Keratoprosthesis as an Aid to Learning Surgical Techniques on Cadaver Eyes

Ute Eckardt, MD
Claus Eckardt, MD

ABSTRACT
Practice on cadaver eyes can be an essential aid for residents and inexperienced surgeons in learning operative techniques. Cadaver eyes, however, have been of only limited utility for teaching highly complicated procedures because of the obscuring of intraocular structures caused by the rapid post mortem onset of corneal swelling. We have overcome this problem by the use of a silicone keratoprosthesis that provides an excellent view of all intraocular tissues. Our model allows the use of donor eyes unsuitable for transplantation and facilitates the learning of even complicated cataract surgery, and vitrectomy techniques on the human eye. It thus can reduce the rate of complications in operations on patients.

Learning surgical techniques on the human eye has always been a problem for residents and inexperienced surgeons. The beginner generally learns an operative procedure by performing individual steps of an eye operation under the direction of an experienced surgeon. This, however, can lead to complications that would not normally occur in operations performed by experienced surgeons. Recent studies report the incidence of capsule ruptures in procedures carried out by residents ranging from 10% to 15%. Unfortunately, studies on the rate of complications in operations by inexperienced surgeons are incomplete.

Some techniques can be practiced on animal cadaver eyes. Human cadaver eyes, which of course would be better suited for learning procedures on human eyes, are unsuited for learning highly complicated procedures because the rapid post mortem onset of corneal swelling obscures the view of intraocular structures.

We overcame this problem by the use of a silicone keratoprosthesis that allows the use of human cadaver eyes for practicing not only complicated procedures in the anterior chamber but diverse vitrectomy techniques as well.

MATERIALS AND METHODS
Donor eyes rejected as unsuitable for transplantation (because of infection, tumor, age, etc.) are used regardless of corneal clouding. The eyes are mounted on a crumpled foam rubber pad and secured by drops of instant glue (Fig 1). The foam rubber pad is affixed by tape to the underlying table. This method of mounting is not only inexpensive but it also allows passive movement of the eye similar to that occurring in vivo during surgical manipulation.

After fixation of the globe, the cornea is trephinated with a 7.0 mm trephine. The iris is excised using an open-sky technique, taking care not to damage the crystalline lens. Only in rare cases of fresh enucleated eyes with a dilated pupil can the iris be left in place.

The keratoprosthesis (Fig 2) is then attached to the corneal bed with four 10.0 nylon sutures to achieve a nearly watertight closure. Of the two types of keratoprosthesis (Wöhlk, Kiel, Germany) available, type I and type II, type II should be used for this model. Its shorter optical cylinder extends less deeply into the anterior chamber and thus allows more space for instruments.

APPLICATIONS
The keratoprosthesis provides an excellent view of all intraocular tissues of the anterior chamber, enabling practice of various cataract surgery techniques. Techniques particularly difficult for the beginner include capsulorhexis, scleral tunnelling, and the conventional or bimanual phacoemulsification techniques. Implantation of diverse types of intraocular lenses (Fig 3) also can be practiced. For learning cataract surgery techniques, the scleral tunnel should be made prior to trephination of the cornea, without, however, opening the anterior chamber. Our experience has shown that preparation of the tunnel after corneal trephination and attachment of the keratoprosthesis is more difficult.

Our model also facilitates the learning of vitrectomies, including complicated techniques, such as retinectomy,
surgery of the subretinal space (Fig 4), injection of perfluorocarbon, and subsequent fluid-gas exchange. Finally, each training session can be concluded by re-attaching the trephined corneal button to practice suturing techniques used in perforating keratoplasty. The same prosthesis can be used several times because the holes left by the 10.0 sutures do little damage to the prosthesis.

DISCUSSION

The large number of experienced surgeons in hospitals and out-patient surgical centers ensures a high standard in surgical procedures on the anterior and posterior segment. Both the patient and the referring ophthalmologist have a right to expect that this high standard is maintained even in operations performed by residents or less experienced surgeons. The reported high rates of complications in cataract surgery need not be an inevitable consequence of the acquisition of surgical skills. Pearson and colleagues were able to reduce the incidence of vitreous loss from 10.3% to 3.2% by implementing a special training program. In this program all residents are able to practice surgical techniques on cadaver eyes under the guidance of experienced surgeons prior to their first operations on patients.

The model presented here, by contrast, is suitable for practicing techniques involving not only the anterior segment but the posterior segment as well. It can make a major contribution to reducing the rate of complications in many forms of eye surgery.

REFERENCES