medical device intended to treat a condition that affects fewer than 4,000 individuals per year in the United States. INTACS is approved for the reduction or elimination of myopia or astigmatism in persons with keratoconus.
to achieve adequate vision with their contact lenses or spectacles, so that their functional vision may be restored a
transplant procedure may potentially be postponed. According to the FDA, the specific subset of keratoconic patie
with INTACS prescription inserts are those who: (i) have experienced a progressive deterioration in their vision, su
achieve adequate functional vision on a daily basis with their contact lenses or spectacles; (ii) who are 21 years of
clear central corneas; (iv) who have a corneal thickness of 450 microns or greater at the proposed incision site; and
transplantation as the only remaining option to impro

According to guidance from the National Institute for Health and Clinical Excellence (2007), INTACS can also be u
degeneration, a non-inflammatory, peripheral corneal thinning disorder characterized by the erosion of the periphe
cornea.

There is limited evidence for the use of INTACS for corneal ectasia not secondary to keratoconus. A technology as
the evidence for the use of INTACS for corneal ectasias other than primary keratoconus consists of case reports a
2009).

**Conductive Keratoplasty** involves the application of radiofrequency thermal energy to increase the curvature of the
reduce hyperopia. Conductive keratoplasty using the ViewPoint CK System (Refractec Inc., Irvine, CA) has been
treatment of patients who are at least 40 years of age, who have mild to moderate hyperopia (0.75 D to 3.25 D), wh
astigmatism, and whose eyesight has changed very little over the previous 12 months (as demonstrated by a chan
refraction). Conductive keratoplasty has not been proven to be effective for correction of other refractive errors. A
conductive keratoplasty temporarily improves distance vision in far-sighted people. Although some patients may re
correction achieved during surgery, for most people the amount of farsightedness correction is temporary and will
without glasses is improved after conductive keratoplasty, but some people still need glasses or contact lenses. S
farsightedness, CKSM does not eliminate the need for reading glasses. Conductive keratoplasty has not been pro
treatment of keratoconus.

Methods of thermokeratoplasty other than conductive keratoplasty, such as the superficial treatment of Gassett an
keratoconus, holmium:YAG laser thermokeratoplasty (laser thermokeratoplasty or LTK), or the hot needle of Fyodo
to be effective for the treatment of refractive errors or keratoconus. These methods of thermokeratoplasty have be
to the corneal wound healing response produced postoperative scarring and instability (Waring, 1995).

**Orthokeratology** involves the application of sequentially flatter hard contact lenses to flatten the cornea and thereby
error. Orthokeratology has not been proven to be effective for the treatment of refractive errors. The AAO Preferr
Refractive Errors states that "[a]ttempts to predict which patients will respond to orthokeratology based on ocular b
parameters have not been successful. The effects of orthokeratology have been unpredictable and poorly controlle
recommended".

In an ophthalmic technology assessment performed for the AAO, Van Meter et al (2008) reviewed the published lit
safety of overnight orthokeratology (OOK) for the treatment of myopia. Repeated searches of peer-reviewed literat
PubMed and the Cochrane Central Register of Controlled Trials for 2005, 2006, and 2007. The searches yielded
reviewed the abstracts of these articles and selected 79 articles of possible clinical relevance for review. Of these
were determined to be relevant to the assessment objective. No study was rated as having level I evidence. Two
the FDA were rated as having level II evidence. There were 2 studies rated as having level I evidence. The main
adverse events associated with OOK was 38 case reports or non-comparative case series (level III evidence). The
the prevalence and incidence of complications associated with OOK have not been determined. Complications, in
cases of infectious keratitis resulting from gram-positive and gram-negative bacteria and Acanthamoeba, have bee
and case series representing observations in undefined populations of OOK users. Data collection was non-stand
various complications can not be determined. Because OOK puts patients at risk for vision-threatening complicatio
otherwise, sufficiently large well-designed cohort or randomized controlled studies are needed to provide a more r
treatment and to identify risk factors for complications. These investigators also stated that OOK for slowing the
children also needs well-designed and properly conducted controlled trials to examine its effectiveness. Because
orthokeratology practice, a wide margin of safety should be built into OOK regimens.
Scleral Expansion Surgery has not been proven to be effective for treatment of presbyopia. Scleral expansion surgery incisions in the eye and inserting bands to stretch the part of the sclera that lies beneath the ciliary muscles that co (NICE, 2004). This procedure is claimed to improve accommodation. An assessment of scleral expansion surgery for Clinical Excellence (2004) recommended that "this procedure should not be used". Based on an assessment of evidence, the assessment concluded that "[current evidence on the safety and efficacy of scleral expansion surgery limited" and that "[a]ll studies identified were of poor quality". The assessment explained that "[t]here is no evidence of patients" and that "[t]here are also concerns about the potential risks of the procedure".

Glasser (2008) noted that a variety of surgical procedures has been considered for restoring accommodation to the surgical expansion of the sclera, using femtosecond lasers to treat the lens or with so-called accommodative IOLs. Evidence suggests that scleral expansion can not and does not restore accommodation.

Intraocular lens implants (clear lens extraction) (aphakic intraocular lenses (IOLs)) have been approved by the FDA for presbyopia, hyperopia, and myopia. Clear lens extraction is similar to cataract removal surgery in that the natural lens is replaced with an intra-ocular lens.

Implantable contact lenses (without lens extraction) (phakic IOLs) (e.g., the Artisan [model 204 and 206] phakic IO Verisy [e.g., VRSM5US and VRSM6US] phakic IOL, and the Collamer lens [e.g., Visian ICL]). Phakic IOLs are near-sightedness. These thin lenses are implanted permanently into the eye to help reduce the need for glasses or contact lenses. They refer to the fact that the lens is implanted into the eye without removing the eye's natural lens. During phakic lens surgery small incision is made in the front of the eye. The phakic lens is inserted through the incision and placed just in front of the natural lens. The Artisan (model 204 and 206) phakic IOL is indicated for: (i) the reduction or elimination of myopia in adults with -20 diopters with less than or equal to 2.5 diopters of astigmatism at the spectacle plane and whose eyes have an (acd) greater than or equal to 3.2 millimeters; and, (ii) individuals with documented stability of refraction for the prior demonstrated by spherical equivalent change of less than or equal to 0.50 diopters. The Visian ICL is indicated for age to (i) correct myopia ranging from -3.0 diopters to less than or equal to -15.0 diopters with less than or equal to 2.5 diopters of astigmatism at the spectacle plane; (ii) to reduce myopia ranging from greater than -15.0 diopters to -20.0 diopters 2.5 diopters of astigmatism at the spectacle plane; and (iii) with an anterior chamber depth (acd) 3.00 mm or great history within 0.5 diopter for 1 year prior to implantation. Implantable contact lenses have not been proven to be effective.

Keratoprostheses have not been proven to be as effective as penetrating keratoplasty using corneal graft tissue. Keratoprostheses undergo the standard penetrating keratoplasty using donor tissue for several reasons (e.g., disease severity, severe conjunctiva, objection to the use of donor tissue, failed past donor tissue transplants, or when measures required to medically contraindicated). For these individuals, penetrating keratoplasty using a keratoprosthesis has been employed. The Alberta Heritage Foundation for Medical Research (AHFMR, 2001) noted that there is inadequate evidence to effectiveness of any keratoprosthesis model, and as keratoprosthesis models keep evolving, these new versions human trials with sufficient follow-up and patient numbers. The AHFMR further stated that "currently there is no optimal device and implantation techniques, and no accepted standard for this procedure. In general, keratoprosthesis complicated, has a narrow safety margin, and requires intensive follow-up, thus a conservative approach is current eye specialists in this area". Alio and colleagues (2004) reported that corneal keratoprosthesis (BIOKOP I, II) did not have an anatomical relation with the surrounding ocular structures. Its ability to restore vision is limited to a short post-oper implanted with severe ocular surface disease. The National Institute of Clinical Excellence (NICE, 2004) stated that safety and efficacy of insertion of hydrogel keratoprosthesis does not appear adequate for this procedure to be used arrangements for consent and for audit or research.

There is evidence of the effectiveness of the Boston Keratoprosthesis (K-pro), also known as the Dohlman Doane with prior failed grafts or as a primary procedure for patients with ocular surface diseases or other conditions that failed penetrating keratoplasty. The success rate for K-pro is lower than it is for a low-risk first penetrating keratoplasty risk diagnoses. But, compared to historical controls, the K-Pro success rate may be higher than for repeat penetrating patients with prior graft failure and other high-risk diagnoses.
Tan et al (2008) established a multi-disciplinary surgical program for osteo-odontokeratoprosthesis (OOKP) surgery for end-stage corneal and ocular surface disease. A total of 16 bilateral blind patients, with end-stage corneal blindness from Stevens-Johnson syndrome, or severe chemical or thermal injury, were included in this study. Osteo-odontokeratoprosthesis surgery involves two procedures—stage 1, an autologous canine tooth is received and implanted into the cheek. The ocular surface is denuded thickness buccal mucosa. Stage 2 surgery, performed 2 to 4 months later, involved retrieval of the tooth-cylinder complex into the cornea, after reflection of the buccal mucosal flap, corneal trephination, iris and lens removal, as well as an extracapsular cataract extraction. Concurrent glaucoma and vitreoretinal procedures were also performed at this stage, as required. Main outcome measures included examination of visual acuity (VA), field of vision, anatomical integrity and stability, as well as ocular and oral complications related or unrelated to the keratoprosthesis device. Osteo-odontokeratoprosthesis surgery was performed on 15 patients, with a mean follow-up of 19.1 months. Operative complications included expulsive hemorrhage (keratoprosthesis device not implanted), tooth fracture (1), and mild inferior optic tilt (n = 1). Anatomical stability and keratoprosthesis retention has been maintained in all cases. Extrusion, retro-prosthetic membrane formation, or keratoprosthesis-related infection. Other complications not dire insertion included retinal detachment (RD) related to silicone oil removal (n = 1) and endophthalmitis related to end cyclonephacoemulsification performed 1 year after OOKP surgery (n = 1). Eleven patients (73.3 %) attained a stable best corrected visual acuity of at least 20/40 or better, whereas 9 (60 %) attained stable 20/20 vision. Four patients achieved their best corrected visual acuity of 20/100 to counting fingers vision, related to pre-existing glaucomatous optic neuropathy or previous RD. The authors concluded that OOKP surgery has the potential to restore good vision to the corneal blind in an Asian setting, with minimal device-related complications. They stated that longer follow-up will be required to confirm the findings.

In a review on "Corneal transplantation", Tran and colleagues (2012) noted that in cases of multiple failed corneal transplants, artificial corneas (keratoprostheses) have been proposed as an alternative. Keratoprostheses have been described such as the OOKP, the AlphaCor, and the Boston keratoprosthesis. The AlphaCor keratoprosthesis offers a potentially low incidence of complications. The Boston type 1 keratoprosthesis (both aphakic and pseudophakic versions) is the most commonly used in clinical practice.

Descemet's stripping automated endothelial keratoplasty (DSAEK) is being investigated as a treatment for corneal endothelial keratopathy. The procedure employs a mechanical microkeratome to harvest the donor corneal lenticule and mechanical stripping of Descemet's membrane. It has been used to treat corneal dysfunction associated with Fuchs' endothelial dystrophy, irido-corneal endothelial syndrome or a failed penetrating graft. Koenig and Covert (2007) reported the results of 26 cases. They found that despite a smooth graft-host interface, only 2 subjects achieved greater than or equal to 20/20 visual results were comparable to vision after deep lamellar endothelial keratoplasty. Although patients experience decreased visual acuity with minimally induced surgical astigmatism, nearly 1/3 of the donor lenticules needed to be either re-positioned or discarded.

In a prospective study (n = 9), Mearza and colleagues (2007) reported their clinical experience and 12-month findings. They concluded that DSAEK provided excellent refractive and reasonable visual outcomes in this limited series, but there was dislocation of the donor tissue, and the graft failure rate was high. The graft failures may be linked to excessive high dislocation rate may be linked to not filling the anterior chamber totally with air after insertion of the donor. Development of the procedure is needed. Additionally, Price and Price (2007) noted that continued evolution of this procedure will aid in reducing complications and further improve outcomes.

In a retrospective observational case series, Oster et al (2009) characterized the clinical and histological features of DSAEK. A total of 16 cases of DSAEK graft failure from 15 patients, all with detailed histological examination of failed grafts included in this study. Hematoxylin-eosin, periodic acid-Schiff staining, and light microscopy were used to examine tissue from all patients. Main outcome measures included examination of specimens for corneal endothelial cell viability and interface characteristics. Clinical history revealed that 88 % (14/16) of studied DSAEK grafts detached before failure examination found that 75 % (12/16) of failed grafts had atrophic corneal endothelium. Examples of residual host DSAEK graft site and improper donor trephination were also identified. The authors concluded that marked loss of the prominent feature of primary DSAEK graft failure. Examples of surgical features, such as incomplete Descemet's membrane, were shown.
In a position paper, the American Academy of Ophthalmology (Lee et al, 2009) explains that endothelial keratoplasty, an alternative to penetrating keratoplasty to replace diseased endothelium with healthy donor tissue, without the need for a cornea. Introduced in 1988, deep lamellar endothelial keratoplasty (DLEK), which involves the creation of a deep lamellar interface for posterior stroma removal with a lamellar transplant, allowed more rapid visual rehabilitation and a smaller incision compared to penetrating keratoplasty, but it was difficult to learn and time consuming. Descemet’s stripping endothelial keratoplasty (DSEK) and Descemet’s stripping automated endothelial keratoplasty (DSEK+AEK) was introduced in 2006; these procedures involve removal of Descemet’s membrane and endothelium and replacement with donor tissue comprised of Descemet’s membrane and endothelium alone, the technique is known as Descemet’s membrane endothelial keratoplasty (DMEK). The AAO position paper states that endothelial keratoplasty procedures are associated with a smaller incision, less visual rehabilitation than penetrating keratoplasty. The position paper states that there remain concerns about potential long-term efficacy of endothelial keratoplasty, including concerns about graft dislocations, endothelial cell loss, and failure. The paper cites the conclusions of an AAO Technology Assessment, which acknowledge the relatively short-term follow-up of endothelial keratoplasty compared with penetrating keratoplasty, and states “there is no evidence that DSAEK carries unacceptable risks for surgical treatment of corneal disease. In comparison to PK, DSAEK appears at least equivalent in terms of safety, efficacy, surgical risk, and superior to PK in terms of refractive stability, postoperative refractive outcomes, wound and suture-related complications of best spectacle corrected visual acuity.

Collagen crosslinking is being investigated as a treatment for keratoconus. Animal studies have shown a significant biomechanical stiffness after collagen crosslinking by combined riboflavin/ultraviolet-A (UVA) treatment. Riboflavin crosslinking has been studied, primarily in Europe, as a method for bringing the progression of keratoconus to a halt, and the current literature is from small, uncontrolled studies with limited follow-up.

In epithelium-off collagen crosslinking (CXL), the epithelium is first abraded with a blunt spatula to allow penetration of the corneal tissue (NICE, 2013). Riboflavin eye drops are applied to the corneal surface before the procedure and intraocular pressure is monitored. The corneal surface is exposed to UVA radiation. Postoperatively, topical antibiotics and antiinflammatory agents are prescribed, with topical steroids if necessary. In some cases, a bandage contact lens may also be used for a few days on one eye at a time and may also be repeated if needed.

In epithelium-on (transepithelial) CXL, the corneal epithelial surface is left intact (or may be partially disrupted) and no epithelial ablation is required (NICE, 2013). Sometimes the procedure is used in combination with other interventions such as Intacs ring segments, photorefractive keratectomy (PRK) or phakic intraocular lens implantation to improve visual acuity. Procedures are referred to as ‘CXL-plus’.

The mechanism of action of the CXL procedures is not fully understood: they may increase the number of ‘anchors’ to strengthen the cornea (NICE, 2013). This is expected to stop the progression of the disease but the duration of this effect is uncertain.

Interim results of a randomized controlled trial of collagen cross-linking with riboflavin and ultraviolet A (UVA) irradiation (Wittig-Silva et al, 2008), reporting an apparent stabilization of refractive results. However, enrollment in the study has been short. Subjects with documented progression of keratoconus were separately randomized into groups. Collagen crosslinking was performed using riboflavin and UVA. At the time of publication, 66 eyes of 49 patients were randomized. Interim analysis of treated eyes showed a flattening of the steepest simulated keratometry value of 0.74 diopters (D) (p = 0.004) at 3 months, 0.92 D (p = 0.002) at 6 months, and 1.45 D (p = 0.002) at 12 months. That a non-significant trend toward improvement in best spectacle-corrected visual acuity was also observed. In the max steepened by 0.60 D (p = 0.041) after 3 months, by 0.60 D (p = 0.013) after 6 months, and by 1.28 D (p < 0.0
investigators reported that best spectacle-corrected visual acuity decreased by logMAR 0.003 (p = 0.883) over 3 m over 6 months, and 0.12 (p = 0.036) over 12 months. The investigators stated that no statistically significant change in spherical equivalent or endothelial cell density.

Coskunseven et al (2009) evaluated the progression of keratoconus in patients treated with collagen cross-linking with ultraviolet A (UVA) irradiation. A total of 38 eyes of 19 patients with progressive keratoconus were enrolled in a prospective study. Average follow-up was 9 +/- 2 months (range of 5 to 12 months). The worse eye was treated with collagen fellow eye served as the control. Corneal epithelium was mechanically removed. Riboflavin 0.1% solution in dextrose was applied every 2 to 3 minutes for 30 minutes throughout the irradiation. Ultraviolet A irradiation (370 nm) was performed with commercially available UVA lamp for 30 minutes. The group treated with collagen cross-linking demonstrated a decrease in spherical equivalent refraction and cylinder of 1.03 +/- 2.22 diopters (D) (range of -5.25 to +3.75 D) and 1.04 +/- 4.00 D, respectively (p < 0.01), and an increase in uncorrected visual acuity (UCVA) and best spectacle-corrected visual acuity (BSCVA) of 0.06 +/- 0.05 (range of 0.00 to 0.20) and 0.10 +/- 0.14 (range of -0.10 to 0.34), respectively (p < 0.01). The maxima of spherical equivalent refraction and cylinder were 1.57 +/- 1.14 D at follow-up. Intraocular pressure increased by 2 +/- 2 mmHg (range of -1 to 6 mmHg) at the end of the study, which was statistically significant. No statistical difference was noted regarding central corneal thickness (p = 0.06) and endothelial cell density.

The untreated group showed no statistical difference for any of the clinical parameters, apart from UCVA and BSCVA, which improved by 0.08 +/- 0.12 (range of -0.40 to 0.10) and 0.06 +/- 0.09 (range of -0.20 to 0.10), respectively (p < 0.01). The authors concluded that riboflavin/UVA collagen cross-linking appears to be efficacious in inhibiting the progression of keratoconus by reducing spherical equivalent refraction, and refractive cylinder in eyes with progressive keratoconus at average 9-month follow-up.

Grewal et al (2009) assessed changes in corneal curvature, corneal elevation, central corneal thickness, lens density, and corneal collagen crosslinking with riboflavin and UVA light in eyes with progressive keratoconus. Subjective refraction (BCVA), Scheimpflug imaging, and optical coherence tomography were performed preoperatively and 1 year after crosslinking. There were no significant differences (p > 0.05) in mean values between pre-operatively and post-operatively, respectively, in BCVA (0.22 +/- 0.10 and 0.20 +/- 0.10), spherical equivalent (-6.30 +/- 4.50 diopters (D) and -6.34 +/- 3.68 D), respectively (p < 0.01), and anterior corneal curvature (50.6 +/- 7.4 D and 51.5 +/- 3.6 D), posterior corneal curvature (-7.7 +/- 1.2 D and -7.3 +/- 1.5 D), anterior corneal thickness (458.9 +/- 40 microm), anterior corneal curvature (50.6 +/- 7.4 D and 51.5 +/- 3.6 D), posterior corneal curvature (-7.7 +/- 1.2 D and -7.3 +/- 1.5 D), anterior corneal thickness (458.9 +/- 40 microm), and foveal thickness (175.7 +/- 35.6 microm; p = 0.1). The authors concluded that stable BCVA, spherical equivalent, anterior and posterior corneal curvature, and foveal thickness were not affected after UVA exposure during crosslinking.

Caporossi et al (2010) reported the long-term results of 44 keratoconic eyes treated by combined riboflavin ultraviolet A light in the first Italian open, non-randomized phase II clinical trial, the Siena Eye Cross Study. After Siena University Institutional Review Board approval, from September 2004 through September 2008, 363 eyes with progressive keratoconus were treated with collagen cross-linking. Forty-four eyes with a minimum follow-up of 48 months (mean of 52.4 months; range of 48 to 60 months) were evaluated before and after surgery. Examinations comprised uncorrected visual acuity, best spectacle-corrected visual acuity, endothelial cell density, anterior corneal curvature, posterior corneal curvature, central corneal thickness, anterior corneal thickness, lens density, and foveal thickness. The authors concluded that keratoconus did not progress. Unchanged lens density and foveal thickness were not affected after UVA exposure during crosslinking.
In a prospective, randomized-controlled clinical trial, Greenstein et al (2011) evaluated changes in corneal topography after collagen crosslinking (CXL) in patients with keratoconus and corneal ectasia and analyze associations of these changes with visual acuity. Corneal collagen crosslinking was performed in eyes with keratoconus or ectasia. Quantitative descriptors of corneal topography were measured with the Pentacam topographer and included 7 indices: (i) index of surface variance, (ii) index of vertical keratoconus index, (iv) central keratoconus index, (v) minimum radius of curvature, (vi) index of height asymmetry, and (vii) index of vertical asymmetry. Follow-up was 1 year. The study comprised 71 eyes, 49 with keratoconus and 22 with post-LASIK ectasia. In the patient cohort, there were significant improvements in the index of surface variance, index of vertical asymmetry, k minimum radius of curvature at 1 year compared with baseline (all p < 0.001). There were no significant differences between keratoconus and ectasia subgroups. Improvements in post-operative indices were not correlated with changes in corrected or uncorrected visual acuity. The authors concluded that there were improvements in 4 of 7 topography indices 1 year after CXL, suggesting improvement in corneal shape. However, no significant correlation was found between the changes in individual topography indices and changes in visual acuity after CXL.

In a randomized, prospective, and comparative study, Henriquez et al (2011) evaluated the safety and effectiveness of CXL for the treatment of keratoconus. This study involved 10 eyes with keratoconus diagnosed between September and December 2010. Each patient underwent CXL in the keratoconus eye. Pre-operative and post-operative (at 1, 3, 6, and 12 months) examinations, distance uncorrected and best-corrected visual acuities, refractive error, endothelial cell counts, keratometry readings, macular thickness, and Scheimpflug analyses were performed and compared. Mean uncorrected visual acuity improved from 1.18 logarithm of the minimum angle of resolution pre-operatively to 0.46 logarithm of the minimum angle of resolution post-operatively (p < 0.001). Statistically significant reductions in the mean maximum keratometry values were present at 12 months post-operatively, in addition there was a 2.25 D reduction in the k minimum radius of curvature (p = 0.01). At the end of follow-up, 8 (80%) and 6 (60%) of the 10 eyes showed a decrease in the anterior and posterior surfaces, respectively, and the thinnest point of the cornea was statistically thinner by a mean of 13.4 μm (p = 0.03). No statistically significant differences were found between pre-operative and post-operative endothelial cell counts and macular thicknesses. The CXL procedure is a safe treatment for keratoconus, yields good visual results, and reduces the progression of the disease.

Letko et al (2011) noted that "despite the lack of large multicenter prospective randomized trials, CXL has gradually become the first line treatment for keratoconus and related corneal conditions. Although available data suggest that CXL is effective, further improvements in CXL are necessary. Other improvements are development of protocols that do not require epithelial removal, which will likely have significant effects on keratitis and stromal scarring, and increase in patient comfort. Delivery of riboflavin into the cornea through a femtosecond laser-created pocket could become an alternative to currently widely accepted administration methods. Further development of topical medications capable of inducing collagen crosslinking is necessary. topographical evaluation is necessary. The guidance noted that either epithelium-off or epithelium-on CXL is also limited.

Guidance from the National Institute for Health and Clinical Excellence (NICE, 2013) concluded that there is adequate and efficacy of epithelium-off CXL using riboflavin and ultraviolet A for keratoconus and keratoprostheses. NICE found the evidence base for these combination procedures (known as 'CXL-plus') is also limited.
and nonrandomized studies included in the assessment concluded that there was improvement or stability of kera
treatment with CXL.

Lamellar keratectomy is a surgical procedure used to correct high degrees of myopia, and low-to-moderate amoun
tack of evidence regarding the effectiveness of lamellar keratectomy for the treatment of epithelial ingrowth followin

In a retrospective study, Rojas et al (2004) evaluated the safety and effectiveness of mechanical debridement and in
the treatment of clinically significant epithelial ingrowth after LASIK. A total of 20 eyes (n = 19 patients) in which
epithelial ingrowth developed after LASIK were treated with lifting of the flap, scraping of the epithelial ingrowth, an
outcome measurements including recurrence of ingrowth, uncorrected VA, manifest refraction, best spectacle-corre
complications were evaluated at the last post-operative examination. At the last post-operative examination (mean
months; range of 1.5 to 64 months), 100 % of eyes had no recurrence of clinically significant epithelial ingrowth. T
changed from 20/20 or better in 7 eyes (35 %) and 20/40 or better in 15 eyes (75 %) pre-operatively to 20/20 or be
20/40 or better in 16 eyes (80 %) at the last follow-up examination. There was no significant change in the mean l
angle of resolution (logMAR) uncorrected VA before (mean +/- SD, 0.3 +/- 0.5; range of -0.1 to 1.7) and after surge
0.4; range of -0.1 to 1.7) (p = 0.40). Mean +/- SD spherical equivalent changed from -0.21 +/- 0.82 diopters (D) (ra
operatively to -0.53 +/- 0.89 D (range of -2.50 to 0.38 D) at last follow-up (p = 0.30). No eyes lost 2 or more lines o
VA, and there were no complications associated with the treatment. The authors concluded that suturing the LASI
mechanical debridement of epithelial ingrowth is a safe and effective treatment for clinically significant epithelial in

Kymionis et al (2009) reported a patient with severe post-LASIK epithelial ingrowth and keratolysis treated with flap
therapeutic keratectomy (PTK) with adjuvant intra-operative mitomycin C (MMC). A 55-year-old woman was refer
department due to severe post-LASIK epithelial ingrowth with corneal melting 2 years after primary LASIK. The pa
attempts for epithelial ingrowth treatment (flap lift and epithelial ingrowth manual removal) that were unsuccessful.
and anterior segment optical coherence tomography showed extensive epithelial ingrowth and keratolysis (thinning
the patient had photophobia and could not tolerate contact lenses. Flap amputation with subsequent PTK (in order
irregularities caused by the keratolysis and/or variations in flap thickness) and adjuvant intra-operative MMC appli
performed. There were no intra- or post-operative adverse events seen during the follow-up period. Six months af
uncorrected VA improved to 20/40 compared with 20/50 pre-operatively, while best spectacle-corrected VA improv
The topographical astigmatism was decreased from 3.24 diopters (D) to 1.00 D. The authors concluded that flap a
adjuvant intra-operative MMC is an option for the management of severe post-LASIK epithelial ingrowth with kerat

Rapuano (2010) reviewed the management of epithelial ingrowth after LASIK. Data of all patients referred to the W
after having undergone LASIK were reviewed. Charts of all patients with the diagnosis of epithelial ingrowth were
patient demographics, previous ocular history, visual acuity, size and location of the ingrowth, and management. A
underwent removal of the ingrowth at Wills were obtained. A total of 305 patients (153 females and 152 males, m
referred for eye problems after LASIK during the study period. Epithelial ingrowth was confirmed in 46 patients (15
males, mean age of 47.4 years) involving 55 eyes (27 right and 28 left). Patients with epithelial ingrowth were see
after LASIK (range of 0.5 to 108 months). Twenty-four eyes had undergone previous enhancements, 2 twice. Fou
previous removal of epithelial ingrowth, 8 more than once (range of 2 to 8). In 35 eyes, simple observation was re
epithelial removal was recommended to the referring physician. Thirteen eyes underwent flap lift and epithelial rem
included flap suturing. One eye required repeat treatment with flap suturing and fibrin glue, after which no recurre
12 eyes, there was no recurrence in 9, small recurrences in 2, and a large recurrence in 1 eye (mean follow-up of 1
concluded that epithelial ingrowth after LASIK is not rare in the authors' referral practice. Mild ingrowth can be obs
ingrowth can respond well to removal with a low chance of significant recurrence.

Elderkin et al (2011) reported the successful treatment of 2 patients who developed flap necrosis preceded by recu
and interface fluid syndrome after LASIK. Patient 1 was treated with epithelial debridement and flap suturing; whil
treated with epithelial debridement and flap suturing, but developed recurrent epithelial ingrowth in the right eye an
eye. Patient 1 developed diffuse interface fluid accumulation in the left eye after epithelial debridement and flap su
timolol meleate 0.5 % solution and methazolamide. The interface fluid resolved and the cornea and flap became c
identified a small area of epithelial ingrowth recurrence, which has remained stable for 3 years. Patient 2 was succ
epithelial debridement followed by fibrin tissue adhesive application. Five months after debridement and fibrin tissue adhesive application, epithelial ingrowth or interface fluid accumulation was noted. The authors concluded that epithelial ingrowth and may be associated with secondary flap necrosis following LASIK, which can be effectively treated with debridement tissue adhesive application.

*Hexagonal keratotomy* employs a computer-assisted microkeratome to reshape the cornea. It works similarly to a hexagonal pattern of cuts versus the radial cuts seen in RK. Hexagonal keratotomy has been used for the treatment of corneal ectasia (Werblin, 1996; Mehta et al, 2012). Hexagonal keratotomy is now rarely used since newer techniques have been developed.

CPT Codes / HCPCS Codes / ICD-9 Codes

**Post-Cataract Post-Transplant Corneal Surgery:**

CPT codes covered if selection criteria are met:

- 65772  Corneal relaxing incision for correction of surgically induced astigmatism
- 65775  Corneal wedge resection for correction of surgically induced astigmatism

Other CPT codes related to the CPB:

- 65750 - 65755  Keratoplasty (corneal transplant); penetrating (in aphakia or pseudoaphakia)
- 65770  Keratoprosthesis

Other HCPCS codes related to the CPB:

- V2100 - V2499  Spectacle lenses
- V2500 - V2599  Contact lens

ICD-9 codes covered if selection criteria are met:

- 367.20 - 367.22  Astigmatism
- 996.51  Mechanical complication due to corneal graft
- V42.5  Cornea replaced by transplant
- V45.61  Cataract extraction status

Other ICD-9 codes related to the CPB:

- 366.00 - 366.9  Cataract
- 379.31  Aphakia
- 743.30 - 743.39  Congenital cataract and lens anomalies
- V43.1  Lens replaced by other means
Phototherapeutic Keratectomy:

Other CPT codes related to the CPB:

65760 Keratomileusis

HCPCS codes covered if selection criteria are met:

S0812 Phototherapeutic keratectomy (PTK)

ICD-9 codes covered if selection criteria are met:

139.1 Late effects of trachoma
264.6 Vitamin A deficiency with xerophthalmic scars of cornea
371.00 - 371.05 Corneal scars and opacities
371.42 Recurrent erosion of cornea
371.46 Nodular degeneration of cornea
371.50 - 371.54 Hereditary corneal dystrophies
371.60 - 371.62 Keratoconus
371.82 Corneal disorder due to contact lens
743.41 Anomalies of corneal size and shape
743.42 Corneal opacities, interfering with vision, congenital
743.43 Other corneal opacities, congenital
918.1 Superficial injury of cornea
921.3 Contusion of eyeball
V10.84 Personal history of malignant neoplasm of eye

ICD-9 codes not covered for indications listed in the CPB:

017.3 Tuberculosis of eye
030.0 Lepromatous [type L]
053.21 Herpes zoster keratoconjunctivitis
054.42 Dendritic keratitis
054.43 Herpes simplex disciform keratitis
055.71 Measles keratoconjunctivitis
076.0 - 076.9 Trachoma
090.3 Syphilitic interstitial keratitis
098.43  Gonococcal keratitis
360.21  Progressive high (degenerative) myopia
367.0 - 367.4  Disorders of refraction
367.89  Other disorders of refraction and accommodation
367.9  Unspecified disorder of refraction and accommodation
370.04  Hypopyon ulcer
370.05  Mycotic corneal ulcer
370.31  Phlyctenular keratoconjunctivitis
370.44  Keratitis or keratoconjunctivitis in exanthema
370.55  Corneal abscess

Refractive Surgery:

Radial keratotomy:

CPT codes covered if selection criteria are met:
65771  Radial keratotomy

Other HCPCS codes related to the CPB:
V2100 - V2499  Spectacle lenses
V2500 - V2599  Contact lens

ICD-9 codes covered if selection criteria are met:
367.1  Myopia

ICD-9 codes not covered for indications listed in the CPB:
367.0, 367.2 - 367.4  Disorders of refraction (other than myopia)
367.89  Other disorder of refraction and accommodation
367.9  Unspecified disorder of refraction and accommodation

Astigmatic keratotomy (AK):

CPT codes covered if selection criteria are met:
65772  Corneal relaxing incision for correction of surgically induced astigmatism
65775  Corneal wedge resection for correction of surgically induced astigmatism

Other CPT codes related to the CPB:
65400 - 65600  Cornea excision, removal or destruction, or cryotherapy of lesion on cornea
ICD-9 codes covered if selection criteria are met:

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<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tr>
<td>367.20</td>
<td>Astigmatism</td>
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<tr>
<td>367.22</td>
<td>Astigmatism</td>
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<tr>
<td>996.51</td>
<td>Mechanical complication due to corneal graft</td>
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<th>Description</th>
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<td>Disorders of refraction (other than astigmatism)</td>
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<td>367.4</td>
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<td>367.89</td>
<td>Other disorders of refraction and accommodation</td>
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<td>367.9</td>
<td>Unspecified disorder of refraction and accommodation</td>
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Other ICD-9 codes related to the CPB:

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<td>V43.1</td>
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</table>

Hexagonal keratotomy:

No specific code

ICD-9 codes not covered for indications listed in the CPB:

<table>
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<tr>
<th>Code</th>
<th>Description</th>
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<td>Hypermetropia [hyperopia]</td>
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<tr>
<td>367.4</td>
<td>Presbyopia</td>
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</table>

Other ICD-9 codes related to the CPB:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>V45.69</td>
<td></td>
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</tbody>
</table>

Laser in-situ keratomileusis:

CPT codes covered if selection criteria are met:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>65760</td>
<td>Keratomileus</td>
</tr>
</tbody>
</table>

HCPCS codes covered if selection criteria are met:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0800</td>
<td>Laser in situ keratomileusis (LASIK)</td>
</tr>
</tbody>
</table>

Other HCPCS codes related to the CPB:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>V2100</td>
<td>V2499</td>
</tr>
<tr>
<td>V2500</td>
<td>V2599</td>
</tr>
</tbody>
</table>
ICD-9 codes covered if selection criteria are met:
367.1  Myopia
367.20 - 367.22  Astigmatism

ICD-9 codes not covered for indications listed in the CPB:
367.0, 367.31 - 367.4  Disorders of refraction (other than myopia and astigmatism)
367.89  Other disorders of refraction and accommodation
367.9  Unspecified disorder of refraction and accommodation

Standard keratomileusis (ALK):
CPT codes not covered for indications listed in the CPB:
65760  Keratomileusis

ICD-9 codes not covered for indications listed in the CPB:
367.0 - 367.4  Disorders of refraction
367.89  Other disorders of refraction and accommodation
367.9  Unspecified disorder of refraction and accommodation

Epikeratoplasty (or epikeratophakia):
CPT codes covered if selection criteria are met:
65767  Epikeratoplasty

Other HCPCS codes related to the CPB:
V2500 - V2599  Contact lens

ICD-9 codes covered if selection criteria are met:
264.6  Vitamin A deficiency with xerophthalmic scars of cornea
371.00  Corneal opacity, unspecified
371.57  Endothelial corneal dystrophy
379.31  Aphakia
743.35  Congenital aphakia
996.51  Mechanical complication due to corneal graft

ICD-9 codes not covered for indications listed in the CPB:
367.0 - 367.4  Disorders of refraction
367.89  Other disorders of refraction and accommodation
367.9  Unspecified disorder of refraction and accommodation

Other ICD-9 codes related to the CPB:
364.00 - 364.3  Iridocyclitis
371.70 - 371.73  Other corneal deformities

Keratophakia:

CPT codes not covered for indications listed in the CPB:
65765  Keratophakia

Other HCPCS codes related to the CPB:
V2785  Processing, preserving, and transporting corneal tissue

ICD-9 codes not covered for indications listed in the CPB:
367.0 - 367.4  Disorders of refraction
367.89  Other disorders of refraction and accommodation
367.9  Unspecified disorder of refraction and accommodation

Other ICD-9 codes related to the CPB:
V42.5  Cornea replaced by transplant
V59.5  Donor, cornea

Lamellar keratoplasty (non-penetrating keratoplasty):

CPT codes covered if selection criteria are met:
65710  Keratoplasty (corneal transplant); anterior lamellar
0289T  Corneal incisions in the donor cornea created using a laser, in preparation for penetr keratoplasty (List separately in addition to code for primary procedure)
0290T  Corneal incisions in the recipient cornea created using a laser, in preparation for pen keratoplasty (List separately in addition to code for primary procedure)

Other HCPCS codes related to the CPB:
V2785  Processing, preserving, and transporting corneal tissue

ICD-9 codes covered if selection criteria are met:
264.6  Vitamin A deficiency with xerophthalmic scars of cornea
371.00  Corneal opacity, unspecified
371.20 - 371.24  Corneal edema
371.40 - 371.49  Corneal degenerations
371.50 - 371.58  Hereditary corneal dystrophies
371.60 - 371.62  Keratoconus
371.70 - 371.73  Other corneal deformities
743.41  Anomalies of corneal size and shape

ICD-9 codes not covered for indications listed in the CPB:
367.0 - 367.4  Disorders of refraction
367.89  Other disorders of refraction and accommodation
367.9  Unspecified disorder of refraction and accommodation
372.40 - 372.45  Pterygium

Other ICD-9 codes related to the CPB:
V42.5  Cornea replaced by transplant
V59.5  Donor, cornea

**Penetrating keratoplasty (PK) (corneal transplantation, perforating keratoplasty):**

CPT codes covered if selection criteria are met:
65730  Keratoplasty (corneal transplant); penetrating (except in aphakia or pseudoaphakia)
0289T  Corneal incisions in the donor cornea created using a laser, in preparation for penetr keratoplasty (List separately in addition to code for primary procedure)
0290T  Corneal incisions in the recipient cornea created using a laser, in preparation for pen keratoplasty (List separately in addition to code for primary procedure)

HCPCS codes covered for indications listed in the CPB:
V2785  Processing, preserving, and transporting corneal tissue

ICD-9 codes covered if selection criteria are met:
053.21  Herpes zoster keratoconjunctivitis
054.40  Herpes simplex with ophthalmic complications
054.43  Herpes simplex disciform keratitis
139.1  Late effects of trachoma
264.6  Vitamin A deficiency with xerophthalmic scars of cornea
364.21  Fuchs' heterochromic cyclitis
370.00 - 370.8  Keratitis
371.00 - 371.05  Corneal scars and opacities
371.20 - 371.24  Corneal edema
371.40 - 371.49  Corneal degenerations
371.50 - 371.58  Hereditary corneal dystrophies
371.60 - 371.62  Keratoconus
371.71  Corneal ectasia
743.41  Anomalies of corneal size and shape
743.42  Corneal opacities, interfering with vision, congenital
743.43  Other corneal opacities, congenital
871.0 - 871.9  Open wound of eyeball
906.0  Late effect of open wound of head, neck, and trunk
996.51  Mechanical complication due to corneal graft
996.80  Complications of transplanted organ, unspecified
996.89  Complications of other specified transplanted organ
V42.5  Cornea replaced by transplant

ICD-9 codes not covered for indications listed in the CPB:

367.0 - 367.4  Disorders of refraction
367.89  Other disorders of refraction and accommodation
367.9  Unspecified disorder of refraction and accommodation

Other ICD-9 codes related to the CPB:

V59.5  Donor, cornea

Photorefractive keratectomy (PRK) and Photoastigmatic keratectomy (PARK or PRK-A):

CPT codes covered if selection criteria are met:

65760  Keratomileusis

HCPCS codes covered if selection criteria are met:

S0810  Photorefractive keratectomy (PRK)

HCPCS not covered for indications listed in the CPB:

S0596  Phakic intraocular lens for correction of refractive error

Other HCPCS codes related to the CPB:

V2100 - V2499  Spectacle lenses
ICD-9 codes covered if selection criteria are met:

367.0  Hypermetropia
367.1  Myopia
367.20 - 367.22  Astigmatism

ICD-9 codes not covered for indications listed in the CPB:

367.20 - 367.4  Disorders of refraction (other than myopia)
367.89  Other disorders of refraction and accommodation
367.9  Unspecified disorder of refraction and accommodation

Intrastromal corneal ring (INTACS):

CPT codes covered if selection criteria are met:

0099T  Implantation of intrastromal corneal ring segments

ICD-9 codes covered if selection criteria are met:

367.0  Hypermetropia
367.1  Myopia
367.20 - 367.22  Astigmatism
371.48  Peripheral degenerations of cornea
371.60 - 371.62  Keratoconus Other

HCPCS codes related to the CPB: V2100 -
V2499  Spectacle lenses
V2500 - V2599  Contact lens

Conductive Keratoplasty (no specific codes):

Other CPT codes related to the CPB:

65771  Radial keratotomy

Other HCPCS codes related to the CPB:

V2100 - V2499  Spectacle lenses
V2500 - V2599  Contact lens

ICD-9 codes not covered for indications listed in the CPB:

367.0  Hypermetropia
367.1 Myopia
367.20 - 367.22 Astigmatism
371.60 - 371.62 Keratoconus

Methods of thermokeratoplasty other than conductive keratoplasty (no specific codes):

ICD-9 codes not covered for indications listed in the CPB:
367.0 - 367.4 Disorders of refraction
367.89 Other disorders of refraction and accommodation
367.9 Unspecified disorder of refraction and accommodation
371.60 - 371.62 Keratoconus

Orthokeratology:
No specific code

Other CPT codes related to the CPB:
92071 Fitting of contact lens for treatment of ocular surface disease
92310 - 92326 Contact lens services

Other HCPCS codes related to the CPB:
V2500 - V2599 Contact lens

ICD-9 codes not covered for indications listed in the CPB:
367.0 - 367.4 Disorders of refraction
367.89 Other disorders of refraction and accommodation
367.9 Unspecified disorder of refraction and accommodation

Scleral Expansion Surgery:
No specific code

ICD-9 codes not covered for indications listed in the CPB:
367.4 Presbyopia

Intraocular lens implants (clear lens extraction) (aphakic intraocular lenses (IOLS)):

CPT codes not covered for indications listed in the CPB:
66840 Removal of lens material; aspiration technique, 1 or more stages
66940 extracapsular (other than 66840, 66850, 66852)
66985 Insertion of intraocular lens prosthesis (secondary implant), not associated with conc
HCPCS codes not covered for indications listed in the CPB:

C1780    Lens, intraocular (new technology)
Q1004    New technology intraocular lens category 4 as defined in Federal Register notice
Q1005    New technology intraocular lens category 5 as defined in Federal Register notice
V2630    Anterior chamber intraocular lens
V2631    Iris supported intraocular lens
V2632    Posterior chamber intraocular lens
V2788    Presbyopia correcting function of intraocular lens

ICD-9 codes not covered for indications listed in the CPB:

367.0    Hypermetropia
367.1    Myopia
367.4    Presbyopia

Keratoprosthesis (artificial cornea):

CPT codes covered if selection criteria are met:

65770    Keratoprosthesis [AlphaCor keratoprosthesis not covered]

HCPCS codes covered if selection criteria are met:

C1818    Integrated keratoprosthesis
L8609    Artificial cornea

Other HCPCS codes related to the CPB:

V2630    Anterior chamber intraocular lens
V2631    Iris supported intraocular lens
V2632    Posterior chamber intraocular lens

ICD-9 codes covered if criteria are met:

053.21    Herpes zoster keratoconjunctivitis
054.40    Herpes simplex with opthalmic complications
054.43    Herpes simplex disciform keratitis
139.1    Late effects of trachoma
264.6    Vitamin A deficiency with xerophthalmic scars of cornea
364.21    Fuch's heterochromic cyclitis
370.00 - 370.8  Keratitis
371.00 - 371.05  Corneal scars and opacities
371.20 - 371.24  Corneal edema
371.40 - 371.49  Corneal degenerations
371.50 - 371.58  Hereditary corneal dystrophies
371.60 - 371.62  Keratoconus
371.71  Corneal ectasia
743.41  Anomalies of corneal size and shape
743.42  Corneal opacities, interfering with vision, congenital
743.43  Other corneal opacities, congenital
871.0 - 871.9  Open wound of eyeball
906.0  Late effect of open wound of head, neck and trunk
996.51  Mechanical complication due to corneal graft
996.80  Complications of transplanted organ, unspecified
996.89  Complications of other specified transplanted organ
V42.5  Cornea replaced by transplant

**ICD-9 codes not covered for indications listed in the CPB:**

361.00 - 361.9  Retinal detachments and defects

**Other ICD-9 codes related to the CPB:**

365.0-365.9  Glaucoma
367.0  Hypermetropia
367.1  Myopia
367.4  Presbyopia
370.00 - 371.9  Keratitis, corneal opacity and other disorders of cornea
372.00 - 372.9  Disorders of conjunctiva
743.41  Anomalies of corneal size and shape
743.42  Corneal opacities, interfering with vision, congenital
743.43  Other corneal opacities, congenital
996.51  Mechanical complication due to corneal graft
996.79  Other complications of internal (biological)(synthetic) prosthetic device, implant, and
V42.5   Cornea replaced by transplant
V43.89  Other organ or tissue replaced by other means

*Endothelial keratoplasty (DSEK, DSAEK, and DLEK):*

CPT codes covered if selection criteria are met:

65756   Keratoplasty (Corneal Transplant); endothelial
65757   Backbench preparation of corneal endothelial allograft prior to transplantation (List se
code for primary procedure)

ICD-9 codes covered if selection criteria are met:

371.20  Corneal edema, unspecified
371.21  Idiopathic corneal edema
371.22  Secondary corneal edema
371.23  Bullous keratopathy
371.24  Corneal edema due to wearing of contact lenses
371.33  Rupture in Descemet’s membrane
371.57  Endothelial corneal dystrophy
371.58  Other posterior corneal dystrophies
996.51  Mechanical complication due to corneal graft
996.53  Mechanical complication due to ocular lens prosthesis

ICD-9 codes not covered for indications listed in the CPB:

364.51  Essential or progressive iris atrophy
364.54  Degeneration of pupillary margin [atrophy of sphincter of iris]
364.59  Other iris atrophy
371.48  Peripheral degenerations of cornea
371.52  Other anterior corneal dystrophies
371.60 - 371.62  Keratoconus
371.00  Corneal opacity, unspecified [corneal scar]
371.71  Corneal ectasia

Collagen crosslinking by combined riboflavin/ultraviolet-A (UVA) treatment, Epithelium-off photochemica
ICD-9 codes covered for indications listed in the CPB:

371.60 - 371.62  Keratoconus
371.71  Corneal ectasia
743.41  Anomalies of corneal size and shape

Other ICD-9 codes related to the CPB:

V45.69  Other states following surgery of eye and adnexa

Collagen crosslinking, Epithelium-on (transepithelial) collagen cross-linkage (CXL plus):

No specific code

ICD-9 codes not covered for indications listed in the CPB (not all-inclusive):

371.60 - 371.62  Keratoconus
371.71  Corneal ectasia
743.41  Anomalies of corneal size and shape

The above policy is based on the following references:

40. Qazi MA, Pepose JS, Shuster JJ. Implantation of scleral expansion band segments for the treatment of pres
2002;134:808-815.
42. Packer M, Fine IH, Hoffman RS. Refractive lens exchange with the array multifocal intraocular lens. J Catar
(3):421-424.
518.
44. Jacobi PC, Dietlein TS, Luke C, Jacobi FK. Multifocal intraocular lens implantation in presbyopic patients wi
1122.
1414.
(4):832-834.
52. Letter from Donna Bea Tillman, Office of Device Evaluation, Center for Devices and Radiological Health, Fo
Administration, Rockville, MD, to Darlene Crockett-Billing, Regulatory Consultant, Addition Technology, Sun
53. Hladun L, Harris M. Contact lens fitting over intrastromal corneal rings in a keratoconic patient. Optometry. 2
(6):547-549.
56. U.S. Food and Drug Administration (FDA). FDA approves implanted lens to correct nearsightedness. FDA T
January 19, 2005.
57. Guo B. Keratoprosthesis for the treatment of severe bilateral cornea disease. Technote TN27. Edmonton, A
Foundation for Medical Research (AHMFAR); April 2001.
58. Alio JL, Mulet ME, Haroun H, et al. Five year follow up of biocolonisable microporous fluorocarbon haptic (B
60. McIntyre L. Osteo-odonto-keratoprosthesis as a treatment for severe corneal opacities. STEER: Succint and
Evidence Reviews. Bazian, Ltd., eds. London, UK: Wessex Institute for Health Research and Development,
61. Mundy L, Parrella A, AlphaCor, artificial cornea: corneal replacement in patients consid
(AHTA) on behalf of National Horizon Scanning Unit (HealthPACT and MSAC); 2004.
62. Mundy L, Parrella A. Implantable collamer lens for the correction of myopic vision. Horizon Scanning Prioriti
Adelaide, SA: Adelaide Health Technology Assessment (AHTA) on behalf of National Horizon Scanning Un
MSAC); 2004.
75. Buenos Aires, Argentina: Institute for Clinical Effectiveness and Health Policy (IECS); 2006.
93. Health Technology Inquiry Service (THIS). Corneal cross linking with riboflavin for keratoconus: Clinical and Ottawa, ON: Canadian Agency for Drugs and Technologies in Health; April 21, 2010.
100. Rapuano CJ. Management of epithelial ingrowth after laser in situ keratomileusis on a tertiary care cornea s (3):307-313.