LAMELLAR KERATOPLASTY*

BY

DERMOT PIERSE AND T. A. CASEY

From the Croydon Eye Unit

THIS report relates to a series of 48 grafts (44 cases) performed in a period of approximately 18 months. About one-third of these were undertaken as an out-patient procedure, the patients being operated upon under normal theatre conditions but returned to their homes by ambulance post-operatively. In a previous communication (Casey, 1958), it was reported that with the simple therapeutic graft this is a satisfactory and safe procedure, and a further year's experience has confirmed this. In no case could any ill-effects be ascribed to the absence of hospitalization. Most of the other cases were admitted to hospital for only very short periods.

This series was undertaken in the belief that there are many patients in the average ophthalmic out-patient department who would benefit from a therapeutic lamellar graft but that this is not performed because of the shortage of hospital beds, the difficulties of correlating donor material availability with admission, and the fact that many cases do not justify the time and expense involved. Moreover, when cases are routinely transferred to a main centre for keratoplasty, surgeons may hesitate to overload the special unit with relatively minor conditions such as recurrent herpetic or acne rosacea keratitis. It was in these conditions that we found most use for this procedure. Much time is consumed in the treatment of old-standing recurrent keratitis and patients endure considerable hardship therefrom. We have been most impressed by their dramatic response to lamellar keratoplasty.

Technique

Although less has been written about the technique of lamellar grafting than about that of penetrating keratoplasty, there is less uniformity of method. Some new points which have arisen in the course of this series are worth noting.

(1) *Donor Material.*—It is not always easy to remove donor eyes within the period of 6 to 8 hrs after death usually described as the maximum permissible. In the hospital from which most of our donor material was obtained the bodies are removed to a refrigerated mortuary within a very short time of death. Taking the temperatures of the eyes of cadavers as measured under the closed lids we found that the eyes reached 4°C. within 3 hrs of being placed in the mortuary. Under

* Received for publication December 8, 1958.

these conditions it seemed unnecessary to hurry the removal of eyes for storage at 4°C. The average time before removal was 14 to 20 hrs and the material was then used within a few days.

(2) *Reduction of Ocular Tension.*—Paufique (1955) has described puncture of the anterior chamber before cutting the host cornea in order to produce a flatter corneal surface and facilitate deep dissection. We have found that retrobulbar injection of xylocaine and hyaluronidase with pressure on the globe for 5 minutes as described for cataract extraction lowers the ocular tension sufficiently to facilitate dissection of the lamellae.

(3) *Suturing.*—Much use has been made of a suture which combines the firm fixation of the direct suture with the support and ease of removal of the overlay. We found this suture particularly valuable in cases treated as out-patients (Fig. 1).

FIG. 1.—Combined overlay and direct suture.

(4) *Inserting Sutures.*—A new instrument has been evolved which greatly facilitates the insertion of sutures. This is especially useful when dealing with a small thin graft. It consists of a very small sucker with two projecting teeth. This can be attached by rubber tubing to an ordinary theatre sucker apparatus or to a mechanical crisophake, or can be used with a rubber bulb. The instrument is placed close to the edge to be sutured, the suction is applied by closing the exhaust hole with the forefinger, and the needle is inserted so that it emerges through the teeth. This has the advantage of firm fixation of the edges to be sutured without the trauma which is inevitable with any type of forceps (Fig. 2, A, B, C).

FIG. 2A.—Enlarged view of needle guide.

FIG. 2, B and C.—The new needle guide is connected to a suction apparatus and enables sutures to be inserted in corneal edges without trauma.

(5) *Transporting the Graft.*—Various types of instrument have been described for carrying the graft from the donor to the host. A new instrument has been devised in the form of a small rubber bulb sucker, similar to Bell's erisophake, which holds the graft firmly without trauma. It has the advantage that the graft is retained in its grasp until it is safely in position in the host (Fig. 3).

FIG. 3.—A small rubber bulb sucker holds the graft firmly without causing trauma.

(6) *Shape of the Graft.*—The use of circular grafts in lamellar keratoplasty as in penetrating grafts is almost universal. In lamellar surgery, however, the accuracy of fitting of the graft edges is not quite so important as in penetrating keratoplasty, principally because Descemet's membrane and endothelium do not have to be joined. We have made much use of rectangular grafts and have found this procedure to possess the following advantages:

(a) The shape and size of the corneal lesion may be such that a square or rectangular graft would spare more normal corneal tissue.

(b) The edge of the graft, with its inevitable slight scar, may be prevented from crossing the pupil.

(c) It is easier to dissect a very deep lamella from the host eye and to keep the dissection in the same plane when starting with the straight side and sharp corner of a rectangle than when starting from a circular edge.

(7) *Preparation of the Donor Lamella.*—Although it is easier to separate the donor lamella by slicing it with a blade, such as a razor blade or the special instrument described by Bock (1949), we feel that this does not give a true separation of the layers of the cornea, and we therefore prefer to use a tearing rather than a slicing technique. The essential steps are:

(a) The whole cornea is removed from the donor eye.

(b) In all subsequent operations the graft is handled by its extreme edge which is finally trimmed off and discarded.

(c) Grasping the straight edge with two pairs of wide forceps, separation is effected between two lamellae mainly by tearing but with some assistance from a Bard-Parker knife (Fig. 4).

FIG. 4.—Separation of lamellae.

(d) The final graft is punched out with a trephine if a circular shape is required, or trimmed to size with scissors for a rectangular shape.

Classification of Cases

The cases in this series may be divided into the groups set out in the Table.

TABLE

Condition						No. of Grafts
Pterygia	..	..	..	..	..	9
Therapeutic	(a) Active	..	..	..	..	4
	(b) Recurrent	..	..	..	..	13
Optical	..	..	..	..	..	11
Preparatory to penetrating graft						4
Cosmetic	..	..	..	..	..	3
Retransplants	..	..	..	..	..	4
Total						48

(1) **Pterygia.**—There were nine grafts for recurrent or malignant pterygia. We use a rectangular graft which extends two mm. on to the sclera. A point in favour of the straight edge of the rectangular graft is that it gives a good guide to further observations of suspected recurrences, while overlapping the sclera may prevent a recurrence in the episcleral tissue where the disease process commences. We feel that, since a high percentage of pterygia recur, lamellar keratoplasty is justified as a primary procedure. A limitation of the action of the medial rectus muscle has been noted in several cases of pterygium operated upon by other techniques, but this seems unlikely to follow a transplant. There has been no sign of recurrence in any of our nine cases, and Case 9 is a typical example.

Case 9, male aged 47, had previously lived for many years in India where he had had an operation upon a pterygium on the left eye 4 years before he was first seen by us. Since his arrival in England 2 years ago the pterygium had recurred and a further excision had been undertaken.

Examination.—He was found to have an active pterygium which had extended almost to the midpoint of the cornea.

Operation (December, 1957).—This consisted of a rectangular half-thickness lamellar graft 7 × 5 mm. secured by three parallel combined overlay and direct sutures. The patient returned home post-operatively.

Result.—Healing was uneventful, and a careful examination with the slit lamp one year later revealed no corneal abnormality beyond the scar line marking the edge of the graft (Fig. 5).

FIG. 5a—Case 9, typical recurrent pterygium. Pre-operative.

FIG. 5b.—9 months after operation. Arrow indicates edge of graft.

(2) Therapeutic

(a) *Active Keratitis.*—The incidence of herpetic keratitis appears to be on the increase. Some cases are persistent and eventually extend into the stroma, causing disciform keratitis, corneal vascularization, persistent uveitis, and even occasionally corneal perforation. Many cases are probably aggravated by the indiscriminate use of steroids. The four cases in this review showed prompt improvement following keratoplasty. It is felt that cases persisting for longer than 2 months should have a keratoplasty.

Since the completion of this series we have increased the use of lamellar grafting in active keratitis with satisfactory results in most cases.

Case 2, a female aged 32, had severe right herpes ophthalmicus in January, 1955, followed by a circular diffuse keratitis about 6 mm. in diameter, involving all layers of the central portion of the cornea. This remained continuously active despite all the usual forms of treatment and caused severe emotional upset. Before the operation the visual acuity was only 2/60.

Operation (December, 1956).—This consisted of a 7-mm. deep circular lamellar graft secured by six direct sutures.

Result.—One month later the cornea was healed and quiet and there was no further keratitis. In October, 1958, the visual acuity was 6/18.

Case 25, a girl aged 9, had developed a severe bilateral keratitis after an attack of measles at the age of one year. Long periods of hospitalization, extensive general investigation, and all available forms of local therapy had had no apparent effect over a period of 4 years. After this, the left eye became quiescent and the visual acuity was noted to be 6/18. However, the inflammation in the right eye remained constantly active and severe photophobia continued to interrupt the child's schooling. Schirmer's test showed almost complete absence of tears.

Operation (February, 1958). A half-thickness 9-mm. circular lamellar graft was secured by four direct and four combined sutures.

Result.—The graft is clear apart from a fine superficial opacity. With the use of artificial tears, her photophobia is very much less, and her eye is quiet. The visual acuity is only 6/60, probably because of amblyopia ex anopsia.

(b) Recurrent Keratitis.—As it is reasonable to assume that in recurrent herpetic keratitis the virus lies latent in the cornea between attacks, removal of the affected cornea is a logical procedure. Other factors may be introduction of donor antibodies, the biological effect of new tissue, and the reduction in vascularity. There were thirteen cases of recurrent keratitis in this series. Most of them were herpetic, mustard gas and acne rosacea being among the main aetiological factors in the remainder. None has had a recurrence of inflammation post-operatively.

Case 3, a female aged 71, had had bilateral acne rosacea keratitis for 10 years and she had made frequent attendances at a London teaching hospital during this period. She had diffuse vascularized opacities and a small focus of active keratitis in the right eye. The visual acuity was 3/60 in the right eye, and 6/60 in the left.

Operation (December, 1956).—An 8-mm. lamellar graft was inserted in the left eye, and (in January, 1957) an 8-mm. lamellar graft in the right eye, both being undertaken as out-patient procedures.

Result.—Healing was uneventful and the visual acuity is now 6/60 in the right eye, and 6/36 in the left. Both grafts show diffuse fine opacities and a few fine blood vessels. Although her vision is little better, this is one of our most grateful patients, as the recurrent episodes of keratitis were painful and the repeated visits to hospital were economically very irksome.

Case 20, a man aged 40, had had eight attacks of herpetic keratitis in the left eye during the past 15 years. He had a dense paracentral nebula with a good deal of surrounding superficial opacity and a few deep blood vessels. The visual acuity in the left eye was 3/60.

Operation (December, 1957).—A 7-mm. deep lamellar graft with six direct sutures was inserted.

Result.—The graft is quite clear but there are some deep blood vessels. The visual acuity is 6/60 (6/12 with a contact lens) in the left eye.

Case 40, a man aged 42, had had recurrent keratitis in the left eye for 15 years, the onset being usually associated with an attack of malaria. There was dense stromal infiltration involving all areas, and many deep blood vessels. The eye was painful and the patient requested excision. The visual acuity was hand movements.

Operation (December, 1956).—A 7-mm. lamellar graft was inserted.

Result.—There was a moderate post-operative reaction for 3 weeks, but no recurrence of keratitis. There is no visual improvement as there is still a marked deep opacity. The patient would benefit optically from a penetrating graft, but is happy to be free from symptoms.

(3) Optical.—The dramatic visual improvement that penetrating keratoplasty often produces can never be rivalled by lamellar keratoplasty but, in certain cases, particularly aphakic cases, a useful degree of visual acuity can be obtained with less risk. Only one of the eleven cases in this group was not improved. This patient had three grafts and on each occasion the graft became opaque. The processes involved in this early clouding have not been elucidated, though recently Havener, Stine, and Weiss (1958) have produced some evidence in favour of blood group antigens. One of the patients died ten weeks after operation and the histology showed no evidence of host replacement.

Case 14, a female aged 85 (Fig. 6, opposite), had a bilateral cataract extraction in 1928. The left eye was blind following a retinal detachment and gross calcareous degeneration. The sight of the right eye had failed gradually within the past 10 years, so that she found it increasingly difficult to get around and reading was impossible, which was a great handicap as she was highly intelligent.

Operation (November, 1957).—This consisted of a rectangular lamellar graft 11×5 mm., using four direct sutures and three combined overlay and direct sutures. The donor graft included the arcus senilis of the donor and it is interesting that 6 months later this commenced to clear.

Result.—The graft is perfectly clear, but because of macular changes the visual acuity is only 6/24 and N 8.

Case 17, a male aged 62, had congenital syphilis with bilateral diffuse superficial and deep opacities, but no vascularization. The visual acuity was 6/60 in the right eye and 6/36 in the left.

Operation (November, 1957).—A 7-mm. deep lamellar graft with six direct sutures was inserted.

FIG. 6a.—Case 14, corneal degeneration in aphakic eye; patient aged 86.

FIG. 6b.—Post-operative appearance. Visual acuity 6/24. Note arcus senilis of donot.

Result.—The graft is quite clear apart from a faint central opacity. The visual acuity in the right eye is 6/12 partly.

(4) Preparatory.—Where there is marked corneal vascularization, penetrating grafts are almost certain to fail. Like other observers we have noted that vascularization often stops at the edge of a lamellar graft, so that a smaller penetrating graft has a much better chance of success. We have also been impressed by the trophic effects of a lamellar graft on the remainder of the cornea. Beta rays have a limited value in reducing vascularization.

Many of our therapeutic grafts for recurrent keratitis, having achieved their primary aim, are now suitable for penetrating keratoplasty.

Case 10, a male aged 60 (Fig. 7), had a very severe lime burn of the left eye following a home decorating accident in 1954. This resulted in a severe symblepharon of the upper lid and the cornea became covered by a densely vascularized membrane.

Operation (February, 1957).—A complete relining of the upper fornix with buccal mucous membrane was satisfactory, and in September, 1957, a total half-thickness lamellar graft secured by ten direct sutures was inserted.

Result.—This was remarkably good at first, but within a few months a superficial opacity with fine vascularization spread over most of the cornea. Despite this a visual acuity of counting fingers was retained, and after peritomy and beta-ray therapy the patient is considered ready for a penetrating graft.

FIG. 7a.—Case 10, very severe lime burn. Completely vascularized cornea.

FIG. 7b.—9 months after 10 mm. lamellar graft. Visual acuity counting fingers at one metre.

Case 22, a boy aged 13, suffered a firework injury in November, 1954, which resulted in a severe burn of the left eye which became secondarily infected. In October, 1955, the upper lid was firmly adherent to the upper two-thirds of the cornea.

Operation (November, 1955).—Before this series was begun the adherent lid was freed from the cornea, the upper lid and fornix were lined with buccal mucous membrane, and the raw area of the cornea was covered with a thin lamellar graft. The mucous membrane graft was satisfactory, but the whole of the upper two-thirds of the cornea became densely vascularized.

Operation (February, 1958).—A rectangular deep lamellar graft 9×6 mm. was secured by three combined and four direct sutures.

Result.—This has proved very satisfactory, apart from some vascularization of the upper portion. Final treatment will be left until the patient is older.

Summary

A series of lamellar corneal grafts is discussed. Some of these were undertaken for comparatively mild conditions and without admission of the patients to hospital. It is stressed that this is a simple procedure of wide application. Some new points of technique are described.

We wish to thank the nursing and administrative staff of the Croydon Eye Unit, Mrs. Edmée Wood for photographs, and Mr. Pain of Messrs. Keelers for technical assistance.

REFERENCES

- BOCK, R. H. (1949). *Arch. Ophthal.*, **9**, 458.
CASEY, T. A. (1958). *Trans. ophthal. Soc. U.K.*, **78**, 709.
HAVENER, W. H., STINE, G. T., and WEISS, L. L. (1958). *A.M.A. Arch. Ophthal.*, **60**, 443.
PAUFIQUE, L. (1955). In "Corneal Grafts", ed. B. W. Rycroft, p. 119. Butterworth, London.