

## Corneal Collagen Cross-linking

**Policy # 00325**

Original Effective Date: 12/21/2011

Current Effective Date: 06/01/2025

*Applies to all products administered or underwritten by Blue Cross and Blue Shield of Louisiana and its subsidiary, HMO Louisiana, Inc. (collectively referred to as the "Company"), unless otherwise provided in the applicable contract. Medical technology is constantly evolving, and we reserve the right to review and update Medical Policy periodically.*

*Note: Implantation of Intrastromal Corneal Ring Segments is addressed separately in medical policy 00164.*

### When Services Are Eligible for Coverage

*Coverage for eligible medical treatments or procedures, drugs, devices or biological products may be provided only if:*

- *Benefits are available in the member's contract/certificate, and*
- *Medical necessity criteria and guidelines are met.*

Based on review of available data, the Company may consider corneal collagen cross-linking (CXL) using riboflavin and ultraviolet A (UVA) as a treatment of progressive keratoconus to be **eligible for coverage.\*\*** (See Policy Guidelines)

*Note: The correction of refractive errors of the eye, including but not limited to radial keratotomy and laser surgery, are excluded from coverage under medical benefits on majority of member contracts. In addition, treatment of complications of non-covered services are also excluded from coverage. If it is determined that corneal ectasia was a complications of refractive surgery, request for corneal collagen cross-linking will be denied as not a covered benefit.*

### When Services Are Considered Investigational

*Coverage is not available for investigational medical treatments or procedures, drugs, devices or biological products.*

Based on review of available data, the Company considers corneal collagen cross-linking (CXL) using riboflavin and ultraviolet A (UVA) for all other indications to be **investigational.\***

### Policy Guidelines

The American Academy of Ophthalmology has not set forth definitive criteria defining progressive keratoconus, but has suggested that signs of progression include changes in refraction, visual acuity and corneal shape ([https://eyewiki.aao.org/Corneal\\_Collagen\\_Cross-Linking](https://eyewiki.aao.org/Corneal_Collagen_Cross-Linking)). In the trials leading to FDA approval of corneal collagen cross-linking, progressive keratoconus was defined as one or more of the following:

- An increase of 1 diopter (D) in the steepest keratometry value

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- An increase of 1 D in regular astigmatism evaluated by subjective manifest refraction
- A myopic shift (decrease in the spherical equivalent) of 0.50 D on subjective manifest refraction
- A decrease  $\geq 0.1$  mm in the back optical zone radius in rigid contact lens wearers where other information was not available

## **Background/Overview**

### **Treatment of Keratoconus**

The initial treatment for keratoconus often consists of hard contact lenses. A variety of keratorefractive procedures have also been attempted, broadly divided into subtractive and additive techniques. Subtractive techniques include photorefractive keratectomy or laser in situ keratomileuses, although generally, results of these techniques have been poor. Implantation of intrastromal corneal ring segments is an additive technique in which the implants are intended to reinforce the cornea, prevent further deterioration, and potentially obviate the need for penetrating keratoplasty. Penetrating keratoplasty (ie, corneal grafting) is the last line of treatment. About 20% of patients with keratoconus will require corneal transplantation. All of these treatments attempt to improve the refractive errors but are not disease-modifying.

None of the currently available treatment options for keratoconus halt the progression of the disease, and corneal transplantation is the only option available when functional vision can no longer be achieved.

Corneal collagen cross-linking has the potential to slow the progression of the disease. It is performed with the photosensitizer riboflavin (vitamin B2) and ultraviolet A irradiation. There are 2 protocols for corneal collagen cross-linking:

1. Epithelium-off corneal collagen cross-linking (also known as “epi-off”): In this method, about 8 mm of the central corneal epithelium is removed under topical anesthesia to allow better diffusion of the photosensitizer riboflavin into the stroma. Following de-epithelialization, a solution with riboflavin is applied to the cornea (every 1-3 minutes for 30 minutes) until the stroma is completely penetrated. The cornea is then irradiated for 30 minutes with ultraviolet A 370 nm, a maximal wavelength for absorption by riboflavin, while the riboflavin continues to be applied. The interaction of riboflavin and ultraviolet A causes the formation of reactive oxygen species, leading to additional covalent bonds (cross-linking) between collagen molecules, resulting in stiffening of the cornea. Theoretically, by using a homogeneous light source and absorption by riboflavin, the structures beyond a 400- $\mu$ m thick stroma (endothelium, anterior chamber, iris, lens, retina) are not exposed to an ultraviolet dose that is above the cytotoxic threshold.
2. Epithelium-on corneal collagen cross-linking (also known as “epi-on” or transepithelial): In this method, the corneal epithelial surface is left intact (or may be partially disrupted) and a longer riboflavin loading time is needed.

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Currently, the only corneal collagen cross-linking treatment approved by the U.S. Food and Drug Administration (FDA) is the epithelium-off method; there are no FDA approved corneal collagen cross-linking treatments using the epithelium-on method. Corneal collagen cross-linking is being evaluated primarily for corneal stabilization in patients with progressive corneal thinning, such as keratoconus following refractive surgery. Corneal collagen cross-linking may also have anti-edematous and antimicrobial properties.

## **FDA or Other Governmental Regulatory Approval**

### **U.S. Food and Drug Administration (FDA)**

In 2016, riboflavin 5' -phosphate in 20% dextran ophthalmic solution (Photrex Viscous<sup>TM</sup>; Avedro) and riboflavin 5' -phosphate ophthalmic solution (Photrex<sup>TM</sup>; Avedro) were approved by the FDA for use with the KXL System in corneal collagen cross-linking for the treatment of progressive keratoconus after refractive surgery.

## **Rationale/Source**

This medical policy was developed through consideration of peer-reviewed medical literature generally recognized by the relevant medical community, U.S. Food and Drug Administration approval status, nationally accepted standards of medical practice and accepted standards of medical practice in this community, technology evaluation centers, reference to regulations, other plan medical policies, and accredited national guidelines.

Corneal collagen cross-linking is a photochemical procedure approved by the U.S. Food and Drug Administration (FDA) for the treatment of progressive keratoconus following refractive surgery. Keratoconus is a dystrophy of the cornea characterized by progressive deformation (steepening) of the cornea. This condition can lead to functional loss of vision and need for corneal transplantation.

### **Summary of Evidence**

For individuals who have progressive keratoconus who receive corneal collagen cross-linking using riboflavin and ultraviolet A, the evidence includes randomized controlled trials (RCTs), systematic reviews, and nonrandomized studies. Relevant outcomes are change in disease status, functional outcomes, and treatment-related morbidity. Based on RCT evidence used to inform FDA approval, corneal collagen cross-linking was associated with significant improvements in corneal curvature score and corrected distance visual acuity and non-significant improvement in uncorrected distance visual acuity compared with sham treatment after 1 year of follow-up. Long-term RCT follow-up is needed. Several non-randomized studies measured visual acuity and found significant and lasting improvements in corrected visual acuity and other measures with corneal collagen cross-linking. The adverse events associated with corneal collagen cross-linking include corneal opacity (haze), corneal epithelial defects, and other ocular findings. Most adverse events resolved in the first month but continued in a few (1% to 6%) patients for 6 to 12 months. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

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## **Supplemental Information**

### **Practice Guidelines and Position Statements**

Guidelines or position statements will be considered for inclusion in ‘Supplemental Information’ if they were issued by, or jointly by, a US professional society, an international society with US representation, or National Institute for Health and Care Excellence (NICE). Priority will be given to guidelines that are informed by a systematic review, include strength of evidence ratings, and include a description of management of conflict of interest.

### ***National Institute for Health and Care Excellence***

In 2013, the National Institute for Health and Care Excellence (NICE) issued guidance on corneal collagen cross-linking using riboflavin and ultraviolet A, updating its guidance based on a 2009 systematic review of primarily low-quality evidence; review authors declared no financial conflicts of interest. The 2013 guidance stratified recommendations for corneal collagen cross-linking as follows:

“Most of the published evidence on photochemical corneal collagen cross-linkage using riboflavin and ultraviolet A (UVA) for keratoconus and relates to the technique known as ‘epithelium-off corneal collagen cross-linking’. ‘Epithelium-on (transepithelial) corneal collagen cross-linking’ is a more recent technique and less evidence is available on its safety and efficacy. Either procedure (epithelium-off or epithelium-on corneal collagen cross-linking) can be combined with other interventions, and the evidence base for these combination procedures (known as ‘corneal collagen cross-linking plus’) is also limited. Therefore, different recommendations apply to the variants of this procedure, as follows.

- 1.1 Current evidence on the safety and efficacy of epithelium-off corneal collagen cross-linking for keratoconus is adequate in quality and quantity. Therefore, this procedure can be used provided that normal arrangements are in place for clinical governance, consent and audit.
- 1.2 Current evidence on the safety and efficacy of epithelium-on (transepithelial) corneal collagen cross-linking, and the combination (corneal collagen cross-linking plus) procedures for keratoconus is inadequate in quantity and quality. Therefore, these procedures should only be used with special arrangements for clinical governance, consent and audit or research.”

### **U.S. Preventive Services Task Force Recommendations**

Not applicable.

### **Medicare National Coverage**

There is no national coverage determination. In the absence of a national coverage determination, coverage decisions are left to the discretion of local Medicare carriers.

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### Ongoing and Unpublished Clinical Trials

Some currently ongoing and unpublished trials that might influence this review are listed in Table 1.

**Table 1. Summary of Key Trials**

<b>NCT No.</b>	<b>Trial Name</b>	<b>Planned Enrollment</b>	<b>Completion Date</b>
<i><b>Ongoing</b></i>			
NCT01112072	Randomized Study of Safety and Efficacy of Corneal Collagen Crosslinking and Intacs for Treatment of Keratoconus and Corneal Ectasia	160	Dec 2025
NCT01604135	Collagen Crosslinking for Keratoconus - a Randomized Controlled Clinical Trial	200	April 2025
NCT03760432	Clinical Trial of Laser Custom Corneal Collagen Cross-Linking in Keratoconus	100	Dec 2025
NCT00560651	German Corneal Cross-Linking Registry	7500	Nov 2027
<i><b>Unknown</b></i>			
NCT01708538 <sup>a</sup>	Phase III Study of Corneal Collagen Cross-linking Using Two Different Techniques	30	Oct 2024
<i><b>Unpublished</b></i>			
NCT04213885	Safety and Effectiveness of the PXL Platinum 330 System for Corneal Collagen Cross-Linking in Eyes With Corneal Thinning Position	300	Aug 2024
NCT01344187 <sup>a</sup>	A Multi-Center, Randomized, Placebo-Controlled Evaluation of the Safety and Efficacy of the KXL System With VibeX (Riboflavin Ophthalmic Solution) for Corneal	236	Jun 2016 (updated 04/26/21)

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NCT No.	Trial Name	Planned Enrollment	Completion Date
	Collagen Cross-Linking in Eyes With Keratoconus		
NCT01972854 <sup>a</sup>	A Multi-Center, Randomized, Placebo-Controlled Evaluation of the Safety and Efficacy of the KXL System With VibeX (Riboflavin Ophthalmic Solution) for Corneal Collagen Cross-Linking in Eyes With Keratoconus	92	Apr 2017 (terminated; updated 04/26/21)
NCT03531047	A Prospective, Controlled Study of Refractive Corneal Cross-linking for Progressive Keratoconus	52	Nov 2021 (status=Completed as of Dec 2023)

NCT: national clinical trial.

a Denotes industry-sponsored or cosponsored trial.

b Terminated to initiate FDA and IND-cleared study protocol.

## References

1. American Academy of Ophthalmology. Corneal Collagen Cross-Linking. September 20, 2021.
2. Avedro Inc. Avedro Briefing Package for Joint Meeting of the Dermatologic and Ophthalmic Drugs Advisory Committee and Ophthalmic Device Panel of the Medical Devices Advisory Committee NDA 203324: Photrexa Viscous and Photrexa (riboflavin ophthalmic solution) and KXL System (UVA light source) Avedro, Inc. 2016;  
<https://www.accessdata.fda.gov/scripts/cder/daf/index.cfm?event=overview.process&ApplNo=203324>.
3. Davis LJ, Schechtman KB, Wilson BS, et al. Longitudinal changes in visual acuity in keratoconus. Invest Ophthalmol Vis Sci. Feb 2006; 47(2): 489-500. PMID 16431941
4. McMahon TT, Edrington TB, Szczotka-Flynn L, et al. Longitudinal changes in corneal curvature in keratoconus. Cornea. Apr 2006; 25(3): 296-305. PMID 16633030
5. McAnena L, Doyle F, O'Keefe M. Cross-linking in children with keratoconus: a systematic review and meta-analysis. Acta Ophthalmol. May 2017; 95(3): 229-239. PMID 27678078
6. Hersh PS, Stulting RD, Muller D, et al. United States Multicenter Clinical Trial of Corneal Collagen Crosslinking for Keratoconus Treatment. Ophthalmology. Sep 2017; 124(9): 1259-1270. PMID 28495149

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7. Toprak I, Yaylali V, Yildirim C. Visual, Topographic, and Pachymetric Effects of Pediatric Corneal Collagen Cross-linking. *J Pediatr Ophthalmol Strabismus*. Mar 01 2017; 54(2): 84-89. PMID 27668869
8. Badawi AE. Accelerated corneal collagen cross-linking in pediatric keratoconus: One year study. *Saudi J Ophthalmol*. 2017; 31(1): 11-18. PMID 28337057
9. Knutsson KA, Paganoni G, Matuska S, et al. Corneal collagen cross-linking in paediatric patients affected by keratoconus. *Br J Ophthalmol*. Feb 2018; 102(2): 248-252. PMID 28655729
10. Papaioannou L, Miligkos M, Papathanassiou M. Corneal Collagen Cross-Linking for Infectious Keratitis: A Systematic Review and Meta-Analysis. *Cornea*. Jan 2016; 35(1): 62-71. PMID 26509768
11. Padmanabhan P, Rachapalle Reddi S, Rajagopal R, et al. Corneal Collagen Cross-Linking for Keratoconus in Pediatric Patients-Long-Term Results. *Cornea*. Feb 2017; 36(2): 138-143. PMID 28060058
12. Raiskup-Wolf F, Hoyer A, Spoerl E, et al. Collagen crosslinking with riboflavin and ultraviolet-A light in keratoconus: long-term results. *J Cataract Refract Surg*. May 2008; 34(5): 796-801. PMID 18471635
13. Raiskup F, Theuring A, Pillunat LE, et al. Corneal collagen crosslinking with riboflavin and ultraviolet-A light in progressive keratoconus: ten-year results. *J Cataract Refract Surg*. Jan 2015; 41(1): 41-6. PMID 25532633
14. Caporossi A, Mazzotta C, Baiocchi S, et al. Long-term results of riboflavin ultraviolet a corneal collagen cross-linking for keratoconus in Italy: the Siena eye cross study. *Am J Ophthalmol*. Apr 2010; 149(4): 585-93. PMID 20138607
15. Wittig-Silva C, Whiting M, Lamoureux E, et al. A randomized controlled trial of corneal collagen cross-linking in progressive keratoconus: preliminary results. *J Refract Surg*. Sep 2008; 24(7): S720-5. PMID 18811118
16. Wittig-Silva C, Chan E, Islam FM, et al. A randomized, controlled trial of corneal collagen cross-linking in progressive keratoconus: three-year results. *Ophthalmology*. Apr 2014; 121(4): 812-21. PMID 24393351
17. Center for Drug Evaluation and Research. Application Number 203324Orig2s000. Summary Review. 2015; [https://www.accessdata.fda.gov/drugsatfda\\_docs/nda/2016/203324Orig2s000SumR.pdf](https://www.accessdata.fda.gov/drugsatfda_docs/nda/2016/203324Orig2s000SumR.pdf).
18. National Institute for Health and Care Excellence (NICE). Photochemical corneal collagen cross-linkage using riboflavin and ultraviolet A for keratoconus and keratectasia [IPG466]. 2013; <https://www.nice.org.uk/guidance/ipg466>.

## **Policy History**

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12/08/2011 Medical Policy Committee review

12/21/2011 Medical Policy Implementation Committee approval. New policy.

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12/06/2012	Medical Policy Committee review
12/19/2012	Medical Policy Implementation Committee approval. No change to coverage.
11/07/2013	Medical Policy Committee review
11/20/2013	Medical Policy Implementation Committee approval. Coverage eligibility unchanged.
11/06/2014	Medical Policy Committee review
11/21/2014	Medical Policy Implementation Committee approval. Coverage eligibility unchanged.
08/03/2015	Coding update: ICD10 Diagnosis code section added; ICD9 Procedure code section removed.
10/29/2015	Medical Policy Committee review
11/16/2015	Medical Policy Implementation Committee approval. Coverage eligibility unchanged.
11/03/2016	Medical Policy Committee review
11/16/2016	Medical Policy Implementation Committee approval. Coverage eligibility unchanged.
01/01/2017	Coding update: Removing ICD-9 Diagnosis Codes
11/02/2017	Medical Policy Committee review
11/15/2017	Medical Policy Implementation Committee approval. Coverage changed from investigational to eligible for coverage. Added that corneal collagen cross-linking using riboflavin and ultraviolet A may be considered eligible for coverage as a treatment of progressive keratoconus and corneal ectasia after refractive surgery. Added that corneal collagen cross-linking using riboflavin and ultraviolet A is considered investigational for all other indications. Added Policy Guidelines section.
11/08/2018	Medical Policy Committee review
11/21/2018	Medical Policy Implementation Committee approval. Coverage eligibility unchanged.
01/01/2019	Coding update
11/07/2019	Medical Policy Committee review
11/13/2019	Medical Policy Implementation Committee approval. Coverage changes “or corneal ectasia after refractive surgery” removed from coverage statement and note added for clarity stating “The correction of refractive errors of the eye, including but not limited to radial keratotomy and laser surgery, are excluded from coverage under medical benefits on majority of member contracts. In addition, treatment of complications of non-covered services are also excluded from coverage. If it is determined that corneal ectasia was a complications of refractive surgery, request for corneal collagen cross-linking will be denied as not a covered benefit.”
05/07/2020	Medical Policy Committee review
05/13/2020	Medical Policy Implementation Committee approval. Coverage eligibility unchanged.



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05/06/2021	Medical Policy Committee review
05/12/2021	Medical Policy Implementation Committee approval. Removed “in patients who have failed conservative treatment (e.g., spectacle correction, rigid contact lens)” from the eligible for coverage statement for corneal collagen cross-linking (CXL) using riboflavin and ultraviolet A (UVA) as a treatment of progressive keratoconus. Added a reference to Policy Guidelines in the eligible for coverage statement.
05/05/2022	Medical Policy Committee review
05/11/2022	Medical Policy Implementation Committee approval. Coverage eligibility unchanged.
05/04/2023	Medical Policy Committee review
05/10/2023	Medical Policy Implementation Committee approval. Coverage eligibility unchanged.
05/02/2024	Medical Policy Committee review
05/08/2024	Medical Policy Implementation Committee approval. Coverage eligibility unchanged.
05/01/2025	Medical Policy Committee review
05/13/2025	Medical Policy Implementation Committee approval. Coverage eligibility unchanged.

Next Scheduled Review Date: 05/2026

## **Coding**

*The five character codes included in the Louisiana Blue Medical Policy Coverage Guidelines are obtained from Current Procedural Terminology (CPT®)†, copyright 2024 by the American Medical Association (AMA). CPT is developed by the AMA as a listing of descriptive terms and five character identifying codes and modifiers for reporting medical services and procedures performed by physician.*

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Codes used to identify services associated with this policy may include (but may not be limited to) the following:

Code Type	Code
CPT	0402T, 66999
HCPCS	J2787
ICD-10 Diagnosis	All Related Diagnoses

\*Investigational – A medical treatment, procedure, drug, device, or biological product is Investigational if the effectiveness has not been clearly tested and it has not been incorporated into standard medical practice. Any determination we make that a medical treatment, procedure, drug, device, or biological product is Investigational will be based on a consideration of the following:

- A. Whether the medical treatment, procedure, drug, device, or biological product can be lawfully marketed without approval of the U.S. Food and Drug Administration (FDA) and whether such approval has been granted at the time the medical treatment, procedure, drug, device, or biological product is sought to be furnished; or
- B. Whether the medical treatment, procedure, drug, device, or biological product requires further studies or clinical trials to determine its maximum tolerated dose, toxicity, safety, effectiveness, or effectiveness as compared with the standard means of treatment or diagnosis, must improve health outcomes, according to the consensus of opinion among experts as shown by reliable evidence, including:
  1. Consultation with technology evaluation center(s);
  2. Credible scientific evidence published in peer-reviewed medical literature generally recognized by the relevant medical community; or
  3. Reference to federal regulations.

\*\*Medically Necessary (or “Medical Necessity”) - Health care services, treatment, procedures, equipment, drugs, devices, items or supplies that a Provider, exercising prudent clinical judgment, would provide to a patient for the purpose of preventing, evaluating, diagnosing or treating an illness, injury, disease or its symptoms, and that are:

- A. In accordance with nationally accepted standards of medical practice;
- B. Clinically appropriate, in terms of type, frequency, extent, level of care, site and duration, and considered effective for the patient's illness, injury or disease; and
- C. Not primarily for the personal comfort or convenience of the patient, physician or other health care provider, and not more costly than an alternative service or sequence of services at least as likely to produce equivalent therapeutic or diagnostic results as to the diagnosis or treatment of that patient's illness, injury or disease.

For these purposes, “nationally accepted standards of medical practice” means standards that are based on credible scientific evidence published in peer-reviewed medical literature generally recognized by the relevant medical community, Physician Specialty Society recommendations and the views of Physicians practicing in relevant clinical areas and any other relevant factors.

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**NOTICE:** If the Patient's health insurance contract contains language that differs from the BCBSLA Medical Policy definition noted above, the definition in the health insurance contract will be relied upon for specific coverage determinations.

**NOTICE:** Medical Policies are scientific based opinions, provided solely for coverage and informational purposes. Medical Policies should not be construed to suggest that the Company recommends, advocates, requires, encourages, or discourages any particular treatment, procedure, or service, or any particular course of treatment, procedure, or service.

**NOTICE:** Federal and State law, as well as contract language, including definitions and specific contract provisions/exclusions, take precedence over Medical Policy and must be considered first in determining eligibility for coverage.