

Subject: Endothelial Keratoplasty
Guideline #: CG-SURG-72
Status: Reviewed

Publish Date: 01/03/2024
Last Review Date: 11/09/2023

Description

This document addresses a variety of endothelial keratoplasty (EK) techniques, also known as posterior lamellar keratoplasty, used to treat conditions affecting the cornea. The available EK procedures include: Descemet's membrane endothelial keratoplasty (DMEK), Descemet's stripping endothelial keratoplasty (DSEK), Descemet's stripping automated endothelial keratoplasty (DSAEK) and Descemet's membrane automated endothelial keratoplasty (DMAEK). Other similar procedures addressed in this document include Femtosecond Laser-Assisted Corneal Endothelial Keratoplasty (FLEK or FLAK) or Femtosecond and Excimer Lasers-Assisted Endothelial Keratoplasty (FELEK). These procedures differ from each other in the manner in which the recipient's endothelium is removed and the methods used to prepare the donor tissue.

Note: Please see the following related documents for additional information:

- [CG-SURG-77 Refractive Surgery](#)
- [CG-SURG-94 Keratoprosthesis](#)
- [CG-SURG-105 Corneal Collagen Cross-Linking](#)

Clinical Indications

Medically Necessary:

The use of DMEK, DSEK, DSAEK and DMAEK, is considered **medically necessary** for the treatment of disorders of the corneal endothelium, including but not limited to the following:

1. Fuchs' endothelial dystrophy;
2. Aphakic and pseudophakic bullous keratopathy (corneal edema following cataract extraction);
3. Failure or rejection of a previous corneal transplant.

Not Medically Necessary:

The use of DMEK, DSEK, DSAEK and DMAEK is considered **not medically necessary** to treat disease or injury of the corneal stroma (for example, keratoconus, corneal ulcers caused by infection and traumatic corneal injuries).

The use of FLEK or FELEK is considered **not medically necessary** for all indications.

Coding

The following codes for treatments and procedures applicable to this guideline are included below for informational purposes. Inclusion or exclusion of a procedure, diagnosis or device code(s) does not constitute or imply member coverage or provider reimbursement policy. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage of these services as it applies to an individual member.

When services may be Medically Necessary when criteria are met:

CPT

	For the following codes when specified as endothelial keratoplasty DMEK, DMAEK, DSEK, DSAEK:
65756	Keratoplasty (corneal transplant); endothelial
65757	Backbench preparation of corneal endothelial allograft prior to transplantation

ICD-10 Procedure

	For the following codes when specified as endothelial keratoplasty DMEK, DMAEK, DSEK, DSAEK:
08R83KZ	Replacement of right cornea with nonautologous tissue substitute, percutaneous approach
08R93KZ	Replacement of left cornea with nonautologous tissue substitute, percutaneous approach

ICD-10 Diagnosis

H18.10-H18.13	Bullous keratopathy
H18.20-H18.239	Other and unspecified corneal edema
H18.331-H18.339	Rupture in Descemet's membrane
H18.501-H18.509	Unspecified hereditary corneal dystrophies
H18.511-H18.519	Endothelial corneal dystrophy (Fuchs' endothelial dystrophy)
T85.29XA-T85.29XS	Other mechanical complication of intraocular lens
T86.8401-T86.8409	Corneal transplant rejection
T86.8411-T86.8419	Corneal transplant failure
T86.8481-T86.8489	Other complications of corneal transplant

When services are Not Medically Necessary:

For the procedure and diagnosis codes listed above when criteria are not met or for all other diagnoses not listed or when the code describes a procedure in the Clinical Indications section as not medically necessary.

When services are also Not Medically Necessary:

For the following procedure codes; or when the code describes a procedure designated in the Clinical Indications section as not medically necessary.

CPT

65756
65757

For the following codes when specified as FLEK/FLAK or FELEK procedures:
Keratoplasty (corneal transplant); endothelial
Backbench preparation of corneal endothelial allograft prior to transplantation

ICD-10 Procedure

08R83KZ
08R93KZ

For the following codes when specified as FLEK/FLAK or FELEK procedures:
Replacement of right cornea with nonautologous tissue substitute, percutaneous approach
Replacement of left cornea with nonautologous tissue substitute, percutaneous approach

ICD-10 Diagnosis

All diagnoses

Discussion/General Information

Corneal endothelial failure may result in impairment or loss of vision. Restoration of vision with corneal transplantation, also known as penetrating keratoplasty (PK or PKP) has been the standard of care to treat diseased or damaged corneal endothelial tissue and stroma. According to the National Eye Institute (NEI), approximately 40,000 PKs, also known as corneal transplants, are performed each year in the U.S. A corneal transplant is commonly performed to replace scarred or diseased cornea. The central portion of a cloudy cornea is removed and replaced with a donor cornea. The donor cornea is sewn in place and the suture remains in place for months to allow the graft to heal properly. After the procedure, eye drops may be used for several months to assist with the healing process. PK has been associated with long healing time and significant complications such as postoperative dehiscence and astigmatism; full recovery from a PK may take up to a year or longer.

Alternatives to standard corneal transplantation (PK), known as EKs, are being used for those diagnosed with various types of endothelial failure or endothelial dysfunction such as Fuchs's endothelial dystrophy, pseudophakic/aphakic bullous keratopathy, and failed prior corneal transplant. Available EK procedures include DMEK, DSEK, DSAEK and DMAEK. DMEK, DSEK, DSAEK, and DMAEK are lamellar (non-penetrating keratoplasty) procedures in which only a portion or partial-thickness of the cornea is removed. These techniques have been developed as an alternative to PK, which involves the replacement of the full-thickness of the recipient cornea with donor cornea. A much smaller incision is needed for these procedures compared to PK, and the graft is maintained in place while healing with a gas tamponade (bubble) rather than sutures as in the full-thickness graft used in PK. PK has been associated with long healing time and significant complications such as postoperative dehiscence and astigmatism. In contrast, EK techniques replace only the diseased corneal endothelium and involve removal of Descemet's membrane (basement layer positioned between the outer corneal stroma and the inner corneal endothelial layer) and diseased endothelium from the recipient cornea. Healthy cadaveric donor corneal endothelial tissue, including Descemet's membrane and a thin layer of donor stromal tissue, are harvested and implanted into the recipient's eye. The various procedures differ in the methods used to prepare the donor cornea and the ways the recipient epithelium is removed. Endothelial keratoplasty has surpassed penetrating keratoplasty as the procedure of choice in cases of endothelial failure without corneal scarring because, most often, more rapid visual rehabilitation and reduction in rejection of the transplant is achieved (AAO, 2018).

Two additional EK procedures, FLEK and FELEK expand on the EK procedures addressed above by using laser cutting tools for intrastromal dissection of the donor tissue prior to removal. This is proposed to provide an improved wound stability and decreased postoperative astigmatism.

As a result of a much smaller and peripheral incision, case series have demonstrated visual recovery following DSEK/DSAEK/DMEK can be achieved more quickly (less than 6 months) compared to PK (12-18 months) (Bahar, 2008; Chen, 2008a; Price, 2009). DSEK and DSAEK compare favorably with PK with respect to the proportion of individuals who achieve 20/40 vision postoperatively. In a prospective case series of 100 eyes by Chen and colleagues (2008a), DSEK and DSAEK resulted in improved vision, corneal thickness and surface regularity. Excluding 26 eyes with known retinal pathology, 97% of the 94 eyes had a vision of 20/40 or better at 6 months and 14% obtained visual acuity of 20/20 or better. The authors concluded that this newer technique of EK yields many of the benefits of its predecessor (PK) and improves visual results, while noting the importance of additional research to determine the safety of DSAEK.

In 2013, van Dijk and colleagues reported results of a case series study of 248 subjects (300 eyes) who underwent DMEK for Fuchs endothelial dystrophy, bullous keratopathy or previous corneal transplant failure. At 6 months, 98% of eyes reached a Best Spectacle Corrected Visual Acuity (BSCVA) of $\geq 20/40$, 79% reached $\geq 20/25$, 46% reached $\geq 20/20$, and 14% $\geq 20/18$. Donor endothelial cell density showed a decrease from 2561 (± 198) cells/mm² before, to 1674 (± 518) cells/mm² at 6 months after surgery ($n=251$; $p<0.0000$).

Guerra and colleagues (2011) reported on the use of DMEK in 136 eyes in 112 subjects with Fuchs' endothelial dystrophy, pseudophakic bullous keratoplasty, or failed previous graft. They reported that at 1 year, 41% of subjects achieved a BSCVA of 20/20 or better; 80% could be corrected to 20/25 or better, and 98% achieved 20/30 or better vision. A slight refractive hyperopic shift was found at 1 year, but it was not statistically significant ($p=0.08$). Also, there was no significant change in the preoperative astigmatism ($p=0.17$). Endothelial cell loss at 1 year was $36 \pm 20\%$ ($n=94$; range, 13%-88%), with most of the loss being observed during the first 3 months after surgery. A total of 11 grafts (8%) demonstrated primary failure and 1 eye (0.7%) had secondary failure resulting from endothelial rejection. Episodes of immunologic rejection were documented in 7 eyes (5.1%) during the first year of follow-up. The authors concluded that DMEK had better visual acuity results in the first year after surgery than typically reported for other EK techniques, such as Descemet's stripping automated EK, while having less refractive changes and similar endothelial cell counts but required a higher re-bubbling rate.

A retrospective case series of DSAEK performed on 118 eyes in 99 subjects reported complications including graft detachment, graft failure, graft rejection, cystoid macular edema, and suprachoroidal hemorrhage (Suh, 2008). The most frequent complication was graft detachment. A total of 27 eyes developed graft detachment; 25 eyes underwent a second procedure with repositioning or rebubbling after surgery, or both. Of the 118 procedures, 21 failed due to ongoing edema post-DSAEK. As noted below, with experience and improvements with DSAEK there are fewer complications reported in the case series.

A published study by Bahar and colleagues (2008) provided the first prospective comparison of DSEK, DSAEK, DLEK and PK from a single center. This nonrandomized comparison reported on 177 eyes in 161 subjects with a mix of endothelial corneal diseases who underwent either PK ($n=48$), DLEK ($n=68$), DSEK ($n=16$) or DSAEK ($n=45$). Postoperative BSCVA outcome at 12 months for PK, DLEK, and DSEK and at 6 months for DSAEK were compared. DSAEK was measured at 6 months because of earlier stability of refraction postoperatively in this group. The BSCVA was 20/53 in the PK group, with DSAEK significantly better than PK (mean BCVA 20/44; $p=0.001$). DSAEK visual outcome was not significantly different from DSEK (20/56), but was better than DLEK (20/80; $p=0.001$). Although this study lacked randomization, the results are consistent with other case series using historic control showing DSEK/DSAEK provides earlier post-operative visual recovery, less post-surgical (sutured incision) astigmatism, and as good or better

BSCVA than PK.

Although PK provides healthy donor endothelial tissue, it also replaces the overlying normal corneal stroma in individuals with disease limited to the endothelial layer. The full-thickness graft used in PK is secured with suture resulting in irregular astigmatism post operatively, often leading to the need for further corneal surgery or use of hard contact lens for visual recovery. Bahar (2008) compared postoperative astigmatism following PK, DSEK and DSAEK in a prospective, comparative nonrandomized study. Postoperative refractive astigmatism was significantly higher in the PK group (3.78 diopters) compared with DSEK (1.86 diopters) and DSAEK (1.36 diopters).

Traumatic globe rupture is a significant risk following PK and visual recovery following traumatic globe rupture is poor. In one case series by Tran and colleagues (2005), only 27% were able to recover visual acuity of 20/200 or better following attempts to repair the globe. Since both DSEK and DSAEK require a much smaller incision to introduce the endothelial graft than the sutured incision needed for a full-thickness corneal graft used in PK, the structural integrity of the globe is felt to be better maintained post operatively. Another case-control series compared the incidence of traumatic globe rupture following PK (5.8%) with traumatic rupture rates for extracapsular cataract surgery 1/221 (0.45%) and 0/6450 for phacoemulsification. Both of these rates were significantly less than after PK ($p=0.005$, $p<0.0001$). With PK, the highest risk period for traumatic globe rupture is the month following surgery, when wound strength is derived almost entirely from sutures. The month following removal of sutures is a second high-risk period. Following PK, the cornea never regains its preoperative strength and remains at risk for traumatic rupture for the remainder of the individual's life (Elder, 2004). In contrast, there have been no reports of traumatic wound failure after DSEK/DSAEK surgery.

Graft dislocation is the most common significant risk of DSEK/DSAEK and may increase the risk of graft failure. However, most cases of dislocation can be corrected with repositioning of the graft and gas tamponade (bubble) in an office-based procedure. Several case series report graft dislocation rates of 1-15%. In a comparative trial (Bahar, 2008), graft dislocation rates were 12.5% for DSEK and 15.6% for DSAEK. In this series, acute rejection rates were 4.2%, 0% and 2.2% for PK, DSEK and DSAEK, respectively and primary graft failure rates were 2.1%, 0%, and 2.2% for PK, DSEK, and DSAEK, respectively. These rates of acute rejection and primary graft failure were not significantly different between PK and DSEK/DSAEK.

The occurrence and extent of initial endothelial cell loss after DSEK/DSAEK is uncertain. In some, but not all case series it has been found to be higher with DSEK/DSAEK than PK. However, in the Bahar 2008 comparative series, endothelial cell loss 1 year after surgery was similar in the DSEK/DSAEK and PK groups (40%). In subsequent trials, larger incision sizes (5 mm rather than 3 mm) and improved insertion techniques have resulted in lower initial endothelial cell loss than reported in early studies (Chen, 2008b). In addition, the DSEK/DSAEK graft is larger (7.5-8.0 mm vs. 8.5-9.0 mm) than the PK graft which does compensate for early cell loss. A prospective case series by Price and colleagues (2010) evaluated outcomes in DSAEK ($n=173$) in comparison to PK ($n=410$) from the Cornea Donor Study. The surgeons used donor tissue between 8.25 mm and 9.0 mm with incision size of 3.2 mm or 5 mm. The author concluded, Descemet's stripping automated endothelial keratoplasty performed by experienced surgeons resulted in a higher 6-month and 12-month percent cell loss than PKP with comparable graft survival and comparable donor and recipient characteristics.

The 3-year results of this trial were published in 2013 (Price, 2013). The 3-year survival rate of the grafts did not differ significantly between DSAEK and PK procedures performed for either Fuchs' dystrophy (96% for both; $p=0.81$) or non-Fuchs' cases (86% vs. 84%; $p=0.41$). The 3-year predicted probability of a rejection episode was 9% with DSAEK versus 20% with PK ($p=0.0005$). The median 3-year cell loss in Fuchs' dystrophy cases for DSAEK and PK were 46% and 51%, respectively ($p=0.33$), and in the non-Fuchs' cases 59% and 61% ($p=0.70$). The authors concluded that graft success rate and endothelial cell loss were comparable at 3 years for DSAEK and PK procedures and that a 5-mm DSAEK incision width was associated with significantly less cell loss than a 3.2-mm incision.

The advantages of DSEK/DSAEK cited above (little if any globe rupture, earlier post-operative visual recovery, and less post-surgical astigmatism), have led to their rapid adoption over PK for the treatment of corneal endothelial failure. EK is currently the most commonly performed keratoplasty in the U.S. Although the advantages of EK procedures over PK have yet to be demonstrated in large, randomized controlled trials (RCTs), evidence from a growing body of case series studies is compelling and has resulted in the rapid adoption of these newer techniques for treating corneal endothelial disease.

The American Academy of Ophthalmology (AAO) released a report in 2009 entitled "Descemet's Stripping Endothelial Keratoplasty: Safety and Outcome". The conclusions of the report include:

The evidence reviewed is supportive of DSEK being a safe and effective treatment for endothelial diseases of the cornea. In terms of surgical risks, complication rates, graft survival (clarity), visual acuity, and endothelial cell loss, DSEK appears similar to penetrating keratoplasty (PK). It seems to be superior to PK in terms of earlier visual recovery, refractive stability, postoperative refractive outcomes, wound and suture-related complications, and intraoperative and late suprachoroidal hemorrhage risk. The most common complications of DSEK do not appear to be detrimental to the ultimate vision recovery in most cases. Long-term endothelial cell survival and the risk of late endothelial rejection are beyond the scope of this assessment.

A 2014 Cochrane review of PK versus EK as treatment for Fuchs endothelial dystrophy analyzed three RCTs representing a total 123 eyes and did not find evidence of improved visual recover after EK procedures and although higher order aberrations were lower in EK recipients, endothelial cell loss was greater. Authors acknowledge that the overall quality of the trials chosen for inclusion were not satisfactory given their small sample size and unmasked design. The review concluded that:

More RCTs are needed to compare PKP with commonly performed EK procedures such as DSEK, DSAEK and DMEK in order to determine the answers to two key questions, whether there is any difference in the final visual outcome between these techniques and whether there are differences in the rates of graft survival in the long term?

A long-standing corneal transplant registry in Australia has provided long-term prospective data for a large cohort of 13,920 PKs, 88 DLEKs, and 2287 EKs performed between 1996 and 2013 (Coster, 2014). The primary outcome of interest in this cohort study was graft survival. Using Kaplan-Meier functions, investigators found that survival of EKs performed for Fuchs' dystrophy or pseudophakic bullous keratopathy were poorer than survival of PKs for the same indications over the same time-frame ($p<0.001$). Visual outcomes were significantly better for PKs than for EK performed for Fuchs' dystrophy ($p<0.001$), but EKs achieved better visual outcomes than PKs for pseudophakic bullous keratopathy ($p<0.001$). Authors conclude that the primary outcome, graft failure, favored PK for longevity. Given the poor outcomes seen following graft failure, including increased risk for subsequent graft failure (Mitra, 2014) more long-term data from randomized, controlled-trials are needed to further define the long-term efficacy of EK compared to the more traditional PK approach. A major-shortcoming of this study design that warrants caution when interpreting results, is its failure to differentiate results by the type of EK technique performed (i.e., DSEK, DSAEK, DMEK, or DMAEK).

A meta-analysis by Yang and colleagues (2020) sought to compare the outcomes of graft survival, endothelial cell loss and vision improvement between PK and DSAEK for treating corneal endothelium diseases. A total of 10 2-arm prospective and retrospective studies ($n=2634$ subjects; 910 eyes treated with DSAEK and 1804 eyes treated with PK) were chosen for inclusion. DSAEK was associated with a greater improvement from baseline in BSCVA, (change from baseline=-0.225, 95% Confidence Interval [CI]=-0.341

to -0.109, $p < 0.001$) and a reduced loss of endothelial cell density, (diff. in means = -292.05 cells/mm², 95% CI = -419.53 to -146.57 cells/mm², $p < 0.001$); graft survival rates were similar (odds ratio = 1.005, 95% CI = 0.329-3.071, $p = 0.993$). The overall results suggested that DSAEK may have an advantage over PK for corneal endothelial dysfunction in terms of the BSCVA, however the lack of definitive time frames limits conclusions with respect to endothelial cell loss and graft survival.

Wu and colleagues (2021) conducted a systematic review and meta-analysis comprised of 25 prospective and retrospective studies (no RCTs) reporting DSAEK/DSEK or DMEK after failed PK. Primary outcome measures included graft survival, detachment rates and postoperative visual outcomes. Ultimately 970 subjects (989 eyes) were enrolled, of which 735 subjects (746 eyes) underwent DSAEK/DSEK surgery and 235 (243 eyes) underwent DMEK surgery. In the DSAEK studies, the graft failure rate was 18% (95% CI, 10%-26%), the detachment rate was 15% (95% CI, 9%-22%) and the rejection rate was 7% (95% CI, 3%-12%). In all of the DMEK studies, the graft failure rate was 14% (95% CI, 4%-27%), the detachment rate was 42% (95% CI, 28%-56%) and the rejection rate was 7% (95% CI, 2%-16%). Endothelial keratoplasty for treatment of failed PK led to improved vision and graft clarity for most individuals. Graft survival rates and rejection rates were comparable between the DSAEK and DMEK groups, whereas the DMEK group showed better visual outcomes and a higher detachment rate.

Dunker and colleagues (2021) conducted a prospective registry study in which 752 consecutive primary DMEK procedures registered in the Netherlands Organ Transplant Registry were identified and enrolled. Graft survival and outcomes of primary transplants for Fuchs' endothelial dystrophy were the primary outcomes. At 3 months, graft survival was 87%, at 6 months and 1 year it was 85%, and at 2 years, it was 78%. Baseline BSCVA in primary transplants with FED significantly improved over the 2-year follow-up ($p < 0.001$). At 3 months, endothelial cell loss measured 33%. This robust pragmatic trial provides continued data to support DMEK as an effective treatment for Fuchs' endothelial dystrophy.

Two more EK techniques to be developed, called FLEK or FLAK and FELEK, utilize laser techniques to prepare the donor tissue for transplantation as opposed to manual methods used for other EK procedures. The literature addressing this procedure is limited. Cheng (2009) reported the results of a randomized trial comparing FLEK with PK for 80 subjects (80 eyes) with Fuchs' endothelial dystrophy, pseudophakic bullous keratopathy, or posterior polymorphous dystrophy, and best spectacle-corrected visual acuity less than 20/50. Subjects were randomly assigned in a 1:1 manner. In the FLEK group, 4 of the 40 eyes which did not receive the procedure were excluded from the analysis. A total of 8 eyes failed (22% of 36), and 2 participants were lost to follow-up due to death. In the PK group, only 1 participant was lost to follow-up. At 12 months postoperatively, refractive astigmatism was lower in the FLEK group than the PK group (86% vs. 51%), but there was greater hyperopic shift. Mean BSCVA was better following PK than FLEK at 3-, 6-, and 12-month follow-up. Endothelial cell loss was reported as greater in the FLEK group (65%) versus the PK group (23%). With the exception of dislocation and need for repositioning of the FLEK grafts in 28% of eyes, the percentage of complications were similar in the 2 groups. Complications in the FLEK group were due to pupillary block, graft failure, epithelial ingrowth, and elevated intraocular pressure, whereas complications in the PK group were related to the sutures and elevated intraocular pressure. The authors concluded that FLEK effectively reduced postoperative astigmatism and eliminated wound healing related problems compared to PK. However, they note that visual acuity is lower compared with conventional PK, and the rate of endothelial cell loss is concerning.

A nonrandomized retrospective comparative study by Chamberlain (2013) involving 100 subjects compared FLEK ($n = 50$) to PK ($n = 50$). Significantly lower topographic astigmatism was achieved in the FLEK group over the PK group in the 4- to 6-month follow-up period ($p = 0.0324$). However, this difference was not present in any other follow-up period up to 24 months postoperatively. A subset analysis of subjects with keratoconus or post-LASIK ectasia did not show any difference in either astigmatism or visual acuity at any time. No significant improvement in BSCVA was noted at any time point.

Cheng (2011) reported a prospective, randomized clinical trial involving 80 subjects (80 eyes) with corneal endothelial dysfunction randomized to undergo FLEK or PK. At the end of 12 months, only 29 (72.5%) FLEK subjects were available for analysis versus 39 (97.5%) in the PK group. In the FLEK group, postoperative refractive and topographic astigmatism values were not significantly different from preoperative values. In the PK group, all postoperative refractive and topographic astigmatism values were significantly higher compared with those before surgery. At 12 months after surgery, the percentage of subjects with a refractive astigmatism of ≤ 3.0 diopters was significantly higher in the FLEK group compared with the PK group (86.2% vs. 51.3%; $p = 0.004$). Post-operatively, the mean BSCVA in the PK group was significantly better when compared with the FLEK group at all follow-up visits. The mean gain in BSCVA at 12 months was not significantly different between the FLEK and PK groups ($p = 0.103$).

A small ($n = 22$) retrospective cohort study from 2013 reported a reduction in visual acuity when the endothelial transplant was prepared with FLEK versus DSAEK (Vetter, 2013). There was also greater surface irregularity with the laser-assisted EK. Given this data, it is unclear that there is any benefit to FLEK, and it may be deduced by the available evidence that PK may be superior to FLEK with regard to postoperative visual acuity.

Currently, FLEX or FLAK, and FELEK are not considered in accordance with generally accepted standards of medical practice and are not considered clinically appropriate.

Definitions

Aphakia: The absence of the natural crystalline lens.

Cornea: The outermost layer of the eye; dome shaped and covers the front of the eye.

Epithelium: The outermost layer of tissue.

Phakia: The presence of the natural crystalline lens.

Pseudophakia: The substitution of the natural crystalline lens with a synthetic lens.

References

Peer Reviewed Publications:

1. Allan BD, Terry Ma, Price FW, et al. Corneal transplant rejection rate and severity after endothelial keratoplasty. *Corneal*. 2007; 26(9):1039-1042.
2. Bahar I, Kaiserman I, McAllum P, et al. Comparison of posterior lamellar keratoplasty techniques to penetrating keratoplasty. *Ophthalmology*. 2008; 115(9):1525-1533.
3. Chamberlain WD, Rush SW, Mathers WD, et al. Comparison of femtosecond laser-assisted keratoplasty versus conventional penetrating keratoplasty. *Ophthalmology*. 2011; 118(3):486-491.
4. Chen ES, Terry MA, Shamie N, et al. Descemet-stripping automated endothelial keratoplasty: insertion using novel 40/60 underfold technique for preservation of donor endothelium. *Cornea*. 2008; 27(8):941-943.
5. Chen ES, Terry MA, Shamie N, et al. Descemet-stripping automated endothelial keratoplasty: six-month results in a prospective study of 100 eyes. *Corneal*. 2008a; 27(5):514-520.

6. Cheng YY, Schouten JS, Tahzib NG, et al. Efficacy and safety of femtosecond laser-assisted corneal endothelial keratoplasty: a randomized multicenter clinical trial. *Transplantation*. 2009; 88(11):1294-1302.
7. Cheng YY, van den Berg TJ, Schouten JS, et al. Quality of vision after femtosecond laser-assisted descemet stripping endothelial keratoplasty and penetrating keratoplasty: a randomized, multicenter clinical trial. *Am J Ophthalmol*. 2011; 152(4):556-566.
8. Chih A, Lugo M, Kowing D. Descemet stripping and automated endothelial keratoplasty: an alternative to penetrating keratoplasty. *Optom Vis Sci*. 2008; 85(3):152-157.
9. Coster DJ, Lowe MT, Keane MC, et al. A comparison of lamellar and penetrating keratoplasty outcomes: a registry study. *Ophthalmology*. 2014; 121(5):979-987.
10. Covert DJ, Koenig SB. Descemet stripping and automated endothelial keratoplasty (DSAEK) in eyes with failed penetrating keratoplasty. *Cornea*. 2007; 26(6):692-696.
11. Dunker SL, Veldman MHJ, Winkens B, et al. Real-World Outcomes of DMEK: A Prospective Dutch registry study. *Am J Ophthalmol*. 2021; 222:218-225.
12. Elder MJ, Stack RR. Globe rupture following penetrating keratoplasty: how often, why, and what can we do to prevent it? *Cornea*. 2004; 23(8):776-780.
13. Guerra FP, Anshu A, Price MO, et al. Descemet's membrane endothelial keratoplasty: prospective study of 1-year visual outcomes, graft survival, and endothelial cell loss. *Ophthalmology*. 2011; 118(12):2368-2373.
14. Koenig SB, Covert DJ. Early results of small-incision Descemet's stripping and automated endothelial keratoplasty. *Ophthalmology*. 2007; 114(2):221-226.
15. Li S, Liu L, Wang W, et al. Efficacy and safety of Descemet's membrane endothelial keratoplasty versus Descemet's stripping endothelial keratoplasty: a systematic review and meta-analysis. *PLoS One*. 2017; 12(12):e0182275.
16. Marques RE, Guerra PS, Sousa DC et al. DMEK versus DSAEK for Fuchs' endothelial dystrophy: A meta-analysis. *Eur J Ophthalmol*. 2019; 29(1):15-22.
17. Mearza AA, Qureshi MA, Rostron CK. Experience and 12 month results of Descemet-stripping endothelial keratoplasty (DSEK) with a small-incision technique. *Cornea*. 2007; 26(3):279-283.
18. Melles GF, Lander F, van Dooren BT, et al. Preliminary clinical results of posterior lamellar keratoplasty through a sclerocorneal pocket incision. *Ophthalmology*. 2000; 107(10):1850-1856.
19. Mity D, Bhogal M, Patel AK, et al. Descemet stripping automated endothelial keratoplasty after failed penetrating keratoplasty: survival, rejection risk, and visual outcome. *JAMA Ophthalmol*. 2014; 132(6):742-749.
20. Moura-Coelho N, Manero F, Elies D, et al. Repeat Descemet membrane endothelial keratoplasty for failed primary Descemet membrane endothelial keratoplasty at a referral center for keratoplasty in Spain: DIMOEK Study. *Am J Ophthalmol*. 2020; 215:49-55.
21. Pavlovic I, Shajari M, Herrmann E, et al. Meta-analysis of postoperative outcome parameters comparing Descemet membrane endothelial keratoplasty versus Descemet stripping automated endothelial keratoplasty. *Cornea*. 2017; 36(12):1445-1451.
22. Price FW Jr, Price MO. Descemet's stripping with endothelial keratoplasty in 200 eyes: early challenges and techniques to enhance donor adherence. *J Cataract Refract Surg*. 2006; 32(3):411-418.
23. Price MO, Fairchild KM, Price FW Jr. Comparison of manual and automated endothelial cell density analysis in normal eyes and DSEK eyes. *Cornea*. 2013; 32(5):567-573.
24. Price MO, Giebel AW, Fairchild KM, Price FW Jr. Descemet's membrane endothelial keratoplasty: prospective multicenter study of visual and refractive outcomes and endothelial survival. *Ophthalmology*. 2009; 116(12):2361-2368.
25. Price MO, Gorovoy M, Benetz BA, et al. Descemet's stripping automated endothelial keratoplasty outcomes compared with penetrating keratoplasty from the Cornea Donor Study. *Ophthalmology*. 2010; 117(3):438-444.
26. Price MO, Price FW. Endothelial cell loss after Descemet stripping with endothelial keratoplasty influencing factors and 2-year trend. *Ophthalmology*. 2008; 115(5):857-865.
27. Singh A, Zarei-Ghanavati M, Avadhanam V, Liu C. Systematic review and meta-analysis of clinical outcomes of descemet membrane endothelial keratoplasty versus descemet stripping endothelial/descemet stripping automated endothelial keratoplasty. *Cornea*. 2017; 36(11):1437-1443.
28. Suh LH, Yoo SH, DeoBhakta A, et al. Complications of Descemet's stripping with automated endothelial keratoplasty: survey of 118 eyes at one institute. *Ophthalmology*. 2008; 115(9):1517-1524.
29. Terry MA, Chen ES, Shamie N, et al. Endothelial cell loss after Descemet's stripping endothelial keratoplasty in a large prospective series. *Ophthalmology*. 2008; 115(3):488-496.
30. Tran TH, Ellies P, Azan F, et al. Traumatic globe rupture following penetrating keratoplasty. *Graefes Arch Clin Exp Ophthalmol*. 2005; 243(6):525-530.
31. Trousdale ER, Hodge DO, Baratz KH, et al. Vision-related quality of life before and after keratoplasty for Fuchs's endothelial dystrophy. *Ophthalmology*. 2014; 121(11):2147-2152.
32. van Dijk K, Ham L, Tse WH, et al. Near complete visual recovery and refractive stability in modern corneal transplantation: Descemet membrane endothelial keratoplasty (DMEK). *Cont Lens Anterior Eye*. 2013; 36(1):13-21.
33. Vetter JM, Butsch C, Faust M, et al. Irregularity of the posterior corneal surface after curved interface femtosecond laser-assisted versus microkeratome-assisted descemet stripping automated endothelial keratoplasty. *Cornea*. 2013; 32(2):118-124.
34. Wang F, Zhang T, Kang YW, et al. Endothelial keratoplasty versus repeat penetrating keratoplasty after failed penetrating keratoplasty: a systematic review and meta-analysis. *PLoS One*. 2017; 12(7):e0180468.
35. Wu J, Wu T, Li J, et al. DSAEK or DMEK for failed penetrating keratoplasty: a systematic review and single-arm meta-analysis. *Int Ophthalmol*. 2021; 41(7):2315-2328.
36. Yang K, Zhao Y, Lu H, et al. Graft survival and endothelial outcomes after penetrating keratoplasty and Descemet stripping automated endothelial keratoplasty: A systematic review and meta-analysis. *Exp Ther Med*. 2020; 20(3):2794-2804.
37. Zhu AY, Markezan MC, Kraus CL, Prescott CR. Pediatric corneal transplants: review of current practice patterns. *Cornea*. 2018; 37(8):973-980.
38. Zhu L, Zha Y, Cai J, Zhang, Y. Descemet stripping automated endothelial keratoplasty versus descemet membrane endothelial keratoplasty: a meta-analysis. *Int Ophthalmol*. 2018; 38(2):897-905.

Government Agency, Medical Society, and Other Authoritative Publications:

1. AAO PPP Cornea/External Disease Committee, Hoskins Center for Quality Eye Care. Corneal Edema and Opacification PPP – 2018. <https://www.aao.org/preferred-practice-pattern/corneal-edema-and-opacification-ppp-2018>. Accessed on September 7, 2023.
2. Deng SX, Lee WB, Hammersmith KM, et al. Descemet membrane endothelial keratoplasty: safety and outcomes: a report by the American Academy of Ophthalmology. *Ophthalmology*. 2018; 125(2):295-310.
3. Lee WB, Jacobs DS, Musch DC, et al. Descemet's Stripping Endothelial Keratoplasty: Safety and Outcomes: A Report by the American Academy of Ophthalmology. Reviewed 2014. Volume 116, Issue 9. September 2009. For additional information visit the AAO website: <http://one.aao.org/ophthalmic-technology-assessment/descemets-stripping-endothelial-keratoplasty-safety>. Accessed on November 10, 2023.

4. Nanavaty MA, Wang X, Shortt AJ. Endothelial keratoplasty versus penetrating keratoplasty for Fuchs endothelial dystrophy. Cochrane Database Syst Rev. 2014;(2):CD008420.
5. Stuart AJ, Romano V, Virgili G, Shortt AJ. Descemet's membrane endothelial keratoplasty (DMEK) versus Descemet's stripping automated endothelial keratoplasty (DSAEK) for corneal endothelial failure. Cochrane Database Syst Rev. 2018; 6:CD012097.

Websites for Additional Information

1. National Eye Institute (NEI). Facts about the cornea and corneal disease. Updated in August 2019. Available at: <https://nei.nih.gov/health/cornealdisease>. Accessed on September 25, 2023.

Index

Descemet's membrane automated endothelial keratoplasty (DMAEK)
 Descemet's membrane endothelial keratoplasty (DMEK)
 Descemet's stripping automated endothelial keratoplasty (DSAEK)
 Descemet's stripping endothelial keratoplasty (DSEK)
 Endothelial keratoplasty (EK)
 Femtosecond and Excimer Lasers-Assisted Endothelial Keratoplasty (FELEK)
 Femtosecond Laser-Assisted Corneal Endothelial Keratoplasty (FLEK or FLAK)
 Partial-thickness, corneal transplant

The use of specific product names is illustrative only. It is not intended to be a recommendation of one product over another, and is not intended to represent a complete listing of all products available.

History

Status	Date	Action
Reviewed	11/09/2023	Medical Policy & Technology Assessment Committee (MPTAC) review. Updated References and Websites sections.
Reviewed	11/10/2022	MPTAC review. Updated Discussion/General Information, References and Websites sections.
Reviewed	11/11/2021	MPTAC review. Updated Discussion/General Information, References and Websites sections.
Reviewed	11/05/2020	MPTAC review. Updated Discussion/General Information, References and Websites sections. Reformatted Coding section.
	10/01/2020	Updated Coding section with 10/01/2020 ICD-10-CM changes; added H18.501-H18.509, H18.511-H18.519 replacing H18.51, H18.59 and T86.8401-T86.8409, T86.8411-T86.8419, T86.8481-T86.8489 replacing T86.840, T86.841, T86.848.
Reviewed	11/07/2019	MPTAC review. Updated References and Websites sections.
Reviewed	01/24/2019	MPTAC review. Updated Discussion/General Information and References sections.
New	01/25/2018	MPTAC review. Initial document development. Moved content of SURG.00108 Endothelial Keratoplasty to new clinical utilization management guideline document with the same title.

Federal and State law, as well as contract language, and Medical Policy take precedence over Clinical UM Guidelines. We reserve the right to review and update Clinical UM Guidelines periodically. Clinical guidelines approved by the Medical Policy & Technology Assessment Committee are available for general adoption by plans or lines of business for consistent review of the medical necessity of services related to the clinical guideline when the plan performs utilization review for the subject. Due to variances in utilization patterns, each plan may choose whether to adopt a particular Clinical UM Guideline. To determine if review is required for this Clinical UM Guideline, please contact the customer service number on the member's card.

Alternatively, commercial or FEP plans or lines of business which determine there is not a need to adopt the guideline to review services generally across all providers delivering services to Plan's or line of business's members may instead use the clinical guideline for provider education and/or to review the medical necessity of services for any provider who has been notified that his/her/its claims will be reviewed for medical necessity due to billing practices or claims that are not consistent with other providers, in terms of frequency or in some other manner.

No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, or otherwise, without permission from the health plan.