

Modern Aspects of Corneal Transplantation

By RAMON CASTROVIEJO, M.D.

*From the Institute of Ophthalmology of the
Columbia Presbyterian Hospital,
New York, N. Y.*

MODERN ASPECTS OF CORNEAL TRANSPLANTATION

DR. RAMON CASTROVIEJO

*From the Institute of Ophthalmology of the
Columbia Presbyterian Hospital*

New York, N. Y.

Introductory Remarks—For more than 100 years, ophthalmologists have been trying to solve the problem of corneal transplantation. The first unsuccessful and even disastrous trials, which have now only historic value, were followed by others that inspire more hope. Technics were multiplied and the efforts of some research workers demonstrated that the substitution of an opaque cornea by a transparent one can successfully be accomplished when a suitable technic is followed. The statistics published during the past few years by Elschnig, Filatov, Thomas and the author give some reason for encouragement towards the solution of this problem.

The subject of this lantern slide and moving picture course is to demonstrate the actual technic of keratoplasty of the men who have had more experience on the subject.

Main Points Covered in Course:

1. Source of donor's material.
2. Types of keratoplasty.
3. Elschnig's technic of partial penetrating keratoplasty.
4. Filatov's technic of partial penetrating keratoplasty.
5. Thomas' technic of partial penetrating keratoplasty.
6. Author's technic of partial penetrating keratoplasty.

1. Source of Donor's Material:

The transplant may be obtained from the same individual "autotransplant," from individuals of the same species "homotransplant," or from individuals of different species "heterotransplant." "Auto" and "homo" transplants offer the only material that can be used. "Heterotransplants" invariably become opaque. In the case of autokeratoplasty the normal cornea of a blind eye replaces the scarred cornea of the second eye. Homotransplants may be obtained from patients who have eye lesions which require enucleation, but whose corneas are normal, from cadavers of adults or infants whose eyes are enucleated shortly after death, or from stillborns from seven months to full term whose eyes are enucleated shortly after delivery. If the recipient is not at hand at the time of enucleation of the donor's eye, autolysis of the enucleated eye can be retarded for two to three days by keeping the eye in Ringer's solution at a temperature of about 2-3° centigrade above zero.

2. Types of Keratoplasty:

Corneal transplants may be of several types.

(A) Total keratoplasty wherein the entire cornea is transplanted as a whole, without or with 2-3 mm. of surrounding conjunctiva. All the cases reported in the literature of this type of operation have resulted in failure. This type of keratoplasty offers only a temporary improvement of vision, the implant invariably becomes opaque and the eye is endangered of being lost through secondary glaucoma or phthisis bulbi.

(B) Circumscribed or partial lamellar keratoplasty, wherein a circumscribed superficial lamella of an opaque cornea is replaced by a similar lamella derived from a transparent cornea. This type is applicable only in cases in which the lesions are very superficial. Superficial lesions rarely extend over the whole surface of the cornea in which case optical iridectomy should be performed instead of keratoplasty. When the opacity is very extensive it may be necessary to perform this type of operation, although the formation of connective tissue at the base of the transplant defeats the success of the operation for visual purposes.

(C) Circumscribed or partial penetrating keratoplasty wherein a variable area of full thickness of the opaque cornea is replaced by a corresponding piece of transparent cornea. This type of operation has offered, up to the present day, the best permanent results. The brief description of the four main technics of partial penetrating keratoplasty now in use, namely: Elschnig's, Filatov's, Thomas' and the author's, will be the subject of the next four points to be covered in this course.

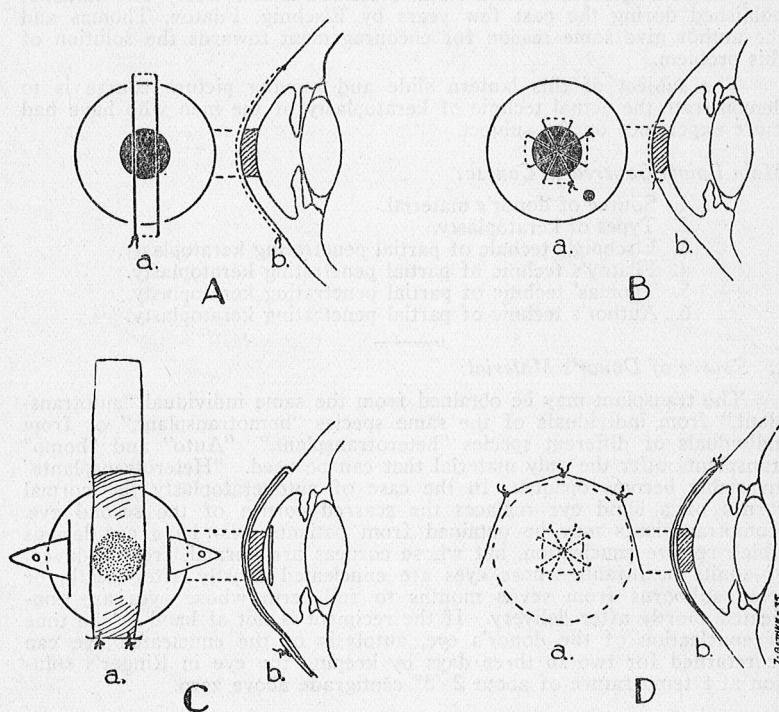


FIG. 1—(Castroviejo)—Technics of circumscribed penetrating Keratoplasty. A, Elschnig's. B, Thomas'. C, Filatov's. C, Author's.

3. *Elschnig's Technic of Partial Penetrating Keratoplasty:*

This technic is a slight modification of Von Hippel's. Von Hippel's trephine of from 4-5 mm. in diameter is used to remove a disc of full thickness from an opaque cornea, which is replaced by a similar disc

of transparent cornea (Fig. 1, A). A bridge suture is placed from the conjunctiva of the upper limbus, over the transplant, and tied in a similar position to the conjunctiva of the opposite side. Eserine is used before the operation in order that the pupil will be contracted, protecting the lens from possible injury with trephine. The operation is performed under local anesthesia. Palpebral akinesia, retrobulbar injection of procaine and epinephrine and superior rectus suture add safety to the operation. The transplant is obtained from a patient's eye or from eyes of adults or infants enucleated shortly after death. Elschmig expresses the belief that any kind of solution hurts the transplant, therefore, he keeps the graft between layers of dry gauze after it has been excised with the trephine.

Of the 174 patients operated on in the last twenty years, 113 had leukoma of the cornea due to flames, chemical burns, or ulceration which destroyed the entire cornea. In twenty-two cases, in a majority of which aphakia was present, the implants did not remain in place and closure of the hole left by the trephine had to be accomplished eventually by means of a conjunctival flap. The disc remained clear in only fifteen cases and partially transparent in thirty-one. In all of these cases, however, there was improvement in vision. In forty-five cases the implant became totally opaque. The greatest improvement of vision was from hand motion to vision graded 6/6.

Of twenty-six cases of interstitial keratitis, in which the scars were thick, one disc was lost, six other discs became opaque, in two cases the flaps were partially transparent, and in seventeen cases the corneas were very clear, and the improvement in vision marked.

Elschnig arrives at the conclusion that the circumscribed, penetrating keratoplasty of Von Hippel is the only dependable method. The opinion he expresses is that among patients with leukoma, who are more than fourteen years of age, whose anterior chamber is normal, and who give no evidence of increase of ocular tension, keratoplasty will be successful in about 22 per cent of all cases, and that it will be successful in about 73 per cent of cases of interstitial keratitis. Transplantable material, he said, can be obtained from the eyes of young as well as of old persons with normal corneas; it is immaterial whether the remaining part of the anterior segment is normal or pathologically changed, or whether the donor has glaucoma of hypotension (phthisis bulbi). Elschmig did not find any relationship between hemolysis or agglutination of the serum and the transparency or opacification of the transplant.

4. *Filatov's Technic of Partial Penetrating Keratoplasty:*

Filatov has modified Von Hippel's operation, trying to eliminate its disadvantages, namely: the imperfect way in which the transplant is held in position and the unfortunate ease with which the iris and lens can be injured with the trephine. A flap is made in the upper part of the bulbar conjunctiva (Figure 1, C), and an incision is made in the lower conjunctiva near the lower limbus. With a cataract knife a puncture and counter-puncture are made in the cornea, leaving, therefore, two parallel perforating incisions through which a strip of celluloid (prophylactic spatula) is passed, penetrating into the anterior chamber and separating the cornea from the iris and lens. The cornea is trephined and a transparent flap taken from an eye of a patient or from an eye enucleated from a cadaver shortly after death, is placed in position. The conjunctival flap with its epithelium surface downwards is stretched over the transplant and fastened with two sutures to the lower incision in the lower conjunctiva near the limbus. The strip of celluloid is then removed. In case it is impossible to use the conjunctival flap because of scar tis-

sue changes, a small round piece of boiled egg's membrane, with its inner surface towards the transplant, is used instead. Radial incisions are made in this egg membrane for better fitting and bridge sutures in the manner of Elschnig are placed vertically and horizontally for fixation both of the egg membrane and the implant. Recently, Filatov has devised a combination of a hand trephine with a safeguarding spatula which facilitates the performance of his operation.

In the period from 1923-32 Filatov has performed 96 partial penetrating corneal transplantations. Of these, 14 resulted in permanent transparent grafts; they were observed from one to six years, except that of one patient who died seven and one-half months after the operation. Two patients' visions were not improved, in the others it was increased from 1/60 to 30/60.

Filatov classifies his cases as follows: according to the quality of the operative field—(a) in 38 eyes with leukoma complicated with glaucoma, buphthalmos, aplanation of the cornea and symblepharon, 48 operations gave no positive results. (b) In 22 rough cicatricial leukomas only in a few was permanent transparency of the transplant obtained. (c) All successful transplantations were done in these 26 leukomas in which some transparent corneal tissue remained. This represented 54 per cent of successful cases. Filatov's experience confirms that of Elschnig that it is of great importance to have corneal tissue in the leukoma in order to obtain successful corneal transplantations.

5. Thomas' Technic of Partial Penetrating Keratoplasty:

A trephine from 4-4½ mm. in diameter is used to outline a disc in the leukomatous cornea (Fig. 1, B). Then the trephine is sloped to about 45° and rotated so as to cut through at one point. Through this point one blade of a scissors penetrates into the anterior chamber and the remaining inner layers of the outlined corneal flap are cut in a shelving manner so that the endothelial aspect of the disc is smaller than the epithelial surface. With the trephine slightly smaller than the one used in the host a similar disc is obtained from a transparent cornea. The leukoma is replaced by the graft and is kept in position by cross-stitches previously inserted into the cornea a small distance from the graft itself.

Thomas attaches considerable importance to the size of the transplant in its relation to the size of the defect. The transplant should be smaller than its bed since the former undergoes some swelling, and if it is originally of the same size as the latter, the result is a bulging cicatrix with irregular edges. In Thomas' technic the transplant is firmly held in position by the cross-stitches. The shelving of the transplant prevents it from falling into the anterior chamber and the dilated pupil prevents anterior synechia. The transplant is obtained from eyes of patients and is kept in olive oil for a short while before it is finally placed in the eye of the host.

Of fifteen cases regarded as suitable for corneal transplantation, operated by Thomas, twelve were successful in the sense that the graft was either clear or reasonably clear and gave considerable improvement of vision. This represented 80 per cent success of the fifteen cases, or 75 per cent success of the sixteen operations. Some of the best cases were improved from finger counting at one foot to 6/36; others 6/60, 5/60 and so on down to 1/60.

A—Conjunctival flaps are made above and below and 4 sutures inserted. *B, C, D*—Square flap is outlined in the cornea with a double knife without penetrating into the anterior chamber. *E, F*—The upper edge of the transplant is cut thru in shelving manner with a special keratome. *G*—The other 3 edges of the transplant are cut also in a shelving manner with a special scissors. *L*—A similar technic is employed to obtain from an enucleated eye ar transparent graft. *H, I*—The leukoma is replaced by the transparent graft. *J, K*—Conjunctival flaps are pulled over the graft and sutures tied.

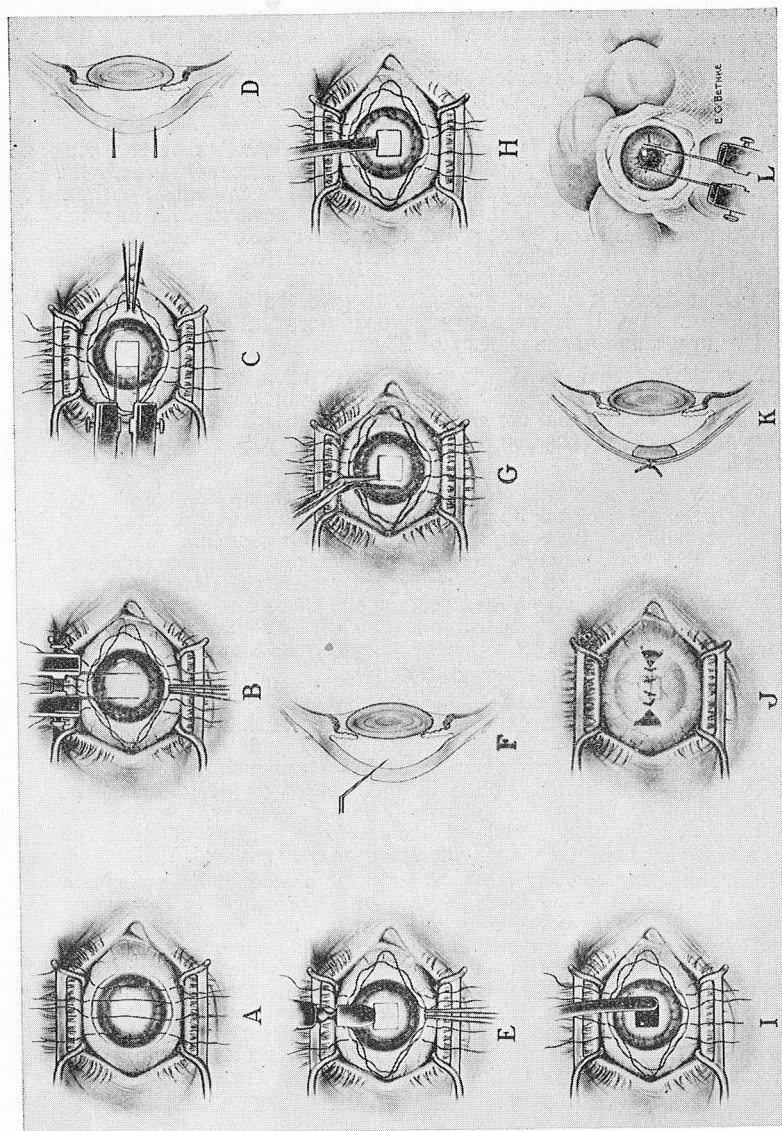


FIG. 2—(Castrorocio) — Author's technic of partial penetrating Keratoplasty.

6. *Author's Technic of Partial Penetrating Keratoplasty:*

The pupil is widely dilated with atropin, conjunctival flaps are made above and below at the bulbar conjunctiva (Fig. 2). The leukomatous area to be removed is outlined with the double knife, the upper edge is cut through with a keratome kept at an angle of about 45° in order to obtain shelving of the edge. The other three edges are also cut in a shelving manner with the aid of special scissors. A transplant of the same size as the removed leukoma is obtained in a similar way from the enucleated eye of a patient or from eyes of stillborns enucleated shortly after delivery and kept from one to forty-eight hours in Ringer's solution at a temperature of 2-3° centigrade above zero. The transparent transplant replaces the dissected leukoma and the conjunctival flaps are sutured over the transplant to hold it in position and furnish nutrition during the first few days.

When the conjunctiva is so scarred that the dissection of two conjunctival flaps is no longer possible, the author has successfully used the following modification of the technic. The transplant is held in position with cross-stitches (Fig. 1, D), and afterwards is covered with one flap of conjunctiva which can be obtained from above, below, temporally or nasally, that is, from the place which is best suited for the dissection of this flap. Since this conjunctival flap contains, as a rule, a great deal of cicatricial tissue, it is not best suited to give the transplant an even pressure, therefore, it is necessary to use cross-stitches to hold the transplant in position in the manner of Thomas.

The author's technic of circumscribed, penetrating keratoplasty varies from all others hitherto described in two fundamental points, namely: the shape of the graft and the manner of dissecting it, and the way of holding the graft in position. The two points will now be briefly discussed.

(a) *Shape of the Transplant*—The author has found that rectangular flaps are better than circular ones to obtain bevelling of the transplant and thus preventing it from falling into the anterior chamber. The combination double knife-scissors gives cleaner sections than the trephine-scissors combination. Microscopic study has proved that linear sections performed with knives have cleaner edges than those made by trephines. The cutting of the edge of the circular flap with scissors becomes progressively more difficult as the diameter of the circle diminishes.

(b) *Conjunctival Flaps*—Conjunctival flaps carried over the graft offer the best means for holding the graft in position, giving desirable gentle pressure and offering the best possible protection for the graft. The conjunctival flaps nourish the graft during the first few days and accelerate the healing process of an avascular tissue such as the cornea. These flaps are particularly useful in these cases of dense leukomas, where nutrition of the graft is greatly impaired. Finally, the conjunctival flaps offer the best possible protection for the graft and the eye in case the former becomes partially detached or does not heal.

During the past two and one-half years, 32 operations following the author's technic, or its modifications, have been performed in 27 eyes of 25 patients. Three eyes were operated twice and one three times. Unselected cases were operated upon in order to determine, after studying the results in a sufficient number of them, which cases would and which would not benefit from surgical intervention. Before the operation, the cases were classified following the criterion of the other authors, who have had considerable experience on the subject, favorable and unfavorable. Those cases are understood as favorable in which the whole pathology of the eye is limited to the cornea, the leukoma is not

very dense, although sufficiently so as to cause considerable impairment of vision, and there are areas of none or little scarred cornea surrounding the graft. Unfavorable cases are those with very dense corneal leukomas in which the transplant is entirely surrounded by dense scar tissue, those with aphakia, anterior synechia, corneal staphyloma, etc. Of the 32 operations, 21 were performed in unfavorable eyes and 11 in favorable ones. Of the 21 unfavorable eyes, reasonably permanent transparency was obtained in seven cases, improving vision from light perception and projection to counting fingers from one to three feet. In one case with faulty projection of light, the transplant remained perfectly transparent in front of a cyclitic membrane, without improvement of vision. Of the 11 cases considered favorable for operation, 9 have remained completely transparent or very nearly so. The improvement of vision in these 9 cases has been very marked, varying from light perception and projection to 20/30 in the best, and from light perception and projection to counting fingers at two feet in the worst. In the author's experience, the transplants did not become swollen after the operations. Perhaps this was due to the presence of the conjunctival flaps.

SUMMARY

"Homo" and "auto" keratoplasty can successfully be accomplished when a suitable technic is followed. When the operation is performed on favorable eyes a high percentage of success may be expected. In those eyes in which the anterior segment is severely affected the results cannot be expected to be so brilliant, but a definite improvement can be obtained when a suitable technic is used. Inasmuch as these eyes have little or nothing to lose and may be considerably improved, operation is justified.

NOTES

NOTES

PRINTED IN U.S.A.