MEDICAL POLICY – 9.03.01
Keratoprosthesis

BCBSA Ref. Policy: 9.03.01
Effective Date: May 1, 2018
Last Revised: April 18, 2018
Replaces: N/A
RELATED MEDICAL POLICIES:
None

Select a hyperlink below to be directed to that section.

POLICY CRITERIA | DOCUMENTATION REQUIREMENTS | CODING
RELATED INFORMATION | EVIDENCE REVIEW | REFERENCES | HISTORY

∞ Clicking this icon returns you to the hyperlinks menu above.

Introduction

The cornea is the clear, dome-shaped tissue that covers the front of the eyeball. The cornea bends light rays to help focus vision. When the cornea becomes cloudy it’s called corneal opacity. This cloudiness can be from any number of eye problems such as inflammation, infection, ulcers on the eye, and many other conditions. When the cloudiness severely limits vision or leads to blindness, a corneal transplant may be done. Most corneal transplants use tissue from donors. If this surgery fails or a person isn’t a candidate for a corneal transplant using donor tissue, surgery using an artificial cornea may be an option. This policy describes when a surgery using an artificial cornea may be considered medically necessary.

Note: The Introduction section is for your general knowledge and is not to be taken as policy coverage criteria. The rest of the policy uses specific words and concepts familiar to medical professionals. It is intended for providers. A provider can be a person, such as a doctor, nurse, psychologist, or dentist. A provider also can be a place where medical care is given, like a hospital, clinic, or lab. This policy informs them about when a service may be covered.
Implantation of a keratoprosthesis is considered a high-risk procedure associated with numerous complications and probable need for additional surgery. Therefore, the likelihood of regaining vision and the patient’s visual acuity in the opposite eye should be taken into account when considering the appropriateness of this procedure. Treatment should be restricted to centers experienced in treating this condition and staffed by surgeons adequately trained in techniques addressing implantation of this device.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Medical Necessity</th>
</tr>
</thead>
</table>
| The Boston (Dohlman-Doane) Keratoprosthesis (Boston KPro) | The Boston (Dohlman-Doane) Keratoprosthesis (Boston KPro) may be considered medically necessary for the surgical treatment of severe corneal opacification in situations where cadaveric corneal transplants have failed or have a very low likelihood of success or under the following conditions:  
  • The cornea is severely opaque and vascularized  
  AND  
  • Best-corrected vision is worse than 20/400 in the affected eye and worse than 20/40 in the opposite eye  
  AND  
  • No end-stage glaucoma or retinal detachment is present  
  AND  
  • The patient has at least one of the following indications:  
    o History of 1 or more corneal transplant graft failures  
    o Stevens-Johnson syndrome  
    o Ocular cicatricial pemphigoid  
    o Autoimmune conditions with rare ocular involvement  
    o Ocular chemical burns  
    o An ocular condition unlikely to respond favorably to primary corneal transplant surgery (eg, libel stem cell compromise or postherpetic anesthesia)  

Note: Implantation of a keratoprosthesis is considered a high-risk procedure associated with numerous complications and probable need for additional surgery. Therefore, the likelihood of regaining vision and the patient’s visual acuity in the contralateral eye should be taken into account when considering the appropriateness of this procedure. Treatment should be restricted to centers experienced in treating this condition and staffed by surgeons adequately trained in techniques addressing implantation of this device. Patients should be able and expected to comply with postoperative care.
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Investigational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent keratoprosthesis for all conditions not listed above</td>
<td>A permanent keratoprosthesis for all other conditions not listed in the Medical Necessity section above is considered investigational.</td>
</tr>
<tr>
<td>All other types of permanent keratoprostheses</td>
<td>All other types of permanent keratoprostheses not listed in the Medical Necessity section above are considered investigational.</td>
</tr>
</tbody>
</table>

**Documentation Requirements**

Keratoprosthesis using the Dohlman Doane Boston KPro (“Boston KPro”) device may be considered medically necessary with clinical documentation of ALL of the following conditions:

- The cornea is severely opaque and vascularized (cloudy and blood vessels growing into it)
- Best-corrected vision is worse than 20/400 in the affected eye and worse than 20/40 in the opposite eye
- Absence of end-stage glaucoma or retinal detachment
- The patient has at least one of the following indications:
  - History of 1 or more corneal transplant graft failures
  - Stevens-Johnson syndrome
  - Ocular cicatrical pemphigoid (a specific form of mucous membrane pemphigoid)
  - Autoimmune conditions with rare ocular involvement
  - Ocular chemical burns
  - An ocular condition unlikely to respond favorably to primary corneal transplant surgery (eg, libel stem cell compromise or postherpetic anesthesia)
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tr>
<td>CPT</td>
<td></td>
</tr>
<tr>
<td>65770</td>
<td>Keratoprosthesis</td>
</tr>
<tr>
<td>HCPCS</td>
<td></td>
</tr>
<tr>
<td>L8609</td>
<td>Artificial cornea</td>
</tr>
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</table>

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**Related Information**

N/A

**Evidence Review**

**Description**

A keratoprosthesis, consisting of a central optic held in a cylindrical frame, is an artificial cornea intended to restore vision to patients with severe bilateral corneal disease for whom a corneal transplant is not an option. The keratoprosthesis replaces the cornea that has been removed and is held in place by the surrounding tissue. Various biologic materials are being investigated to improve integration of the prosthetic into the eye.

**Background**

**Cornea**

The cornea, a clear, dome-shaped membrane that covers the front of the eye, is a key refractive element of sight. Layers of the cornea consist of the epithelium (outermost layer); Bowman layer; the stroma, which comprises approximately 90% of the cornea; Descemet membrane; and the endothelium.
Treatment

The established surgical treatment for corneal disease is penetrating keratoplasty, which involves making a large central opening through the cornea and then filling the opening with a full-thickness donor cornea. In certain conditions, such as Stevens-Johnson syndrome, ocular cicatricial pemphigoid, chemical injury, or prior failed corneal transplant, survival of transplanted cornea is poor. The keratoprosthesis was developed to restore vision in patients for whom a corneal transplant is not an option.

Keratoprosthetic devices consist of a central optic held in a cylindrical frame. The keratoprosthesis replaces the section of the cornea that has been removed, and, along with being held in place by the surrounding tissue, may be covered by a membrane to further anchor the prosthesis. A variety of biologic materials are being investigated to improve the integration of prosthetic corneal implants into the stroma and other corneal layers.

The Dohlman-Doane keratoprosthesis, most commonly referred to as the Boston Keratoprosthesis (KPro), is manufactured under the auspices of the Harvard Medical School–affiliated Massachusetts Eye and Ear Infirmary. The Boston type 1 KPro uses a donor cornea between a central stem and a back plate. The Boston type 2 prosthesis is a modification of the type 1 prosthesis and is designed with an anterior extension to allow implantation through surgically closed eyelids. The AlphaCor, previously known as the Chirila keratoprosthesis (Chirila KPro), consists of a polymethylmethacrylate (PMMA) device with a central optic region fused to a surrounding sponge skirt; the device is inserted in a 2-stage surgical procedure.

Autologous keratoprostheses use a central PMMA optic supported by a skirt of either tibia bone or the root of a tooth with its surrounding alveolar bone. The most common is the osteo-odontokeratoprosthesis, which uses osteodental lamina derived from an extracted tooth root and attached alveolar bone that has been removed from the patient’s jaw. Insertion of the osteo-odontokeratoprosthesis device requires a complex staged procedure, in which the cornea is first covered with buccal mucosa. The prosthesis itself consists of a PMMA optical cylinder, which replaces the cornea, and is held in place by biologic support made from a canine tooth extracted from the recipient. A hole is drilled through the dental root and alveolar bone, and the PMMA prosthesis is placed within. This entire unit is placed into a subcutaneous ocular pocket and is then retrieved 6 to 12 months later for final insertion.

Hydroxyapatite, with a similar mineral composition to both bone and teeth (phosphate and calcium), may also be used as a bone substitute and as a bioactive prosthesis with the orbit. Collagen coating and scaffolds have also been investigated to improve growth and
biocompatibility with the corneal epithelial cells, which form the protective layer of the eye. Many of these materials and devices are currently being tested in vitro or animal models.

Summary of Evidence

For individuals who have corneal blindness and have failed or are not candidates for corneal transplantation who receive a Boston Keratoprosthesis (Boston KPro), the evidence includes case series and systematic reviews. Relevant outcomes are change in disease status, morbid events, quality of life, and treatment-related morbidity. Numerous case series have been published. Together, studies have assessed thousands of eyes. A 2015 systematic review of Boston KPro efficacy included 22 series with a total of 2176 eyes. Systematic reviews and case series with longer follow-up (ie, at least 2 years) have shown improvement in visual outcomes in a substantial percentage of patients with Boston KPro. This procedure is high-risk and associated with numerous complications (eg, the growth of retro prosthetic membranes) and a probable need for additional surgery, thus careful patient selection is important. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who have corneal blindness and have failed or are not candidates for corneal transplantation who receive a keratoprosthesis using the AlphaCor device, the evidence includes case series. Relevant outcomes are change in disease status, morbid events, quality of life, and treatment-related morbidity. Only a few published case series have evaluated the AlphaCor device. There are insufficient data on improvement in vision outcomes using the AlphaCor device. Moreover, the device has been associated with complications, including thinning or melting of the anterior corneal surface and corneal necrosis. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have corneal blindness and have failed, or are not candidates for corneal transplantation who receive an osteo-odontokeratoprosthesis, the evidence includes case series and a systematic review. Relevant outcomes are change in disease status, morbid events, quality of life, and treatment-related morbidity. A 2012 systematic review of case series, all conducted outside of the United States, found high anatomic survival rates at 5 and 20 years, but vision outcomes were not well-described. Osteo-odontokeratoprosthesis is a complex surgical procedure and has been associated with a number of complications, including extrusion of the keratoprosthesis, retinal detachment, and vitreoretinal complications. The evidence is insufficient to determine the effects of the technology on health outcomes.
Ongoing and Unpublished Clinical Trials

Some currently unpublished trials that might influence this policy are listed in Table 1.

Table 1. Summary of Key Trials

<table>
<thead>
<tr>
<th>NCT No.</th>
<th>Trial Name</th>
<th>Planned Enrollment</th>
<th>Completion Date</th>
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<tr>
<td>NCT02084745</td>
<td>Timing of Glaucoma Drainage Device With Boston KPro Surgery (GDD-KPro)</td>
<td>40</td>
<td>Mar 2020</td>
</tr>
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</table>

NCT: national clinical trial.

Clinical Input Received From Physician Specialty Societies and Academic Medical Centers

While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during the review process, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted.

In response to requests, input was received from one specialty society and four academic medical centers while this policy was under review in 2009. Reviewers generally supported a limited role for the Boston KPro in selected patients. Some reviewers recommended use without first attempting a transplant in specific conditions that have a poor prognosis for corneal transplant; however, other input indicated that this is controversial. Some reviewers recommended use only in patients who have limited visual acuity in the contralateral eye. Overall, input indicated that the Boston KPro is reserved for cases in which no other alternative (ie, corneal transplantation) is available for treatment of corneal opacification.

Practice Guidelines and Position Statements

A 2013 Preferred Practice Parameter on ocular edema and opacification by the American Academy of Ophthalmology did not provide specific recommendations on the keratoprosthesis, but included this discussion of the technology\(^\text{20}\).
Significant improvements in the design and postoperative management of the Boston type 1 keratoprosthesis has resulted in a steady rise in the number of these procedures performed both in the United States and abroad. Reduced incidence of postoperative stromal necrosis and bacterial endophthalmitis due to the chronic use of protective soft contact lenses and topical antibiotics has resulted in improved retention and visual outcomes and has had a positive impact on surgeons’ perceptions of when to recommend keratoprosthesis. Once considered a procedure of last resort in patients with severe bilateral visual impairment, it is now being used for a variety of unilateral and bilateral indications, such as ocular trauma, herpetic keratitis, aniridia, Stevens-Johnson syndrome, and congenital corneal opacification. More recently, as corneal surgeons have gained a greater appreciation of the failure rate of repeat corneal transplantation, a role for a keratoprosthesis in cases of multiple graft failure has become clearer.

Patients with severe dry eye and autoimmune ocular surface diseases (particularly Stevens-Johnson syndrome and OMMP [ocular mucous membrane pemphigoid]) remain a difficult management group despite the other successes of the Boston type 1 keratoprosthesis. Epithelial defects, scleral necrosis, extrusion, and endophthalmitis are the principal concerns. This group of patients has had some success with a Boston type 2 keratoprosthesis designed to be used through the lid and the osteo-odonto-keratoprosthesis.

Regulatory Status

In 1992, the Boston KPro (Dohlman-Doane keratoprosthesis; Massachusetts Eye and Ear Infirmary) was approved by the U.S. Food and Drug Administration through the premarket approval process for use in patients with severe corneal opacity. The device is used when standard corneal transplant has failed or would be unlikely to succeed. There are 2 types of Boston KPro. Type 1 is used in eyes when eyelids, blink mechanism, and tear film are intact. Type 2 is used with severe dry eye and in eyes with mucosal keratinization and obliteration of normal conjunctival fornices.

In August 2002, the AlphaCor® (Chirila Keratoprosthesis) was cleared for marketing by the Food and Drug Administration through the 510(k) process. The Food and Drug Administration determined that this device was substantially equivalent to the Dolman-Doane keratoprosthesis. The AlphaCor® device is indicated as a keratoprosthesis in adults with corneal opacity when standard penetrating keratoplasty with donor tissue is not suitable, when patients have declined
standard penetrating keratoplasty, or when adjunctive procedures to prevent graft rejection are contraindicated.

References


### History

<table>
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<tr>
<th>Date</th>
<th>Comments</th>
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<td>01/97</td>
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<td>05/13/03</td>
<td>Replace Policy - Policy statement unchanged; expanded description and benefit application sections.</td>
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<tr>
<td>05/11/04</td>
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<td>10/12/04</td>
<td>Replace Policy - Policy updated with new HCPCS code; 2 previously approved FDA Devices; and Medicare Policy text; no change in policy statement.</td>
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<td>Replace Policy - Policy updated with literature search; reference added; no change to policy statement. Status changed from AR to BC.</td>
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<td>02/09/10</td>
<td>Replace Policy - Policy updated with literature search. Policy statement changed to be considered medically necessary when specific criteria are met. References added.</td>
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<td>Cross Reference Update - No other changes.</td>
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<td>Replace Policy - Policy updated with literature review through December 2010; reference added; policy statement unchanged. ICD-10 codes added to policy.</td>
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<td>04/25/12</td>
<td>Replace policy. Policy updated with literature review through December 2011; references 3 and 12-15 added; some references removed; policy statements unchanged.</td>
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<td>Update Coding Section – ICD-10 codes are now effective 10/01/2014.</td>
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<td>04/16/13</td>
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<td>06/04/13</td>
<td>Update Related Policies. Remove 9.03.14 as it was archived.</td>
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<td>10/16/13</td>
<td>Update Related Policies. Add policy 9.03.25.</td>
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<tr>
<td>05/05/14</td>
<td>Annual Review. Policy updated with literature review through January 14, 2014; references 8 and 19 added; policy statement unchanged. Remove all codes except CPT 65770; it is the only specific code to this policy.</td>
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<tr>
<td>10/22/14</td>
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<td>12/22/14</td>
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<tr>
<td>04/24/15</td>
<td>Annual Review. Policy updated with literature review through January 13, 2015. References 10-11 added; additional conditions that are likely to have poor outcomes from a corneal transplant were added to the medically necessary policy statement.</td>
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<td>08/25/15</td>
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<td>06/01/16</td>
<td>Annual Review, approved May 10, 2016. Policy updated with literature review through February 8, 2016; references 1, 3, 10-13, and 27 added. In medically necessary policy statement, “multiple graft failures changed” to “history of 1 or more” graft failures and “an ocular condition unlikely to respond favorably to primary corneal transplant surgery” was added. Indications for keratoprosthesis retained in policy statement.</td>
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<tr>
<td>05/01/18</td>
<td>Annual Review, approved April 18, 2018. Policy updated with literature review through January 2018; no references added. Policy statements unchanged. Removed Related Policy 9.03.15 as it was archived.</td>
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U.S. Department of Health and Human Services
200 Independence Avenue SW, Room 509F, HHH Building
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