

Boston keratoprosthesis – indications, technique, results

Quresh B. Maskati¹

The Journal of the College of Ophthalmologists of Sri Lanka 2015; 21: 10-11

Introduction

Keratoplasty or corneal transplant is accepted as one of the most successful of all transplants done in the body, with a fairly low rejection rate. However, this is only in cases where immunological isolation of the cornea is preserved. Even today, in the 21st century, there are cases in which keratoplasty is doomed to failure. For very severe ocular surface disorders with bilateral loss of vision, such as severe Stevens' Johnson syndrome with keratinisation, severe chemical burns, ocular pemphigus with significant dry eye, disorganised anterior segments due to trauma, any cause of bilateral total stem cell loss or deficiency, severely vascularised recipient eyes etc, keratoplasty will not work and should not be attempted. The world over, the search for the perfect keratoprosthesis (KP) is a continuous process for such cases. There are several dozens of KP invented over the years. Only a handful however are currently in use and stood the test of time. The Daljit Singh champagne cork KP also known as the Worst-Singh KP has perhaps the largest number implanted till date (over 5000 - personal communication). The others are the Modified osteo-odonto keratoprosthesis (MOOKP) and the pintucci bio-integrated keratoprosthesis (PBIKP). The Dohlman or Boston keratoprosthesis is useful in less severe eye conditions such as vascularised corneal opacities, repeated failed grafts, chemical burns and Stevens' Johnson syndrome without keratinisation. For the Boston keratoprosthesis (BKP), some degree of tear secretion and a normal blink mechanism are essential for long term success. For any KP, it is essential to have accurate light perception and to rule out pre-existing end stage glaucoma or a retinal detachment. The PBIKP and the BKP are the two which the author has personal experience. The latter will be described in this article.

The Boston keratoprosthesis (BKP)

This is the most commonly implanted keratoprosthesis worldwide today. The Type 1 is implanted in eyes with good tear secretion. There is also a Type 2 which has a longer PMMA cylinder and can be implanted to project through the closed upper lid or through an opening created between the sealed upper and lower lids. However, the author has no experience with Type 2, hence only the Type 1 will be described.

The current design is a 3 piece structure.

1. The front part is a mushroom shaped structure with a stem (all PMMA). The front plate is 5mm in diameter while the stem is 3.35mm.
2. The back plate, made of PMMA with 8.5mm diameter, has a central hole and 16 holes of 1.2mm each. It earlier had only 8 holes, but has been modified to double the number of holes.
3. A titanium locking ring which fits posterior to the back plate.

There is also another version called the "Lucia" model, where the locking ring is eliminated. Instead the back plate with holes is made of titanium. However, this is cosmetically not as appealing and is not commercially available on a wide scale at the time of writing this article (July 2015).

Two types are available, a BKP for aphakic eyes and one for pseudophakic eyes. Depending on the case, the appropriate one is ordered. If the eye has an anterior chamber IOL or an ill-fitting PC IOL, it is better to remove the IOL at time of surgery. Also, if the eye still has a crystalline lens, the crystalline lens has to be removed at time of surgery and either no IOL is implanted or a zero powered PC IOL can be implanted. In all these cases, an aphakic type BKP is ordered. It is necessary to send the axial length measurement to the supplier to obtain the appropriate powered DKP. If the eye is pseudophakic with a well centered PC IOL in situ, one can order a pseudophakic BKP, which comes in standard power, so no axial length information is necessary.

Surgical technique

The surgery is done in a single stage. First the donor cornea of 8.5 mm is punched out as usual in a penetrating keratoplasty using a Teflon block and a trephine of one's choice. A 3mm hole is made in the centre of the donor cornea using a special disposable dermatological trephine, which is supplied with the BKP. The BKP is then assembled as follows. The front mushroom plate is kept plate down on a flat surface.

¹President, All India Ophthalmology Society, India.

Visco-elastic is applied to the stem. The donor cornea with the central hole punched out is then slid onto the stem, with the epithelial side closer to the plate. The endothelium is coated with viscoelastic and then the back plate is pushed into place, with the central hole accommodating the end of the stem. Finally the titanium ring is pushed onto the stem and locks into position with an audible snap. Once the BKP along with the donor cornea is assembled it can be placed back into the MK medium container while attention is now paid to the recipient.

A central corneal button of a diameter 0.5mm less than the donor cornea is partially trephined, again with a trephine of the surgeon's choice. The Anterior chamber (AC) is gently entered with a sharp knife and the button is excised with right and left corneal scissors as with any penetrating keratoplasty. A peripheral iridectomy is done. If the patient has a posterior chamber IOL already in place in the bag, it need not be disturbed. Any ill-fitting IOL is removed. If the eye is phakic it is made either aphakic (leaving posterior capsule intact) or pseudophakic with the appropriate IOL inserted to give emmetropia. If the eye is already aphakic with no posterior capsule or if vitreous presents into the AC during the surgery, a central core vitrectomy is recommended. The BKP assembly is then inserted into the central opening and the donor cornea is sutured with interrupted 9/0 or 10/0 nylon sutures. The knots are buried. A large diameter special soft lens that is provided with the BKP is inserted to cover the ocular surface. This is from Kontur and is a Plano lens with 16 mm diameter with a 9.8 mm base curve.

Post op treatment

Dr. Dohlman's group from Boston recommends vancomycin (14mg/ml) eye drops at least once a day

for life and claims that the incidence of post op endophthalmitis have dropped to almost nil after this regime has been started. The author has been using vancomycin drops for the first month q.i.d and then switching to the commercially available fourth generation fluoroquinolone eye drops tapered to once a day for life.

Topical steroids are used 4 times a day and tapered off within one to 2 months, unless the eye is inflamed, when they may be continued for longer. If there is glaucoma, they may be stopped earlier or replaced with milder steroids.

Anti-glaucoma drops may be used if glaucoma is suspected by finger palpation method and confirmed by disc and visual field changes. In case glaucoma still persists an Ahmed glaucoma valve or Baerveldt glaucoma drainage device implantation surgery may be necessary.

The contact lens is recommended to be worn as an extended wear lens for life and replaced every 2 months or earlier if it has too many deposits.

Reason for success

The BKP (Type 1) is done for less severe indications – chief among them being failed grafts. Careful case selection, rejecting cases with very dry eyes and inadequate blink and those with a keratinised ocular surface have enhanced the success rate. The problems with the earlier screwed on back plate have been eliminated by having a snap-on titanium ring locking the assembly into place. The use of long term topical antibiotic and the Kontur lens have reduced the complication rate considerably.