been reported previous to a certain time, does not mean it can never occur, and it is only fair for those who would be dogmatic to consider such a case as this with an open mind.

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KERATOPLASTY

BY

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During the last few years much attention has been drawn to corneal grafting by numerous publications in ophthalmological and other journals. The experimental work of Tudor Thomas in England and Castroviejo in America has illuminated the subject considerably, but has perhaps tended on the whole to emphasize the difficulties of the procedure in the minds of medical men. The demand for the relief afforded by keratoplasty is relatively small in Western countries, and this, together with the comparative scarcity of good material for transplants, limits the field and tends to make the majority of ophthalmic surgeons in the West hesitate to adopt a measure which presents so many apparent difficulties.

Conditions are different in the Near and Far East, where the demand for relief by corneal grafting is considerable and suitable grafting material is easy to obtain. Under such circumstances it is only to be expected that simplification of technique and greater rapidity of execution should be aimed at and acquired, and although reports of cases and operative detail from Eastern Europe, India, and adjoining areas do not show up prominently in the literature, there is little doubt that in these areas much more practical experience has been obtained in performing corneal grafting on the human subject than elsewhere.

A Simple Technique

I am not familiar with the exact methods adopted by the various ophthalmic surgeons who freely employ keratoplasty in the East, but I have evolved a simple technique which appears to hold out as good a chance of success as the more elaborate methods described in recent literature. It has the advantage that it can be undertaken confidently by any ophthalmic surgeon of experience. I demonstrated this method in Melbourne at the Annual Meeting of the British Medical Association, but only on the rabbit, as a patient and donor were not available.

The trephine is used for both graft and bed. The nests of trephines made for me by Messrs. Down Brothers give a fair range in size. Although I have employed a 12-mm. trephine on two occasions my impression is that this is too big, not because the graft does not readily take, but because anterior synechiae are more likely to occur. The formation of an anterior synechia with the back of the graft junction is the complication most to be dreaded in keratoplasty. A 3-mm. trephine is too small except when one employs it for the graft method of treating fistula which I have described. The best average trephine diameter is perhaps 6 mm. There is no real need to have special nests of trephines, although the finish of the edge in specially made cylinders gives a bevel to the margin of graft and trephine hole. Cork borers, such as are found in a laboratory, are almost equally good. No other special instrument is required, although of course it is preferable to use fine needles, such as Barraquer's or Kalt's half-circle 7 mm. point to eye (maker's 12 mm.), and a delicate needle-holder such as that made for me by Weiss. The various steps in the procedure are briefly as follows.

The cornea chosen for grafting should preferably have a normal anterior chamber. (This is highly advisable in earlier attempts. Later the surgeon may consider what we refer to as reconditioning the anterior chamber before grafting, a much more difficult and tedious procedure.) The graft should for preference be obtained from a living human eye. I have no experience of grafts obtained post mortem. Eyes blind from glaucoma furnish quite good grafts, as do eyes removed in the course of exenteration for malignant disease. It appears to be unnecessary to choose a donor of the correct blood group. The donor and recipient are placed on adjoining tables and prepared in the usual way as regards surgical cleanliness. Akinesia and anaesthesia are established by novocain and adrenaline; pantocaine drops are given. The recipient's pupil should be small, the donor's wide, if this is possible. The necessary instruments for completing the enucleation or exenteration on the donor are left ready and an operator detailed for this work.

Preparation for Transplantation

Having decided on the disk diameter and the trephine to be used, the site is demarcated on the recipient's leucomatous cornea by a few rotations of the trephine. The stitches are then put in, taking the first bite at 6 o'clock just off the cornea, where an easy but firm grip can be taken with the point of suture, which does not produce conjunctival drag or puckering. One end of the thread is held; the needle with the other is carried across the cornea to 12 o'clock, where a similar bite is taken. The needle is then unloaded and the free end carried back to 6 o'clock and laid beside the end already in position. This manœuvre is repeated at points corresponding to 7.30 and 1.30, 9.30 and 4.30. It is well to do this clockwise and remember the order of placing the sutures. One observes how they will eventually be related to the graft by noting where they cross the demarcated area. The stitches are then pulled free of the demarcated area, the lids closed, and attention given to the donor, who now has a speculum *in situ* and is ready prepared.

Trephining the Donor

Here the same trephine is used in a corresponding position on the cornea. Good fixation of the globe is desirable. This can be effected simply by a T-shaped fixation forceps. The trephine must be used evenly and freely.

It is desirable to go right through and get the disk cut away clean as far as possible. There is generally a hinge left: the shorter this is the better. On removing the trephine the disk opens outwards on its hinge, pushed by the contents of the globe. One should try to avoid damaging the uvea and getting pigment on the graft. If the graft tilts, the hinge is easily cut free on the bevel with fine sharp scissors, either fine blunt-pointed or curved, with one sharp and one beaded point. A fine Stevens type of scissors answers satisfactorily.

If the trephining has been well done the hinge consists of a narrow belt of Descemet's membrane, which is readily cut free. The graft must on no account be touched at this stage except with a camel-hair brush or an equally inoffensive piece of apparatus, and then only on the epithelial aspect. Should the hinge be larger and the graft remain *in situ*, it is perhaps best to complete the separation of the hinge with a narrow Graefe's knife. The knife is plunged through the gap already cut, deep into the eye regardless of the lens, which is dislocated backwards if necessary. The edge is then approximated to the hinge, which is cut on the bevel as the knife is withdrawn. This is repeated. Cutting in the other direction is more dangerous to the graft, and Descemet's membrane is more likely to be rucked up. The severed disk is now received—epithelium downwards—on a Volkman spoon encouraged by a camel-hair brush. It is submerged in saline—or more elaborate physiological isotonic solution—about body heat. Should vitreous or pigment appear to be adherent to the endothelial face it is gently removed with the brush from the centre towards the periphery. The graft is treated from the beginning like a delicate histological section in process of mounting. The donor is then left to another surgeon and the process of trephining the recipient commenced.

Trephining the Recipient

Here one must proceed with great caution. With even rotation, trephine as far through the cornea as possible; it is generally fairly obvious when one is nearly through. A slight tilt is then given to the trephine, which goes through followed by an aqueous escape. In this case the hinge is likely to be much larger, possibly two-thirds the circumference of the circle. Fortunately one can seize the disk in a forceps and deliberately sever the hinge slowly and carefully with a suitable bevel by means of the knife or scissors, such as mentioned above. The chamber is now inspected. Let us assume the pupil is contracted, the iris intact, and the lens clear. This is the ideal background. A little normal saline is run in from the irrigator. This temporarily gives a view towards the angle and leaves a little fluid between iris and cornea.

The Transplantation

The graft is now lifted with the Volkman spoon and camel-hair brush from its warm saline, tumbled into the aperture, and adjusted to its new position by a few touches of the brush. The stitches are then replaced over it in their order and tied off by means of a pair of forceps suitable for this purpose. Suture-tying forceps are most desirable at this stage, and Silcock's iris forceps are more useful for this than the purpose for which they were originally intended. Atropine and iodoform ointment is now placed in the conjunctival sac, the eye closed, and both eyes bandaged. The patient is kept somewhat quieter than a cataract case, gently examined on the third day, and a little more atropine and iodoform ointment given. The graft has usually taken by this time and the

chamber formed. On the fifth day the stitches are removed. Atropine is continued. The patient is allowed to walk to inspection, and goggles are given on the eighth day.

Points of General Interest

It is undesirable here to go into all the variations that may have to be adopted if the condition of the recipient's eye is other than that suggested above—for instance, in leucoma adherens with shallow or non-existent anterior chamber and the whole gamut of abnormal conditions in the anterior segment which follow gross corneal ulceration. The procedure of preliminary investigation and preparation naturally varies in every case, but its detailed discussion is more suited to a thesis on corneal plastic methods. There are a few points of general interest and practical importance which may be noted here:

A cornea that has previously been vascularized—for example, one which has been affected by interstitial keratitis or trachomatous pannus—offers better soil for a graft than a cornea free of such old vessels. This has been known for a long time, and is referred to by Elschnig.

A child is a much more difficult subject for keratoplasty than an adult.

It is important to respect Descemet's membrane; it readily lifts, buckles, and detaches at the cut edge.

Anterior synechiae are liable to form in this situation. These are almost certain to be followed by opacification of the graft unless very trivial and freed early. The use of eserine is preferable to that of atropine in the grafted eye if the graft is large. Atropine may be desirable if the graft is small; this requires judgement. The main object is to avoid anterior synechiae.

The stitches must not be left too long; they may damage the graft: five days is quite long enough. An optimum result with a clear graft and really good visual acuity is exceptional. Improvement to the extent of allowing a previously "led" patient to see large objects and get about alone is a modest expectation in straightforward cases. Patients must be warned not to expect too much; this saves disappointment. The most theatrical effects are produced by successful keratoplasty when the blind patient is made to see, but this is by no means the only indication for corneal grafting. As a method of repair it is often far superior to the conjunctival flap, the epithelial graft, and such plastic procedures.

Sir E. John Russell, F.R.S., of the Rothamsted Institute, Harpenden, is to lead a group of members and friends of the Le Play Society to Russia in August. The visit will afford an opportunity for seeing something of what is being done in the application of science to everyday problems in Russia, particularly in regard to farming. The general geographical features of the country, its geology, vegetation, and various social experiments will also be studied. This group will leave London on August 6, travelling via the Black Sea to Erivan in Soviet Armenia, returning via Moscow and Leningrad by boat to London. Finnish Lapland is to be visited by another Le Play group, who will stay for a short time on the Arctic coast. For geographers, botanists, and geologists this presents a particularly interesting area for vacation study. The party will leave London on August 4. Similar arrangements are being made for visits to Yugoslavia (Old Serbia), where there will be special interests for the geologist and the botanist, to Czechoslovakia, to the Dalmatian coast, and to the Outer Hebrides. Full details of these vacation visits can be had from Miss Margaret Tatton, director, the Le Play Society, 58, Gordon Square, London, W.C.1.