The Boston keratoprosthesis:

10-year experience from Denmark

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Artificial corneal implants

Modern corneal transplantations are generally considered safe and effective. However, recurrent corneal graft failure remains a challenging complication in a small subset of patients. For this group, clinicians may consider artificial corneal implants as a final resort; among these implants, the Boston keratoprosthesis type 1 (Boston KPro) is the most widely used.[1] The Boston KPro was developed in the 1960s by the Swedish professor Claes Dohlman at Harvard Medical School in Boston, Massachusetts. It was approved by the Federal Drug Administration in 1992 and subsequently CE-marked, and it has since been improved in design and surgery implant techniques. By 2019, it was estimated that over 19,000 prostheses had been implanted worldwide.[2]

The Boston KPro in Scandinavia: the Danish cohort

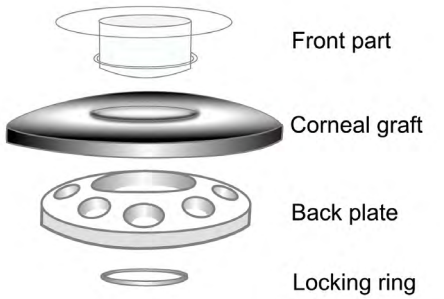
During the past decade, Aarhus University Hospital has gained experience in Boston KPro implantation. This study evaluated the outcomes and complications after Boston KPro implantation in our cohort.

Repeating corneal graft failure and severe corneal surface disease

The first patient was enrolled at our institution in 2012. To date, 15 procedures have been performed in 12 eyes of 10 patients. The indication for surgery was corneal graft failure or severe corneal surface disease. The underlying diseases causing corneal failure varied. Diagnoses included aniridia, congenital glaucoma, juvenile uveitis, congenital cataract, Stevens–Johnson syndrome, keratoconus, and alkali chemical injury. The average number of conventional corneal transplants before Boston KPro was 2.9 (0–6). The mean follow-up time was 66 months (18–126 months).

Visual improvement in most patients

The pre-operative best-corrected Snellen visual acuity was less than 0.05 in all patients (light perception to 0.05). In 5 of the 10 patients, the fellow eye had no light perception at the time of surgery. Most patients achieved a favorable outcome; 10 of the 12 eyes (83%) exhibited improved visual acuity. Visual acuity remained the same in one eye, and visual acuity deteriorated in one eye. In 45% of eyes (5/11), postoperative visual acuity was at least 0.1 after 2 years. Furthermore, in 43% of eyes (3/7), visual acuity was at least 0.1 after 5 years. This is comparable to the 57% of eyes with a visual acuity of 0.1 or better (over an average follow-up of 8.5 months) previously reported in an international multicenter study.[3]



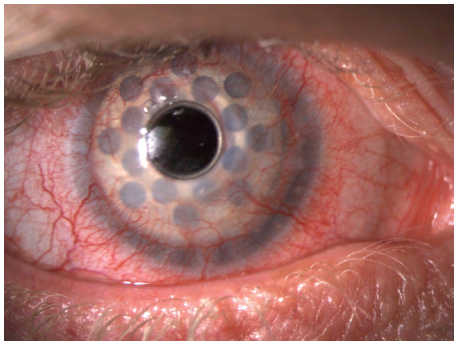


Figure 1. A donor corneal graft is positioned between a solid PMMA front plate and a titanium back plate with a built-in locking component. The back plate is fenestrated to enable the transport of nutrition to the donor cornea from the aqueous humor. It is available in pseudophakic and aphakic designs. A soft contact lens is recommended to protect the surface. Chloramphicol drops and bandage contact lenses are indicated for life.

Anatomical success

The mean retention time was 60 months. The retention rate was 100% (12/12) after 1 year, 82% (9/11) after 2 years, and 86% (6/7) after 5 years. This is comparable to the retention rate of 75% after 5 years reported in a meta-analysis of 26 studies.[4] No cases of acute explanation and no cases of enucleation were recorded.

Complications

The most frequent complication was retrolental membrane formation (in 10 out of 12 eyes). Other complications included postoperative vitreous hemorrhage, which cleared over time (3 out of 12 eyes), hypotony/phthisis (4 out of 12 eyes), and corneal graft thinning (4 out of 12 eyes). In two eyes (17%), the thinning of the donor cornea caused threatening extrusion of the graft and required re-implantation of a new Boston KPro. One patient in the cohort experienced a deterioration of pre-existing glaucoma. No cases of endophthalmitis were observed.

Safe and effective last-resort procedure

According to our experience, the Boston KPro is effective as a safe last-resort procedure to preserve some functional vision in eyes with recurrent corneal graft failure. The indications for implantation of KPro are expanding internationally,[5] and newer generations of KPro are under development to address the problems of retroprosthetic membrane formation, extrusion, and glaucoma development; however, we still suggest that KPro implantation should be used only as a final resort because the recipients of Boston KPro implants may develop glaucoma and potentially endophthalmitis. Patients and caregivers must also be prepared for frequent consultations and lifelong follow-up to prevent and manage complications.

Conflict of interest: None

References

1. Dohlman C. The Boston Keratoprosthesis — The First 50 Years: Some Reminiscences. *Annu Rev Vis Sci*. 2022 Sep 15;8:1-32.
2. Fu L, Hollick EJ. Artificial Cornea Transplantation. 2023 Mar 6. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan–. PMID: 33760451.
3. Zerbe BL, Belin MW, Ciolino JB; Boston Type 1 Keratoprosthesis Study Group. Results from the multicenter Boston Type 1 Keratoprosthesis Study. *Ophthalmol*. 2006 Oct;113(10):1779.e1-7.
4. Ahmad S, Mathews PM, Lindsley K, Alkharashi M, Hwang FS, Ng SM, Aldave AJ, Akpek EK. Boston Type 1 Keratoprosthesis versus Repeat Donor Keratoplasty for Corneal Graft Failure: A Systematic Review and Meta-analysis. *Ophthalmol*. 2016 Jan;123(1):165-77.
5. Nonpassopon M, Niparugs M, Cortina MS. Boston Type 1 Keratoprosthesis: Updated Perspectives. *Clin Ophthalmol*. 2020 Apr 29;14:1189-1200.