Review

Decision-Making in Keratoprosthesis: Navigating Device Selection in Complex Ocular Scenarios

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Abstract

Keratoprosthesis (KPro) implantation serves as a last resort for visual rehabilitation in patients with end-stage bilateral corneal blindness, particularly when conventional corneal transplantation is no longer viable. Advances in biomaterials and refinements in prosthetic design have significantly enhanced anatomical retention and visual outcomes. Among the various types available, the Boston type 1 and 2 devices and the modified osteo-odonto-KPro remain the most widely utilized globally. This review aims to support comprehensive clinical decision-making by providing an in-depth overview of the design characteristics, surgical considerations, and postoperative care protocols associated with the most widely used KPro devices. In addition, we discuss a broad range of influencing factors, including the status of the ocular surface, eyelid anatomy, tear film adequacy, underlying systemic or autoimmune diseases, and patient-related logistical and socioeconomic concerns. Special emphasis is placed on the importance of preoperative evaluation and counselling and the role of a multidisciplinary approach in achieving successful long-term outcomes. Drawing on current evidence and clinical experience, we propose a practical decision-making algorithm to aid ophthalmologists in selecting the most appropriate KPro tailored to individual patient profiles.

Keywords: Keratoprosthesis, Boston type 1, modified osteo-odonto-keratoprosthesis, MOOKP, Boston type 2, tibial keratoprosthesis

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Introduction

Keratoprosthesis (KPro) is considered as a last resort for visual rehabilitation in end-stage ocular surface disorders with bilateral corneal blindness, particularly when the risk of failure with conventional penetrating keratoplasty is high. Pellier de Quengsy first introduced the concept of a KPro using a convex glass plate with a silver rim. Although early outcomes were poor and interest declined, the discovery of polymethyl methacrylate (PMMA) as a biocompatible material reignited advancements in KPro development.[1,2]

Broadly based on the indication for use, KPros are categorized as type 1 or 2, with the choice dependent on the underlying etiology, adequacy of the preocular tear film, eyelid function, overall health of the recipient, specific expertise of the surgeon, and also the availability of the KPro. Decision-making in KPro is a critical factor in determining the final outcome. The prognosis of type 1 KPro in autoimmune disorders is generally less favorable compared to type 2, and therefore it is not typically recommended.[3,4] Selecting the appropriate type of KPro is essential for achieving the best possible prognosis and clinical outcome.

This article aims to support clinical decision-making across diverse scenarios by outlining key design features of commonly used and available KPros, assessment of ocular and systemic conditions, and consideration of other relevant factors.

Keratoprosthesis Devices and Surgical Technique

KPro devices vary in design, material, and indication. Commonly used types include the Boston type 1 and 2, modified osteo-odonto-KPro (MOOKP) and the osteo/tibial bone KPro (TBK) (Figure 1). Each device requires a tailored surgical approach depending on the ocular surface condition (Table 1).

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Type 1 Keratoprosthesis

The Boston type 1 KPro (Massachusetts Eye and Ear, Boston, MA, USA) consists of two main components: a front plate (5 mm) with central optic (3.5-3.7 mm) made of PMMA, and a fenestrated back plate made of PMMA or titanium which keeps the device in place and allows aqueous humor to reach the corneal graft. A corneal graft is sandwiched between the front and back plate and enables implantation of the device into the host. Both aphakic and pseudophakic versions are available. The aphakic version is selected based on the axial length of the eye, whereas the pseudophakic comes in a standard configuration.[5,6]

The Auro and Lucia type 1 KPros are modified versions of the Boston type 1 KPro. The Aurolab KPro (AuroKPro; Aurolab, Madurai, India) closely replicates the design of the Boston KPro, comprising a PMMA optic and back plate, secured with a titanium locking ring. Like the Boston KPro, it is also available in both aphakic and pseudophakic versions.[7] The Lucia KPro (Massachusetts Eye and Ear, Boston, MA, USA) features a titanium back plate with a PMMA optic and front plate and is designed as a single-axial-length device to reduce manufacturing costs and improve affordability (Figure 2).[8]

Once assembled around the corneal donor graft, the surgical steps are the same for all these Boston KPro modifications, and require suturing of the assembled device and corneal graft as in a full-thickness penetrating keratoplasty (Figure 3). A bandage contact lens is placed over the KPro at the end of the surgery to avoid desiccation and replaced on a schedule determined by the type of contact lens and the quality of the recipient's tear film (usually every 2-3 months).

The surgical steps are as demonstrated in recent surgical videos on ocular surface surgeries.[9]

Type 2 Keratoprosthesis

The Boston type 2 KPro (Massachusetts Eye and Ear, Boston, MA, USA) shares a similar design with the type 1 Boston KPro, with the key difference being a 2-mm-longer optical stem that extends anteriorly through surgically fused eyelids or an oral mucosal graft.[10] It is implanted in a single surgery with complete removal of all ocular surface epithelium and is usually combined with a complete vitrectomy and glaucoma valve implant. If the eyelids are retracted due to scarring or lost due to trauma, it can be implanted through an oral mucosal graft, in which case implantation requires an intact and healthy mucosa before the KPro is implanted. In a first stage, buccal mucosa is harvested and draped over a surgically deepithelialized ocular surface followed by implantation of the KPro months later, once the mucosa is confirmed to be intact and well-vascularized. For KPro implantation, the mucosa is reflected and after securing the KPro, the mucosa is sutured back with the optic protruding through an opening created by the surgeon (Figure 4).[11]

The surgical steps are as demonstrated in recent surgical videos on ocular surface surgeries.[9]

Modified Osteo-Odonto-Keratoprosthesis

The osteo-odonto-KPro was first designed by Strampelli and later modified by Falcinelli (MOOKP).[12] In MOOKP, the anterior segment is reconstructed with an epicorneal tooth root alveolar complex, a mucosal graft, and a central PMMA optic

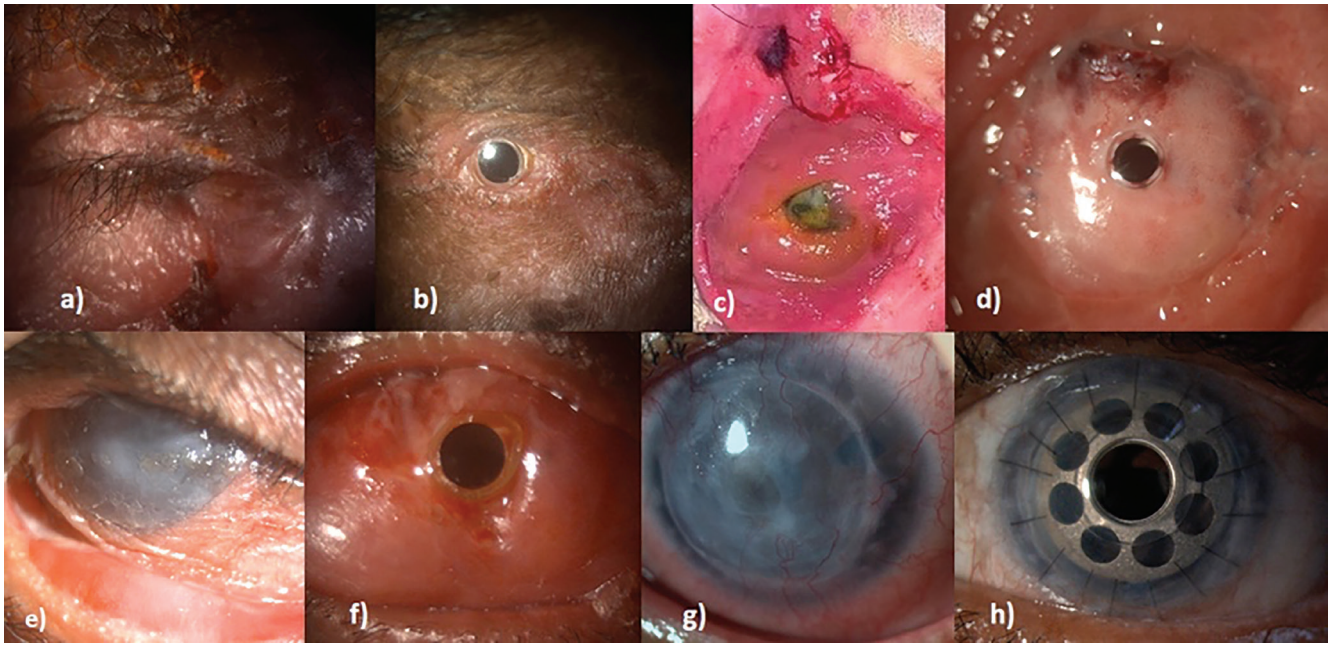

Figure 1. Representative clinical images demonstrating the use of various keratoprosthesis devices customized to underlying ocular surface and adnexal conditions. a, b) Boston type 2 keratoprosthesis done through the lid for a patient with total ankyloblepharon following chemical burns. c, d) Boston type 2 keratoprosthesis done through the mucosa for a patient with absent lids and significant facial burns following thermal burns. e, f) Osteo-odonto-keratoprosthesis done in a patient with Stevens-Johnson syndrome with dry keratinized ocular surface. g, h) Lucia type 1 keratoprosthesis in a patient with multiple failed grafts

Table 1. Overview of commonly used keratoprostheses: design features, indications, and surgical techniques

Keratoprosthesis reference	Composition	Indications	Wet/dry eye*	Surgical Technique
Boston type 1[6]	Solid PMMA front plate and optical stem, donor corneal button, and titanium or PMMA back plate with holes. Aphakic and pseudophakic versions available	- Multiple failed grafts - Herpetic keratitis - Silicon oil filled eyes - Post chemical/thermal injury - Aniridia	Wet	Single stage surgery similar to PK
Aurolab type 1[7]	Same as Boston 1 (only PMMA back plate) and has a locking ring	Same as Boston 1	Wet	Single stage surgery similar to PK
Lucia type 1[8]	Same as Boston 1 with titanium back plate. Available as single axial length aphakic device	Same as Boston 1	Wet	Single stage surgery similar to PK
Boston type 2[9]	Same as Boston 1 with longer optical stem	- Autoimmune disorders (SJS, OCP) - Severe chemical/thermal burns	Dry	Single-stage surgery similar to PK, with complete removal of conjunctival epithelium and tarsorrhaphy with central opening for the optic
MOOKP[11]	Osteo-odonto-acrylic lamina with central PMMA optic	- Autoimmune disorders (SJS, OCP) - Severe chemical/thermal burns	Dry	2/3-stage surgery Stage 1A: iris removal + lens cryoextraction + anterior vitrectomy +/- tectonic PK Stage 1B+C: Buccal mucosa anchored over the eye and OOAL complex prepared and placed in subcutaneous pouch Stage 2: OOAL placed in the eye
TBK[14]	Tibial bone haptic with central PMMA optic	- Autoimmune disorders (SJS, OCP) - Severe chemical/thermal burns	Dry	Similar to MOOKP but using tibial bone instead of canine tooth

*Wet eye defined as Schirmer's >5 mm. PMMA: Polymethyl methacrylate, SJS: Stevens-Johnson Syndrome, OCP: Ocular cicatricial pemphigoid, PK: Penetrating keratoplasty, OOAL: Osteo-odonto acrylic lamina, MOOKP: Modified osteo-odonto-keratoprosthesis, TBK: Tibial bone keratoprosthesis

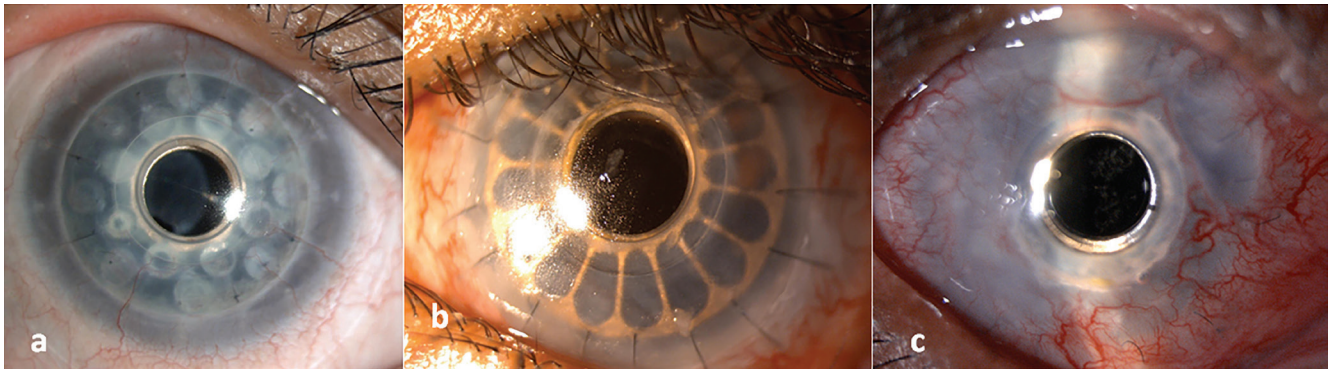

Figure 2. Slit-lamp pictures demonstrating the 3 different versions of type 1 keratoprosthesis. a) Boston, b) Lucia, c) Auro

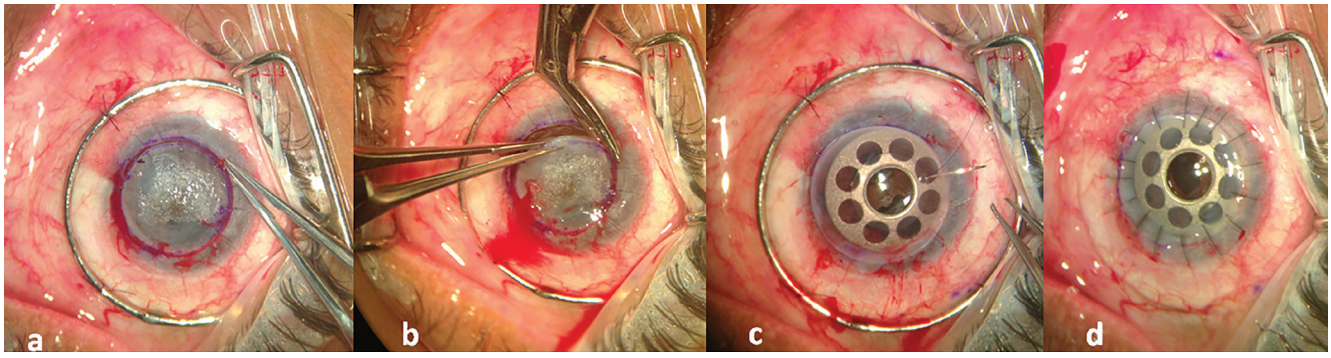

Figure 3. Surgical steps in type 1 keratoprosthesis (KPro) in an aphakic eye with total limbal stem cell deficiency following chemical injury. a) Fleringa ring is anchored and host bed is marked with 8/8.5-mm trephine. b) After KPro assembly, the host cornea is excised carefully. c) The assembled KPro is anchored using 16 interrupted 9-0 nylon sutures. d) The sutures are then buried and a 16-mm bandage contact lens is placed

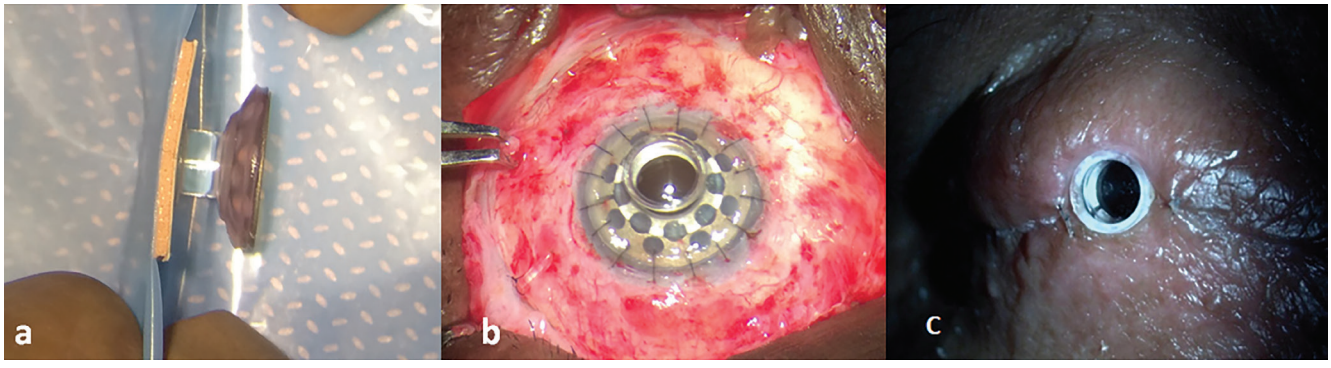

Figure 4. Surgical steps in Boston type 2 keratoprosthesis (KPro) in an eye with total limbal stem cell deficiency following Stevens-Johnson syndrome. a) The assembled Boston type 2 KPro. b) The KPro is secured with 16 interrupted 9-0 nylon sutures; Ahmed glaucoma valve is placed superotemporally with pars plana tube after complete vitrectomy; conjunctiva is excised from bulbar, palpebral, and tarsal surfaces. c) The lids are then sutured in 2 layers with the optic protruding centrally

cylinder cemented through a drilled hole in the tooth. A single rooted tooth (preferably the canine) is harvested, fashioned into a lamina, and drilled centrally, and the PMMA optic is then glued in the center. MOOKP is typically performed in 2 or 3 stages, following the Rome-Vienna protocol.[12,13] In Stage 1A, the eye is prepared by iris removal, lens cryoextraction, and limited anterior vitrectomy. A tectonic penetrating keratoplasty is added only if significant corneal thinning is present. Approximately one month later, Stages 1B and C involve harvesting a maxillary canine tooth, shaping it into a lamina, and embedding the optical cylinder within it. This complex is stored in a subcutaneous cheek pouch to allow fibrovascular ingrowth. Simultaneously, buccal mucosa (~3 cm) is harvested and grafted onto the ocular surface, anchored to the four recti muscles. After 2-3 months, Stage 2 is performed: the lamina is retrieved, the cornea is trephined to accommodate the optical cylinder, and the lamina is secured in place by suturing to the episclera. The oral mucosa is repositioned over the implant with a central opening to expose the optical cylinder (Figure 5).[13,14] The detailed surgical steps for each stage are as demonstrated in recent surgical videos on ocular surface surgeries.[9]

Tibial/Osteo-Keratoprosthesis

In 1987, Temprano introduced the use of a tibial bone-derived osteo-lamina for KPro in edentulous patients. Instead of the canine tooth–bone complex, this technique harvests a round lamina from the upper inner third of the tibia. The PMMA optical cylinder is affixed to a drilled hole in the lamina and implanted into a subcutaneous pocket in the inferior orbit for approximately three months to allow for biointegration (Figure 6). In the second stage, the integrated complex is retrieved, buccal mucosa is lifted, and following central corneal trephination and removal of the iris and lens (if not done in stage 1A), the lamina is implanted onto the corneal surface with the optic through the cornea. The buccal mucosa is then repositioned over the optic as in MOOKP.[15]

Moscow Eye Microsurgery Complex

The Moscow Eye Microsurgery Complex (MICOF KPro) involves a two-stage implantation. In the first stage, a titanium frame with a central ring is embedded in a lamellar pocket created within the corneal stroma. After three months, the cornea within the ring is trephined, and the PMMA optic is inserted

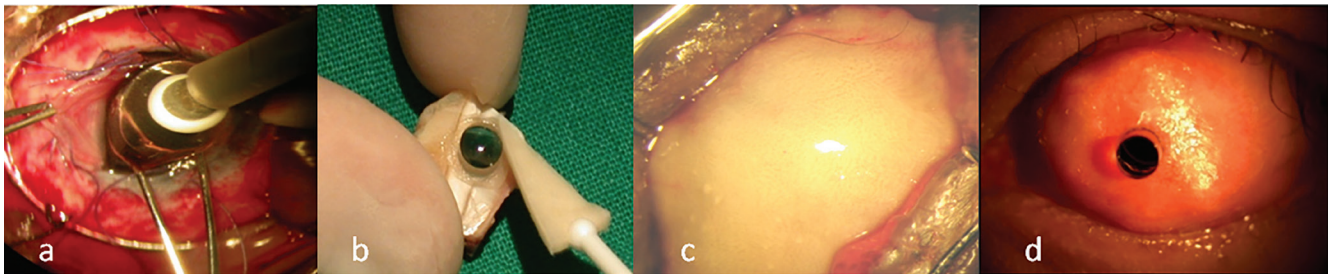

Figure 5. Surgical steps of modified osteo-odonto-keratoprosthesis in a patient following Stevens-Johnson syndrome. a) Stage 1A: intracapsular cataract extraction, complete iridectomy, and limited anterior vitrectomy are performed, along with tectonic keratoplasty if required. Intraoperative posterior segment evaluation is performed to assess the optic nerve and macula. b, c) Stage 1B (after ~2 months): the canine tooth is harvested, fashioned into a lamina, and implanted in the cheek for fibrovascular cover. Simultaneously, the ocular surface is covered with oral mucosa harvested from the cheek. d) Stage 2 (after ~3 months): the buccal mucosa is reflected, corneal trephination is performed, and the osteo-odonto-lamina is anchored into the eye, followed by resuturing the mucosa and making a central opening for optic exposure

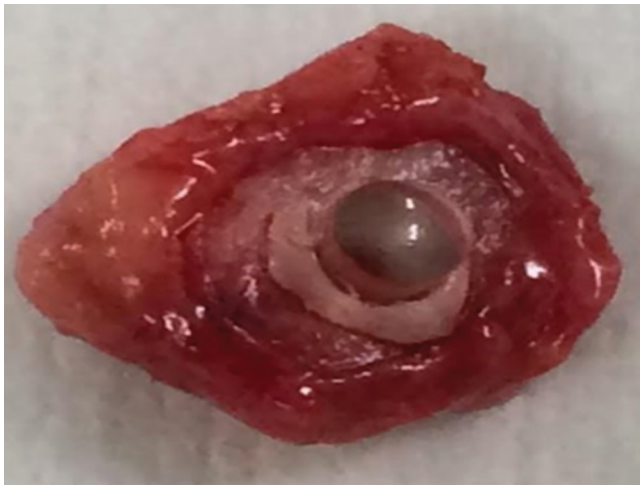

Figure 6. Lamina of the tibial bone keratoprosthesis with fibrovascular cover and central optic following stage 1C, ready to be implanted in the eye during stage 2

to extend into the anterior chamber. A pars plana vitrectomy is performed to remove the iris and lens.[16]

The Fyodorov-Zuev KPro, an early Russian design very similar to the MICOF, features a titanium frame with ear-shaped flanges and a threaded PMMA optic that can be implanted in one or two stages. The device is embedded within a donor corneal lamella and implanted like a penetrating keratoplasty. Lens, iris, and anterior vitreous removal is performed, and the construct is covered with conjunctiva or oral mucosa.[16] For the most part, both devices are available only in Russia and China.

Complications

KPro surgery carries a distinct set of complications that demand meticulous and lifelong follow up. These have been primarily grouped as KPro-related or ocular. KPro-related events include retroprosthetic membrane, perioptic graft melts, and lamina resorption or extrusion, whereas the ocular complications primarily encompass glaucoma, retinal detachment, and endophthalmitis. Their occurrence is most often influenced by the underlying etiology, the condition of the ocular surface, and patient compliance.

In a recently published systematic review and meta-analysis of the Boston type 1 KPro, retroprosthetic membrane (36.6%) and glaucoma (39.3%) were reported to be the most common long-term complications.[17] In a 15-year follow-up of 157 eyes (136 patients) undergoing Boston type 1 KPro, Bernstein et al.[18] reported de novo glaucoma as the most common complication (63.6%), followed by retroprosthetic membrane formation (46.5%). The most common indication was aniridia (26.1%) and 54% of their patients had at least one failed graft prior to KPro, possibly explaining the higher incidence of glaucoma in their study. The timing of glaucoma intervention is crucial in such cases. In their retrospective study of 100 eyes, Geoffrion et al.[19] noted that glaucoma progression was significantly higher when glaucoma surgery was performed post-KPro compared with pre-KPro surgery or medical management alone, thus recommending surgical intervention prior to or simultaneous to KPro implantation.

Long-term outcome data provide valuable guidance in selecting the appropriate type of KPro. In a cohort with follow-up of 5 years or more, the probabilities of maintaining or improving visual acuity were 75.0% and 66.7% at 5 and 10 years, respectively, with device retention remaining stable at 89.2%. Notably, the incidence of complications continued to rise beyond 5 years, with corneal melt, surgical glaucoma interventions, and endophthalmitis showing a tendency for late onset (Figure 7a, b).[20] While there are few studies comparing the three different versions of type 1 KPro, Shanbhag et al.[21] reported that the outcomes of the Auro KPro were comparable to those achieved with the Boston type 1 KPro in eyes with limbal stem cell deficiency.

Over an average follow-up of approximately 4 years, the most frequently reported postoperative complications among 56 eyes that underwent Boston type 2 KPro were new-onset or progressive glaucoma (41.1%), choroidal effusion (30.3%), retinal detachment (25.0%), and end-stage glaucoma (25.0%). Univariate analysis revealed that patients who suffered

irreversible visual decline (≥20/200 loss) were significantly less likely to have received concurrent glaucoma drainage device implantation compared to those who maintained visual acuity of ≥20/200.[10] Perioptic skin gape requiring skin resuturing is another common complication in the early postoperative period (Figure 7c, d).

MOOKP complications vary across surgical stages, as multiple procedures are performed in the same eye and require lifelong monitoring. In a comprehensive review of 37 case series (28 analyzed for complications) involving 958 patients, autoimmune disorders (39.1%) and chemical injuries (38.8%) were the leading indications. Intraoperative complications (21.7%) commonly included maxillofacial issues, vitreous hemorrhage or vitritis, and mucosal breakdown. The predominant postoperative complications were lamina-related (16.1%), oral mucosa-associated (14.8%), secondary glaucoma (11.5%), and choroidal or retinal detachment (10%), while retroprosthetic membrane formation occurred in 6.2% (Figure 7e, f). The follow-up duration ranged from 1 to 364 months (median: 36.7 months). Overall, 78% of eyes achieved a visual acuity of ≥20/400, with a mean anatomic retention rate of 88.3% (range: 50-100%).[22]

Charoenrook et al.[23] compared long-term outcomes of MOOKP and TBK. Anatomical survival at 10 years was similar between groups (MOOKP 67%, TBK 54%), whereas functional survival favored MOOKP (49% vs. 25%). Postoperative complications were more frequent in TBK (65%) than MOOKP (40%), with mucous membrane necrosis and retroprosthetic membrane formation occurring predominantly in the TBK group.[23]

In a series of 90 eyes with MICOF KPro and a mean follow-up of 58.2±36.3 months, the most common complications were glaucoma (60%) and corneal melt (40%). One eye experienced KPro extrusion, and two eyes had implant site leakage. Among 7 eyes with endophthalmitis, final visual acuity was limited to light perception.[16] Ghaffariyeh et al.[24] evaluated 10 eyes implanted with the Fyodorov-Zuev KPro over a mean follow-up of 52 months and reported a retention rate of 70%. The main postoperative complications included retroprosthetic membrane formation (40%), glaucoma (20%), retinal detachment (10%), and endophthalmitis (10%).

While outcomes and complication profiles vary across KPro types, glaucoma, retroprosthetic membrane formation, and corneal melt remain the most frequent long-term challenges influencing visual prognosis and device retention.

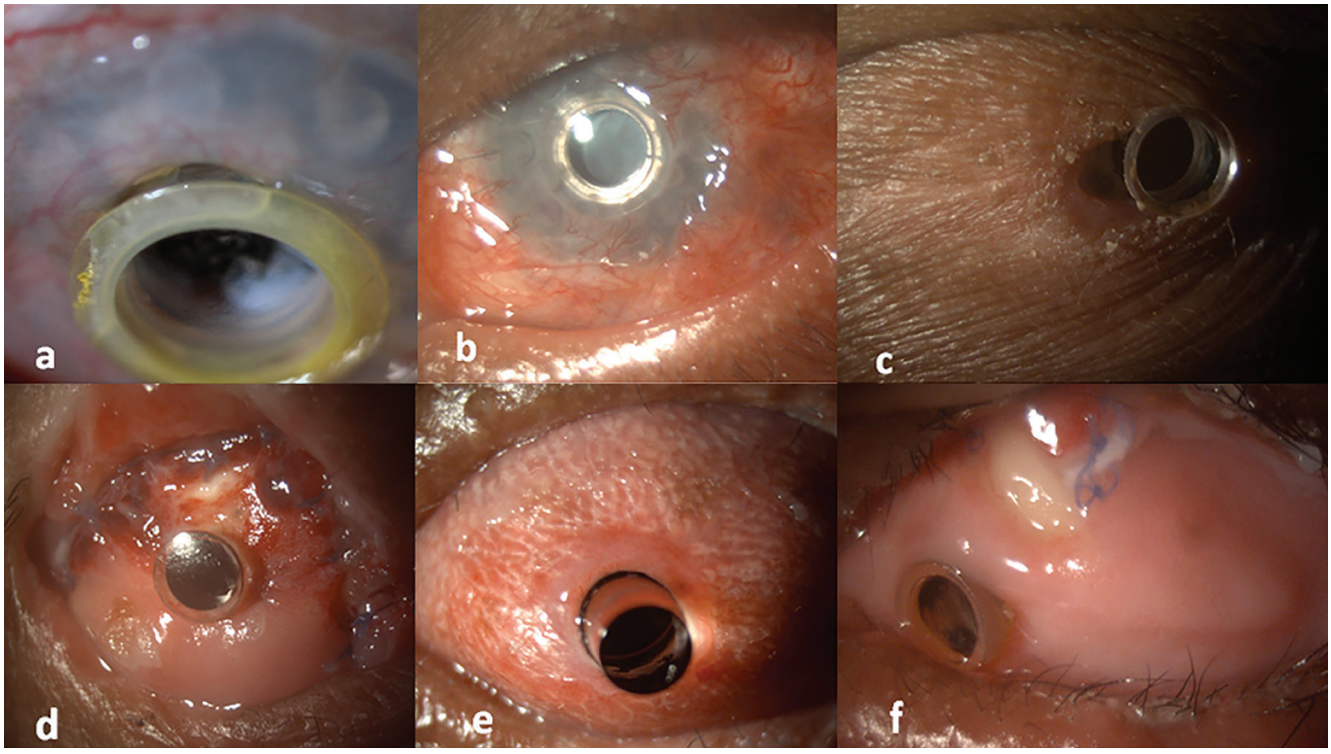

Figure 7. Representative complications across different keratoprosthesis (KPro). a) Perioptic melt in Boston type 1 KPro managed with lamellar patch graft. b) Dense retroprosthetic membrane in Boston type 1 KPro requiring surgical membranectomy. c) Perioptic skin gape in Boston type 2 KPro necessitating resuturing. d) Mucosal necrosis over Boston type 2 KPro managed with mucous membrane revision. e) Optic protrusion with perioptic leak eight years after modified osteo-odonto-KPro, indicating laminar resorption. f) Early postoperative lamina exposure after modified osteo-odonto-KPro, managed by mucous membrane revision

Key Factors in Keratoprosthesis Selection

Choosing the appropriate KPro is a complex decision that requires careful evaluation of multiple interrelated factors. Each KPro has unique design features, surgical demands, and postoperative requirements. Key factors include careful consideration of the ocular surface, the status of which is directly related to the etiology of the corneal blindness, as well as the overall health of the patient. It is also important to consider implementation-related factors such as the patient's capacity to understand and comply with medication and eye care instructions, attend scheduled follow-up visits, and seek care in a timely fashion should concerning symptoms arise. Compliance is typically dependent to a great degree on the support of family members. If living distant to the surgeon, the patient must have proximity to transportation and the resources to access it.

Presurgical Evaluation

A thorough assessment of ophthalmic and general medical history, visual acuity, the ocular surface, intraocular pressure (IOP), and intraocular structures is essential before deciding if KPro implantation is appropriate, and then in selection of the optimal device and surgical procedure. The visual potential must be weighed in light of pre-existing limitations such as amblyopia, glaucoma, and retinal disorders.

Ocular Factors

The status of the ocular surface, including eyelid position, blink, tear film, and fornices, is critical in determining the appropriate KPro. A moist ocular surface with a complete blink and intact fornices is essential for successful outcomes with type 1 KPros. In contrast, type 2 KPros are indicated for eyes with a compromised ocular surface, for example those with absent or non-functional eyelids, incomplete blink, marked dryness, keratinization, or ankyloblepharon, in which conventional surface reconstruction is not feasible or is likely to fail.

The underlying etiology remains a key determinant in the selection of the appropriate type of KPro. Eyes with multiple failed grafts, silicone oil tamponade, herpetic keratitis, or aniridia typically exhibit a relatively favorable prognosis with type 1 KPro implantation.[25,26,27] In contrast, chemical and thermal burns are associated with a more guarded outcome when managed with type 1 devices, and at minimum implantation of a KPro in such cases requires careful consideration.

Patients with autoimmune disorders such as ocular cicatricial pemphigoid and Stevens-Johnson syndrome, as well as other causes of severe cicatricial surface disease with ocular surface keratinization and significantly foreshortened fornices, are generally poor candidates for type 1 KPros because of a much higher incidence of persistent graft defect, corneal melts, and infection. In such cases, type 2 KPros are preferred due to their design tailored for severely compromised ocular surfaces.[3,10,13,22]

Glaucoma remains a major vision-threatening complication following KPro implantation. It is often also pre-existing—either primary or secondary to the underlying pathology or prior ocular surgeries—or may develop de novo postoperatively. Diagnosing glaucoma preoperatively can be difficult because severe corneal opacity makes preoperative assessment of the pupillary responses and optic disc impossible.[28] IOP assessment can be compromised by corneal calcification, thinning, and a flat anterior chamber. Imaging the anterior segment with ultrasound biomicroscopy may be hindered by severe symblepharon or ankyloblepharon.[29] After KPro implantation, IOP measurements are at best estimations based on palpation of the globe, although disc and regular visual fields can be assessed and are recommended for monitoring. Topical antiglaucoma medications can be used after type 1 KPro but their efficacy after a type 2 KPro is limited because of poor penetration through mucosa and essentially non-existent with fused eyelids, leaving only systemic carbonic anhydrase inhibitors as non-surgical alternatives when treatment or prophylaxis is indicated. The timing of glaucoma surgery is very crucial. For patients with preexisting glaucoma receiving a type 1 KPro, glaucoma surgery is recommended prior to or simultaneously with KPro implantation.[19] In eyes with uncontrolled pre-existing glaucoma undergoing MOOKP or TBK, glaucoma valve implantation is best performed before the mucosal graft, when the surface anatomy is least altered. This approach also helps prevent an IOP spike after the mucosal graft, which can further obstruct episcleral outflow.[30] In monocular patients being considered for a type 2 KPro, particularly those with advanced glaucomatous damage and a guarded visual prognosis, a single-stage Boston type 2 KPro may be a more practical option compared to the more complex, multi-stage procedures such as MOOKP or TBK.

Determining the status of the posterior segment of the eye is essential before embarking on KPro implantation. B-scan ultrasonography is essential to evaluate retinal attachment and optic nerve cupping. The presence of posterior segment pathology such as retinal detachment or posterior staphyloma may significantly limit visual outcomes, thereby influencing both the choice of KPro and the nature of preoperative counselling. If cupping is evident on B-scan, it can be assumed to be significant and likely greater than or at least equal to a 0.8 cup-to-disc ratio.

Systemic Factors

In addition to local ocular factors, comorbidities such as poorly controlled diabetes, other autoimmune disorders, or severe cardiopulmonary disease may preclude surgical eligibility or influence the choice of prosthesis, as systemic fitness for general anesthesia is mandatory in all type 2 KPro surgeries,

given the multi-stage and/or prolonged surgical procedures involved.[10,11,12,15] Additionally, patients considered for MOOKP must undergo detailed preoperative dental and oral mucosal assessment, including a spiral computed tomography scan to evaluate the canine teeth. In contrast, candidates for TBK utilizing tibial bone should ideally undergo a bone mineral density scan to exclude underlying osteoporosis, which may compromise the long-term viability of the osteo-lamina.[11,15] In patients with immunosuppressive states, poor oral hygiene, or edentulism, a Boston type 2 may be preferable over osteo-based KPros.

Implementation-Related Factors

Patient-related factors, including psychological resilience and the ability to adhere to long-term care and rehabilitation, play a critical role in selecting the appropriate type of KPro. Socioeconomic and logistical considerations—such as access to specialized care, the capacity to attend regular follow-ups, and compliance with lifelong topical therapy—can significantly impact the long-term outcome of surgery. The need for bandage contact lens replacement once every 3 months and continued monitoring for onset or worsening of glaucoma mandates close follow-up. Cosmetic considerations need to be addressed appropriately by counselling of the patient and family, especially with the type 2 KPros, as they dramatically alter the patient's appearance. Counselling regarding the lifelong possibility of complications, the potential need for repeat or multiple surgeries, the real risk of implant failure and irreversible blindness, and even KPro extrusion, is crucial to ensure that patient expectations are aligned with reality.

Finally, the success of KPro surgery, particularly the more complex procedures like MOOKP, is heavily dependent on the experience of the surgical team and the capabilities of the center. A multidisciplinary team including cornea, glaucoma, and retinal surgeons, oral and maxillofacial surgeons, and anesthesiologists is mandatory. The steep learning curve for the surgical team, especially for osteo-based KPros, underscores the need for adequate training, surgical backup, and long-term patient management infrastructure. In addition to surgical expertise, comprehensive postoperative care to identify complications early and manage them goes a long way in improving outcomes. The availability of specific KPro types may vary by region or center, influencing the choice of implant. Regulatory approvals and cost can also impact surgical planning and timing.

Based on the above factors, we propose a structured algorithm to guide the appropriate selection of KPro (Figure 8). The algorithm does not include MICOF and Fyodorov-Zuev KPros due to their limited availability.

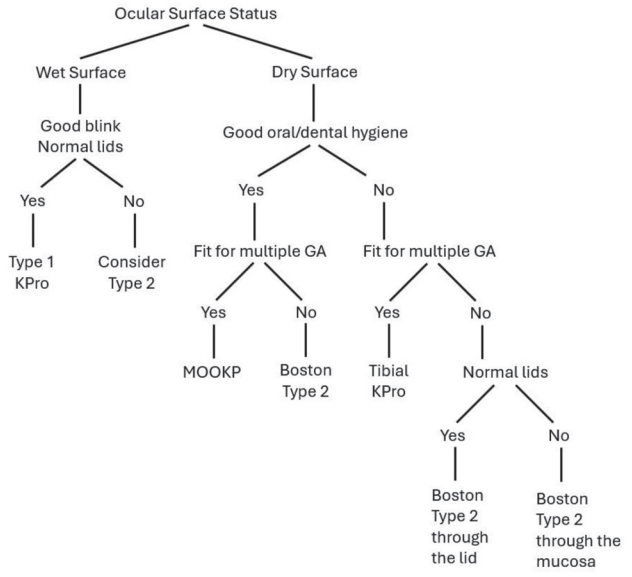

Figure 8. Algorithm to guide keratoprosthesis device selection based on ocular surface and systemic status

GA: General anesthesia, MOOKP: Modified osteo-odonto-keratoprosthesis

Conclusion

Recent progress in material science and a better understanding of the drawbacks of earlier KPro designs have led to the development of several new models, as well as improvements in existing ones, with the goal of achieving better outcomes. Among the currently available options, the Boston type 1 KPro is the most commonly used worldwide. Over the years, changes in the design and material of the backplate have helped to reduce complications such as retroprosthetic membrane formation and perioptic melts. Among the type 2 devices, the MOOKP is often considered the gold standard due to its superior long-term visual and anatomical results. However, its complex surgical steps and less favorable cosmetic appearance have limited wider use. The Boston type 2 and tibial KPro serve as good alternatives in suitable cases. Given an expanding array of KPro options—each with distinct advantages, indications, and limitations—it is increasingly important to adopt a structured, individualized approach to device selection. A comprehensive algorithmic framework, informed by ocular surface status, systemic factors, and surgical feasibility, is essential to optimize patient outcomes and guide clinical decision-making in this complex and evolving field.

Declarations

Authorship Contributions

Concept: S.A., J.C., Design: S.A., J.C., Data Collection or Processing: S.A., V.B., M.R., J.C., Analysis or Interpretation: S.A., V.B., M.R., J.C., Literature Search: S.A., V.B., M.R., J.C., Writing: S.A., V.B., M.R., J.C.

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References

1. Avadhanam VS, Smith HE, Liu C. Keratoprostheses for corneal blindness: a review of contemporary devices. Clin Ophthalmol. 2015;9:697-720.
2. Barber JC. Design of a retainable keratoprosthesis: history, design and evaluation in cats. 1st ed. Bloomington, USA: Author House; 2011.
3. Alexander JK, Basak SK, Padilla MD, Yu F, Aldave AJ. International outcomes of the Boston type I keratoprosthesis in Stevens-Johnson syndrome. Cornea. 2015;34:1387-1394.
4. Zarei-Ghanavati M, Liu C. Keratoprosthesis: current choices and future development. Asia Pac J Ophthalmol (Phila). 2019;8:429-431.
5. Dohlman CH, Schneider HA, Doane MG. Prosthokeratoplasty. Am J Ophthalmol.1947;77:694-700.
6. Dohlman C, Harissi-Dagher M, Graney J. The Boston keratoprosthesis: a new thread less design. Digital J Opthalmol. 2007;13:3.
7. Venugopal A, Rathi H, Rengappa R, Ravindran M, Raman R. Outcomes after auro keratoprosthesis implantation: a low-cost design based on the Boston keratoprosthesis. Cornea. 2016;35:1285-1288.
8. Ortiz-Morales G, Vera-Duarte GR, Jimenez-Collado D, Rivera JA, Rivera KA, Domene-Hickman JL, Müller-Morales CA, Navas A, Ramirez-Miranda A, Chodosh J, Graue-Hernandez EO. Results of Lucia keratoprosthesis implantation in severe corneal disease. Am J Ophthalmol. 2024;268:388-394.
9. Ocular Surface Gurukul. Youtube. Available from: youtube.com/@OcularSurfaceGurukul
10. Saini C, Chen TC, Young LH, Vavvas DG, Vangel M, Papaliodis GN, Mukai S, Turalba AV, Rhee DJ, Wu DM, Eliott D, Miller JB, Song BJ, Shen LQ, Pasquale LR, Chodosh J. Restoration of vision in severe, cicatricial, ocular surface disease with the Boston keratoprosthesis type II. Am J Ophthalmol. 2022;243:42-54.
11. Orive Bañuelos A, Fideliz de la Paz M, Feijóo Lera R, Santamaría Carro A, Martínez Grau A, Andollo Victoriano N, Etxebarria Ecenarro J. Transmucosal Boston keratoprosthesis type II in a case of severe bilateral chemical burn. Cornea. 2024;43:261-264.
12. Hille K, Grabner G, Liu C, Colliardo P, Falcinelli G, Taloni M, Falcinelli G. Standards for modified osteoodontokeratoprosthesis (OOKP) surgery according to Strampelli and Falcinelli: the Rome-Vienna Protocol. Cornea. 2005;24:895-908.
13. Iyer G, Srinivasan B, Agarwal S, Talele D, Rishi E, Rishi P, Krishnamurthy S, Vijaya L, Subramanian N, Somasundaram S. Keratoprosthesis: Current global scenario and a broad Indian perspective. Indian J Ophthalmol. 2018;66:620-629.
14. Falcinelli G, Falsini B, Taloni M, Colliardo P, Falcinelli G. Modified osteo-odonto-keratoprosthesis for treatment of corneal blindness: long-term anatomical and functional outcomes in 181 cases. Arch Ophthalmol. 2005;123:1319-1329.
15. Charoenrook V, Michael R, de la Paz MF, Ding A, Barraquer RI, Temprano J. Osteokeratoprosthesis using tibial bone: surgical technique and outcomes. Ocul Surf. 2016;14:495-506.
16. Wang L, Huang Y, Du G, Dong Y, Guo H, Wang D, Yu J, Wang Q, Chen B, Hou L. Long-term outcomes and complications of Moscow Eye Microsurgery Complex in Russia (MICOF) keratoprosthesis following ocular surface burns: clinical experience in China. Br J Ophthalmol. 2015;99:1669-1674.
17. Priddy J, Bardan AS, Tawfik HS, Liu C. Systematic review and meta-analysis of the medium- and long-term outcomes of the Boston type 1 keratoprosthesis. Cornea. 2019;38:1465-1473.
18. Bernstein A, Gheth Y, Nassrallah W, Berkache M, Haagdorens M, Harissi-Dagher M. Long-term outcomes of the Boston keratoprosthesis: a 15-year follow-up. Can J Ophthalmol. 2025:S0008-4182(25)00362-X.
19. Geoffrion D, Hassanaly SI, Marchand M, Daoud R, Agoumi Y, Harissi-Dagher M. Assessment of the role and timing of glaucoma surgery in Boston keratoprosthesis type 1 patients. Am J Ophthalmol. 2022;235:249-257.
20. Kanu LN, Niparugs M, Nonpassopon M, Karas FI, de la Cruz JM, Cortina MS. Predictive factors of Boston type I keratoprosthesis outcomes: a long-term analysis. Ocul Surf. 2020;18:613-619.
21. Shanbhag SS, Senthil S, Mohamed A, Basu S. Outcomes of the Boston type 1 and the Aurolab keratoprosthesis in eyes with limbal stem cell deficiency. Br J Ophthalmol. 2021;105:473-478.
22. Ortiz-Morales G, Loya-Garcia D, Colorado-Zavala MF, Gomez-Elizondo DE, Soifer M, Srinivasan B, Agarwal S, Rodríguez-Garcia A, Perez VL, Amescua G, Iyer G. The evolution of the modified osteo-odonto-keratoprosthesis, its reliability, and long-term visual rehabilitation prognosis: an analytical review. Ocul Surf. 2022;24:129-144.
23. Charoenrook V, Michael R, de la Paz MF, Temprano J, Barraquer RI. Comparison of long-term results between osteo-odonto-keratoprosthesis and tibial bone keratoprosthesis. Ocul Surf. 2018;16:259-264.
24. Ghaffariyeh A, Honarpisheh N, Karkhaneh A, Abudi R, Moroz ZI, Peyman A, Faramarzi A, Abasov F. Fyodorov-Zuev keratoprosthesis implantation: long-term results in patients with multiple failed corneal grafts. Graefes Arch Clin Exp Ophthalmol. 2011;249:93-101.
25. Yaghouti F, Nouri M, Abad JC, Power WJ, Doane MG, Dohlman CH. Keratoprosthesis: preoperative prognostic categories. Cornea. 2001;20:19-23.
26. Bouhout S, Robert MC, Deli S, Harissi-Dagher M. Corneal melt after Boston keratoprosthesis: clinical presentation, management, outcomes and risk factor analysis. Ocul Immunol Inflamm. 2018;26:693-699.
27. Iyer G, Srinivasan B, Agarwal S, Pattanaik R, Rishi E, Rishi P, Shanmugasundaram S, Natarajan V. Keratoprostheses in silicone oil-filled eyes: long-term outcomes. Br J Ophthalmol. 2019;103:781-788.
28. Akpek EK, Karakus S, Yohannan J, Jabbour S, Sotimehin AE, Li G, Ramulu PY. Reliability of several glaucoma tests in patients with Boston type 1 keratoprosthesis. Cornea. 2022;41:310-316.
29. Nascimento E Silva R, Taniguchi EV, Cruzat A, Paschalis EI, Pasquale LR, Colby KA, Dohlman CH, Chodosh J, Shen LQ. Angle anatomy and glaucoma in patients with Boston keratoprosthesis. Cornea. 2020;39:713-719.
30. Iyer G, Srinivasan B, Agarwal S, Shetty R, Krishnamoorthy S, Balekudaru S, Vijaya L. Glaucoma in modified osteo-odonto-keratoprosthesis eyes: role of additional stage 1A and Ahmed glaucoma drainage device-technique and timing. Am J Ophthalmol. 2015;159:482-489.