

## KERATOPROSTHESIS: AN ALTERNATIVE IN ANTERIOR SEGMENT RECONSTRUCTION

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Blindness due to corneal causes has long been a challenge to anterior segment surgeons, and keratoplasty with or without anterior segment reconstruction is not universally successful. Fortunately, recent technologic alloplastic advances in the field of keratoprosthetic research have improved the success rate for anterior segment reconstruction.

The idea of replacing the scarred cornea with artificial material was first conceived by Pellier de Quengsy, who suggested intracorneal implantation of glass. In 1853, Nussbaum<sup>1</sup> reported implantation of glass in the rabbit cornea. Later investigators unsuccessfully implanted glass, celluloid and quartz in human corneas.<sup>2</sup> Shortly after World War II, it was found that the cornea tolerated imbedded acrylic plastic (Plexiglas) exceptionally well. This observation stimulated research into both corneal and lens alloplastic implants.

Stone<sup>3</sup> developed the conceptual framework for keratoprosthetic design; his polymethylmethacrylate keratoprosthetic device consisted of a fenestrated sup-

porting plate with a threaded removable optical cylinder (Fig. 1). The fenestrations permit ingrowth of connective tissue and improve nutrition of anterior corneal layers. The supporting plate accepts either a perforating or a nonperforating optical cylinder (Fig. 2),<sup>4</sup> allowing the surgeon to postpone perforation until the supporting plate is fixed on the host cornea.

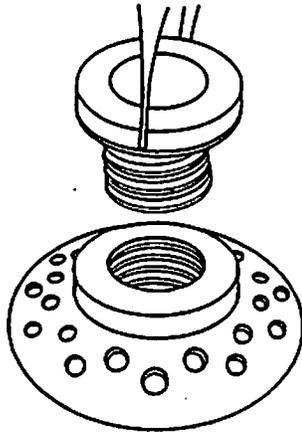


Fig. 1(Bath). Stone keratoprosthesis device.

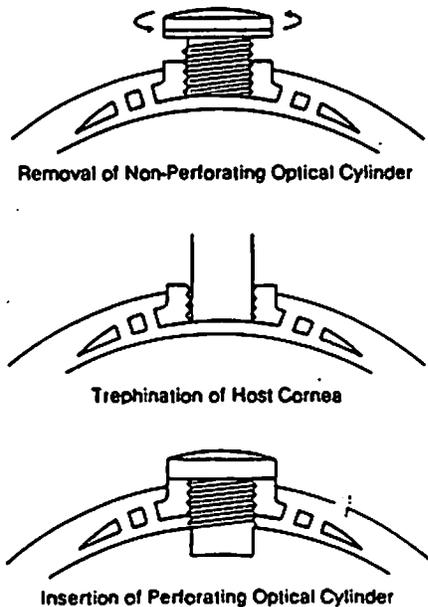


Fig. 2(Bath). Stone keratoprosthesis device: sequence shows conversion of nonperforating optical cylinder to perforating.

Cardona and his associates<sup>5</sup> developed the nut-and-bolt and the through-and-through (TT) keratoprosthesis devices, which are the most widely used keratoprostheses in the United States. The TT keratoprosthesis device (Fig. 3) has a flexible Teflon supporting plate which improves conformation to the corneal contours. The optical cylinder of both styles is threaded with an inner pigmented core to reduce glare.

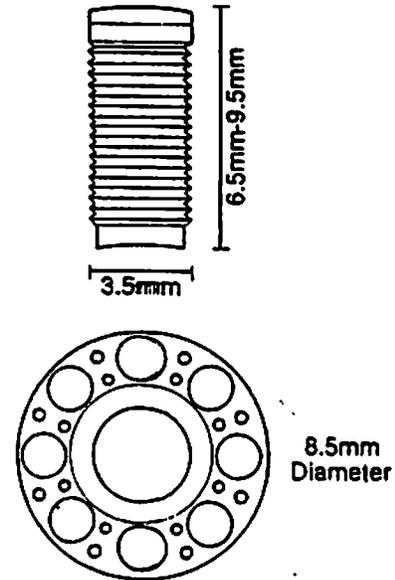


Fig. 3(Bath). The Cardona TT keratoprosthesis device has a polymethylmethacrylate optical cylinder and a Teflon skirt.

Although keratoprosthesis, or prosthokeratoplasty, has been advocated as the primary treatment for aphakic bullous keratopathy,<sup>6</sup> the severity of potential complications should reserve this procedure for advanced cases which would have a poor prognosis with penetrating keratoplasty. Use of keratoprosthesis may be considered in the following set of conditions: 1) bilateral blindness due to corneal scarring and corneal vascularization; 2) a history of repeated keratoplasty failure or the presence of keratitis sicca, pemphigoid or alkali burn; and 3) vision of at least light perception, with some evidence of projection and macular function. Keratoprosthesis may be contraindicated by useful vision in one eye, a keratoprosthesis device in one eye, or no evidence of macular function.

Reported rates of implant extrusion,<sup>5-9</sup> the most serious potential complication of keratoprosthesis, are not comparable with respect to preoperative diagnosis and follow-up times. However, the most recently reported data, from Rao's series<sup>9</sup> of 21 cases receiving Cardona TT keratoprosthetic devices implanted with Cardona's techniques,<sup>5</sup> show an encouraging absence of both extrusion and endophthalmitis over a maximum follow-up period of 3½ years.

The complication of endophthalmitis is usually observed in conjunction with erosion and extrusion of the keratoprosthetic device; however it may also occur independently as a result of aqueous leakage around the optical cylinder and concomitant intraocular invasion by pathogens. Aqueous leakage may also be associated with ingrowth of epithelial tissue along the optical cylinder, resulting in epithelial down-growth and retroprosthetic membranes.<sup>7-9</sup>

The extensive anterior segment pathology in eyes eligible for keratoprosthesis makes glaucoma a frequent problem either preoperatively or postoperatively. Diagnosis and management of glaucoma in a keratoprosthetic eye is complex because there is no accurate way to measure intraocular pressure and standard perimetric measurements are altered by the optics of the prosthesis. Serial observations of the optic nerve head coupled with tactile tonometry are clinically rational and useful methods of glaucoma assessment; however better methods of glaucoma surveillance are needed for these cases.

Extrusion of implanted keratoprosthetic devices has spurred on-going investigations of autologous tissues which may offer better bioadhesion than the polymethylmethacrylate, Teflon and Dacron synthetics. Strampelli<sup>10</sup> describes a technique of osteo-odontoprosthokeratoplasty which uses a patient's tooth as the supporting structure for the acrylic optical cylinder. Using this technique, he has rarely observed extrusion and never encountered the complication of conjunctival overgrowth. Other investigators are exploring the feasibility of using human unguis tissue (onychotransplantation).<sup>11,12</sup> Promising alloplastic research is being done by Frank M. Polack, M.D., using a ceramic keratoprosthetic device (unpublished data, 1979). The ceramic material (aluminum oxide-magnesium oxide) offers improved bioadhesion,<sup>13</sup> and it is available with a larger optical cylinder to give a wider visual field.<sup>14</sup>

Modern prosthokeratoplasty is an appropriate surgical alternative for anterior segment reconstruction in selected cases. Continuing advances in keratoprosthetic design and technology will undoubtedly increase the indications for this procedure in the future.

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