

COMMUNICATIONS

LAMELLAR CORNEAL GRAFTS*

CLINICAL REPORT ON 62 CASES

BY

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DURING the last 100 years the pendulum of surgical fashion in keratoplasty has vacillated between partial and full thickness grafts. In the latter half of the 19th century opinion had become divided on choice of method, not as to-day because of the different applications of the two methods, but because of the relative risks which then arose mainly from infection. Between the two world wars the impetus had begun to swing towards full thickness grafts with due appreciation of the formidable risks involved, but to-day that swing now tends again towards grafts of partial thickness.

These vagaries of fashion, however, have taught modern surgeons to retain open minds, and it is now accepted that both methods have a place in the surgery of keratoplasty: for some corneal defects, such as conical cornea or descemetocoele, a full thickness graft is the method of choice, whereas for superficial corneal scars or epithelial dystrophies a graft of partial thickness is more satisfactory.

This report concerns a series of 62 cases of lamellar keratoplasty performed in sequence at East Grinstead without any attempt to select those cases likely to give better results than others. The object was to establish a technique, based on that of the Franco-Swiss School, which should be applicable to conditions in Great Britain, bearing in mind the problems of untrained personnel, immature technique, donor difficulties, and shortage of special instruments.

PERSONAL COMPARISON OF THE TWO METHODS OF KERATOPLASTY

(1) INFECTION.—Initial infection of lamellar grafts was not seen in this series. In early cases local and general penicillin was used as a routine but now only local penicillin is used in the pre-operative stage.

There were four cases of late interstitial abscess which appeared as a tiny yellow spot of infiltration in the graft bed about 4 weeks after operation. Such an abscess could hardly have been due to infection at the time of operation but aerial contamination of the graft bed is a possible cause. Tiny threads of gauze, granules of talcum powder, and globules of paraffin oil have been detected on slit-lamp examination between the graft and the

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bed: foreign elements which must have got there at operation. They have been seen to remain for months without causing any reaction or local infiltration. As a result of these observations great importance is attached to spray lavage of the graft and graft bed before the graft is placed *in situ*, and aerial contamination is prevented by cover during operation. The whole donor eye is also washed in 1 per cent. Cetavlon solution to remove the liquid paraffin after it has been taken from the container. No dry wool swabs or free gauze edges are allowed to come near the eye and each graft is also meticulously cleansed in this detergent before application. Barraquer Moner uses a small marten-hair brush which is very suitable.

To avoid contamination by talc, rubber gloves are no longer used, since although the air in the theatre is conditioned both before and during the operation, aerial suspension is always possible. Contaminants must not be confused with tiny clusters of epithelial "pearls" which are seen underneath the graft and which result from epithelial inclusion at operation. In recent cases no foreign-body contamination was noted.

In a series of penetration grafts (1933-1938 and 1946-1951) no immediate infection occurred. One patient with a penetration graft with a small anterior synechia had the misfortune to injure his grafted eye 3 years after operation with consequent infection and panophthalmitis. This case is important in emphasizing that all anterior synechiae should be removed from penetrating grafts as soon as possible after operation even though the eye is quiet. In this case the graft had been clear for 3 years.

Keratitis and iritis, except in mild form, were not encountered in this series of lamellar grafts.

(2) SCAR REPLACEMENT.—This comparison is closely related to the selection of cases. By narrow beam and wide angle slit-lamp examination with special attention to the edges of the scar, it is generally possible to estimate the depth of the corneal involvement. Retro-illumination helps to give an idea of the density, and transillumination is valuable to outline pupil shape, movements, and adhesions when a dense corneal scar is present: it has not been found to be of much value for the prediction of lens changes.

In epithelial dystrophies or scars of neurotrophic keratitis there is little difficulty in estimating the extent of the scar, but in disciform or interstitial types the problem is not easy and can often be settled only at operation. If at operation scar tissue is found to extend to Descemet's membrane a lamellar graft will not be fully effective, though it may in course of time improve residual scar tissue and corneal clarity by local tissue stimulation. There is no doubt that there is considerable evidence to support Filatov's contention that scar areas adjacent to homo-grafts do tend to clear in time, and this is a factor which can help in the ultimate prognosis of lamellar grafts.

In lamellar grafts the area of the graft can be varied up to 10 mm., but in penetration grafts 6 mm. is considered to be the optimum size because with larger grafts it is difficult to get a water-tight joint. Also, lamellar grafts

have the advantage that they can be repeated without risk and can be used to prepare the area prior to a penetration graft. Again, lamellar grafts have more scope than penetration grafts, for they may be employed not only for improvement of vision but also for the treatment of acute forms of keratitis and for reconstruction. In our experience a cosmetic tattoo of a corneal leucoma is vastly improved by the addition of a lamellar overlay graft. In this Unit a lamellar case stays in hospital about 14 days whereas a penetration case remains for one month.

(3) **OPERATION RISKS.**—There is no doubt that the operation of penetration keratoplasty is one of considerable difficulty requiring long practice and meticulous technique if good visual results are to be obtained. Lamellar keratoplasty is not quite so difficult in technique but requires experienced judgment.

(a) *Iris Inclusion.*—In a penetration graft the possibility of iris inclusion is always a hazard, and neither miosis nor mydriasis is a sure preventative. The iris may adhere to the section in small penetration grafts by the rim (pupillary anterior synechia): in larger grafts the collarette may stick to the section if miosis has been used (stroma anterior synechia), and in some cases there may be a peripheral anterior synechia to the rim of the host cornea. It is, perhaps, this complication more than any other which has forced surgeons to examine the possibilities of lamellar keratoplasty. Iris prolapse, apart from direct injury to the eye by the patient, depends on a leaking suture line, and the larger the area of the graft the more likely is this complication to arise. It is as true in penetration graft surgery as in cataract surgery that the quality of the section is of paramount importance and determines the early re-establishment of the anterior chamber: the accurate fit of the graft in a clean-cut section is the surest way to achieve an immediate seal. In the mushroom combination the central perforation should be small, and the lamellar overlay helps to seal the anterior chamber quickly. This type of graft invests penetration with a larger margin of safety and is likely to have many applications in future graft surgery.

(b) *Secondary Glaucoma.*—In lamellar cases this complication was not encountered where the pre-operative tension was normal, but in penetration cases there were many examples before the practice of the early removal of anterior synechiae became routine. Where there is moderate tension during a lamellar keratoplasty, puncture of the anterior chamber at the limbus or the pre-insertion of a needle will help the graft to settle into place.

(c) *Graft Displacement.*—Occasionally at first dressing a slight displacement of the graft was noticed, and it is thought that this was due to the overlay stitches being tied too tightly: this is of no great consequence, however, as the tiny gutter epithelializes with no ill-effects.

In three cases total displacement occurred, but again in lamellar keratoplasty this is not a catastrophe. One case occurred in a cosmetic tattoo, possibly because the graft did not "take" on the tattooed graft bed; another occurred through direct injury by a young patient rubbing his eye underneath the bandage, and the third as a result of diminished fibroplasia when full systemic cortisone therapy was

being used in an early trial. The graft was entirely free and no sign of reaction was present.

In cases of total displacement, a replacement can immediately be done if a donor is available, or else epithelialization can be allowed to occur with a view to another formal keratoplasty later.

In a penetration graft, on the other hand, displacement is a major tragedy which may lead to lens loss or secondary glaucoma. In an early series two grafts were displaced: one was the result of severe post-operative vomiting where general anaesthesia had had to be used, and the other was due to straining in acute retention of urine. Primary direct sutures were not then in vogue, but were used to repair the grafts in these two cases; both grafts healed well but remained opaque.

(4) GRAFT OPACIFICATION.—Three types of opacification have been recognized as common to both methods of keratoplasty:

Early opacification from reaction oedema in the immediate post-operative period usually clears by the second week: it appears to spread from the edge of the graft to the centre and clears in a similar fashion. It is not associated with much vascularity and the eye is quiet.

More serious is the opacification which never really clears and in which the vascularity steadily increases after the first week. This is the type of vascularity which shows excellent control with intensive local cortisone; the graft then clears in most cases but occasionally the vascularity increases and much fibrosis occurs. It is thought that allergy is responsible for this small group which does not respond to treatment.

Thirdly, there is graft malady, which is a constant menace up to 3 months after operation: the malady will come on about 3 or 4 weeks after operation in a graft which has appeared to be successful and clear. It is characterized by rapid massive vascularity which itself is largely the cause of opacification.

One is forced to the conclusion that in many of these cases an antigen immunity reaction must be a causal factor. In this connection the work of Klima (1949a) merits further attention. Using rabbits and corneal extracts, he showed that in one group (when corneal extracts were injected into the other cornea of the same rabbit) no reaction was produced, indicating that tissue damage itself was not the cause of the reaction. In the second group (where other rabbits were injected with corneal extracts) eighteen cases out of 45 showed vascular reaction. Klima claims that these results show immunobiological differences between host and donor and that it is pure chance whether this relationship is encountered or not.

Since this uncertainty exists, it is considered wise to treat all corneal graft cases with post-operative antihistamine therapy: cortisone has lately been used as routine local application after the first week in an attempt to block this reaction. The other treatment of neo-corneal vascularization includes shock therapy with T.A.B. injections, which probably depends for its advantageous results on the stress release of ACTH and retrobulbar alcohol-xylocaine injections which abolish axon reflexes and help to quieten the eye.

Pre- and post-operative x-radiation has not been decisive because it has been found difficult to form any conclusions in the absence of accurate control.

Much work remains to be done in the investigation of the allergy factor: it may be dependent on the age of the graft or on tissue sensitivity, and there may be some parallel relationship with the survival of homo skin grafts or with lens protein reactions.

TECHNIQUE

In lamellar keratoplasty the technique of Paufigue and his colleagues has been followed and it is unnecessary to describe it here in detail as it is so well known. Occasionally this technique has been modified at East Grinstead owing to the difficulty of obtaining special instruments or on account of personal taste.

Preliminary Preparation Anaesthesia.—For many years preliminary sedation by luminal (gr. 3 in adult cases one hour before operation) combined with the use of ear packs to shut out ward noises has been satisfactory. All conjunctival irrigations and preliminary cocaine instillations are completed before transport to the theatre so that disturbance is reduced to the minimum and the patient arrives in a calm and tranquil state.

Penicillin drops are used for 3 days before operation: a sticky over-night pad is an absolute indication for the postponement of the operation and more attention is paid to this feature than to the results of a conjunctival culture. In the theatre quietness is the rule and becomes absolute after the patient has been rehearsed in eye movements and given final instructions. As stated before gloves are not used, but the hands are washed and finished with 1 per cent. Cetavlon solution and dried off in spirit.

Anaesthesia is commenced one hour before operation and is by local 4 per cent. cocaine with adrenaline drops. Retrobulbar injections are not now used in lamellar cases as it is felt that a softened globe has occasionally hindered an accurate trephine section. A dilated pupil is preferred in case a mushroom graft may have to be carried out. In view of the tendency of the pupil to dilate under cocaine-adrenaline anaesthesia it is felt that dilatation and the risk of lens damage is preferable to miosis and the occurrence of an anterior synechia in the event of adventitious penetration. Facial akinesia by the O'Brien method and superior rectus infiltration with a retraction suture are routine. Lid retraction is by sutures, Desmarres' retractors, or Barraquer's speculum. The work of Barraquer Moner in the use of curare to avoid facial block and retrobulbar injection is of great interest and this method is now under trial.

Preparation of Graft Bed.—After trial of many needles, the 5-7 mm. Barraquer corneal needle (Grieshaber) is now exclusively used. This needle is so sharp that fixation of the globe is generally unnecessary and only light counter pressure is required. All points and cutting edges of instruments have been previously examined on the slit lamp before operation, as advised by Arruga, and this procedure has certainly prevented trouble.

Since our practice is now to use large lamellar grafts, fixation is by overlay retention sutures at the limbus or by direct sutures: it appears to be of little consequence whether the suture is atraumatic or not. For overlay stitches two contra-lateral insertions are made and the spread of the suture is adjusted by the travel of the needle in corneal tissue; four insertions per suture are no longer made. The pupil centre is marked with a pen dipped in Bonney's blue and the extent of the scar is measured with calipers. A suitable size of Franceschetti trephine is selected, and with increasing experience larger sizes (8-10 mm.) are now being used. The depth is set according to the lesion, *i.e.*, shallow for epithelial dystrophy and deep for a burns scar; fixation of the globe is by Von Mandach or Barraquer forceps. It is most important to inspect the relationship of the cutting edge of the trephine to the edge of the piston. It has been noted occasionally that after a trephine has been resharpened these two edges were not parallel, and as a result there

is a likelihood of unequal depth penetration. Just as in cataract surgery, where the initial section is of such importance, so here great care must be taken to centre the trephine exactly.

The next important step in the excision of the corneal disk is to start the section at the pre-determined level so as to keep to the same plane across the base of the graft bed. A miniature Desmarres' blade without corners and set at an angle to the shaft has been designed for this purpose (Fig. 1). Once the plane of separation has been determined, the disk should be separated by smooth strokes rather than by small irregular cuts. The new pyriform knife of Barraquer Moner helps this manoeuvre considerably. As the disk is split it is lifted with a pair of fine-tooth forceps (Jayle, Castroviejo, or Sobhy Pasha pattern), but it must not be stretched or there is a risk of tenting Descemet's membrane and opening the anterior chamber adventitiously. The disk should be removed in one piece of even thickness, but when the scar is soft and friable this is not always possible.

Attention is next given to the graft bed, which is accordingly cleared to an even

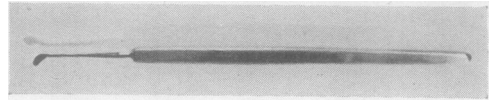


FIG. 1.—Modified Desmarres' knife.

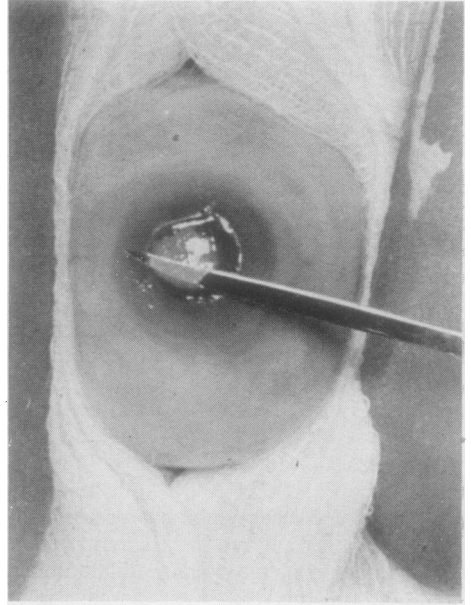


FIG. 2.—Residual scar is seen in the base of the graft bed. A narrow Graefe knife is passed through the scar and cuts out so as to make a free edge which can be gripped by forceps without risk of penetrating the anterior chamber.

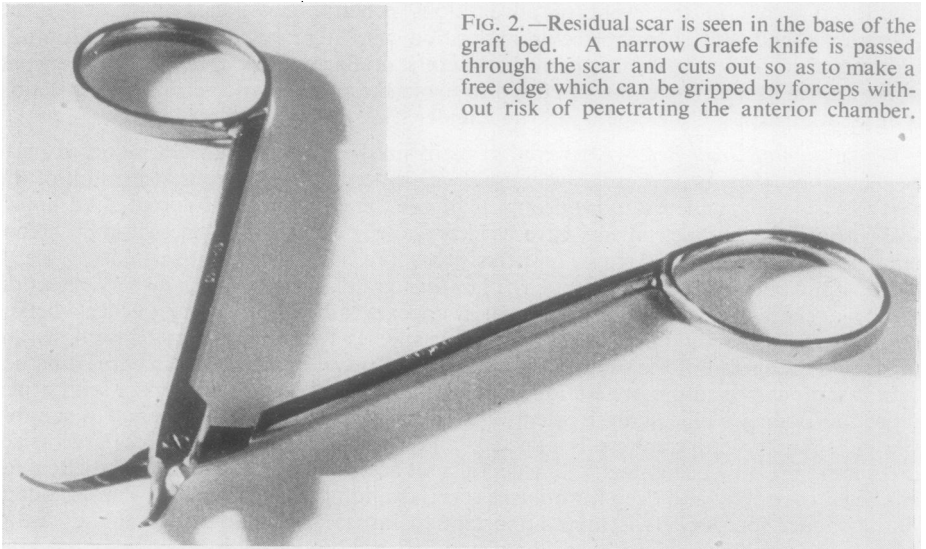


FIG. 3a.—Graft scissors are curved on the flat with a serrated edge along one blade (Down Bros.)

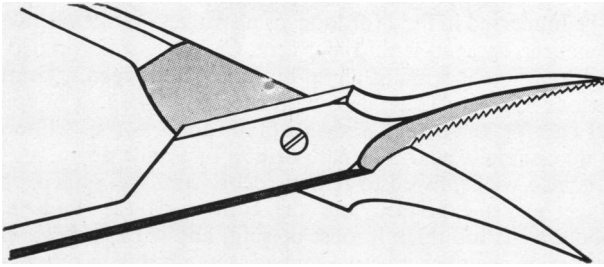


FIG. 3*b*.—Diagram (by courtesy of Mr. Robin Dale, F.R.C.S.) showing serrations pointing towards the hinge, which are difficult to demonstrate in a photograph.

depth at the edges: haemostasis with heated probe must be complete. Professor Offret demonstrated a useful method of removing remaining fine bands of scar tissue from the graft bed which could not be picked up with forceps. A 1.5-mm. Graefe knife is slid under the band, which is excised and so given a free edge which can be picked up with forceps (Fig. 2). To trim the edges of the bed or of the graft, special scissors have been designed in which one edge is serrated towards the hinge: this prevents elastic corneal tissue from slipping away from the bite, a nuisance which occurs especially in penetrating grafts (Figs 3*a* and 3*b*) When the preparation of the graft bed is complete the lids are pulled together and the graft is prepared.

Graft Preparation.—After many trials a graft is used of diameter 0.1 mm. less than the bed. A Gillette blade 'A' (Fig. 4) is used to obtain small grafts, and a Desmarres' knife enables larger grafts to be prepared. By regulating the pressure of the excised globe with the holding fingers the graft can be smoothly sawn off. It is important that the

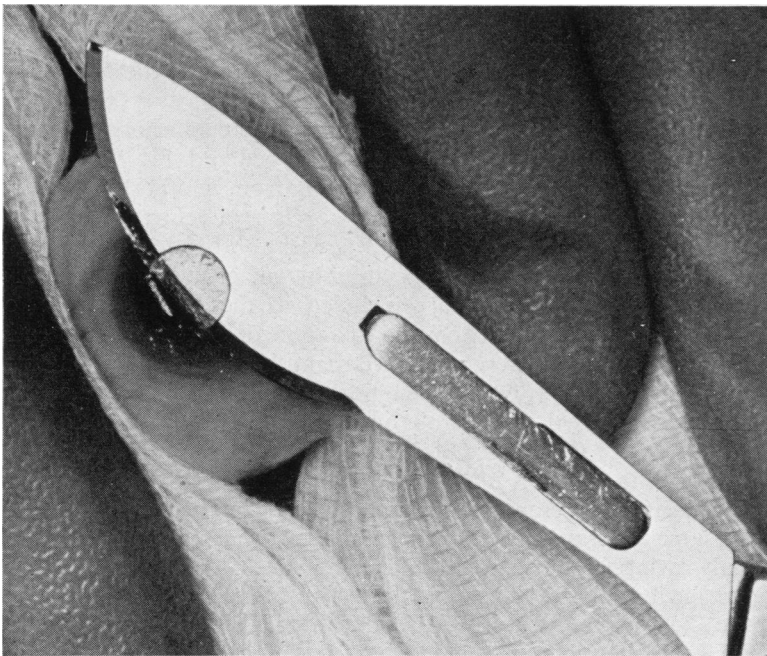


FIG. 4.—Excision of 6-mm. lamellar graft by large Gillette Blade A.

graft should not be immersed in fluid for long, as a swollen graft leads to an inaccurate fit. After the graft has been sprayed with 1 per cent. Cetavlon solution it is placed between layers of moist gauze where it remains damp but not waterlogged. Grafts from different levels of the donor cornea have been used with success. The loss of epithelium is of no consequence, and a graft taken from the stroma of the donor cornea without any membrane (sandwich graft) takes quite well in normal position or upside down.

The graft bed is also well sprayed to remove debris and the graft is placed in position by firm moulding; air is expressed and the contour is the guide to a satisfactory placement. If the graft is too thick it must be split, and if Descemet's membrane bulges too sharply the anterior chamber must be tapped, though this has rarely been necessary. The surgeon waits and satisfies himself that the graft is adherent and in the proper position before the egg membrane is applied. The overlay stitches are carefully tied so as not to disturb either membrane or graft. No atropine or eserine is used in uncomplicated cases.

In this Unit graft cases remain undisturbed for a week, as it is felt that early dressing may irritate the eye and either aggravate initial vascularity or delay epithelialization. French colleagues, on the other hand, successfully dress their cases on the 3rd or 4th day. At the end of a week double pads and stitches are removed: a single pad is retained for a few days until 2 clear days have elapsed without fluorescein stain. Anti-histamine therapy (Thephorin (Roche)) is given for 14 days in an endeavour to control the antigen reaction of host-donor corneal tissues. Massive doses (5 g.) of vitamin C are also given following the advice of American authors; where there is undue abdominal discomfort vitamin C is given by injection. Cortisone drops are begun, if healing is satisfactory, on the 8th day. Lamellar grafts are discharged from hospital at the end of 14 days but such grafts are not considered safe until one month after operation has elapsed. Occasionally in the 2nd or 3rd week a small erosion of epithelium occurred, but this healed quickly when the eye was covered for 48 hours.

COMPLICATIONS

(a) *During Operation.*—It cannot be too strongly emphasized that a careful slit-lamp examination of graft instruments before beginning the operation will go far in preventing difficulties during the operation. The most serious complication in lamellar keratoplasty is the accidental opening of the anterior chamber. If the penetration is early in the preparation of the graft bed and if it is on the periphery it may be possible to remove the disk by starting from another direction. If it is late, a mushroom graft may be performed by excising a central 4-mm. area of the graft bed. In other instances, however, it is wise to abandon the operation and to replace the corneal disk, fixing it in position by one or two intra-corneal sutures. Five examples of this procedure are included in the present series: one was completed as a lamellar graft, two were abandoned to have the operation at a later date, and the other two were converted to mushroom grafts, of which one gave an excellent visual result (6/9). When penetration has occurred atropine and mydracaine are always used. It is probable that a soft globe has misled the surgeon as to depth in some of these cases of adventitious penetration, but in mustard gas keratitis or pemphigus this is always to be expected owing to the uneven, deep crater-like deficiencies present in the corneal scars in these diseases. The conversion of a lamellar graft to a full penetration graft has not been practised in our series, mainly owing to shortage of donor material.

Haemorrhage in the graft bed should always be controlled by gentle heat cautery. It should not be a marked feature of an optical graft but it may be troublesome in cases where a therapeutic graft is being employed.

It has been found useful to surround grafts with a second larger trephine cut:

this not only checks haemorrhage but may delay vascularization. It is well known that a superficial trephine cut alone will often improve the clarity of a corneal scar, and may give the appearance of a good graft where in fact no graft has been performed.

When a band of scar tissue remains on Descemet's membrane, it is a great temptation to try to remove it. If there is a risk of penetration in a satisfactory graft bed, it has been our practice to resist this temptation, for it is surprising how wide is the variation between the improvement of vision and the presence of deep corneal scar fibrils. Sometimes a graft bed may appear to be semi-opaque by reflected light but when a drop of saline is placed on it and refraction improved the anterior chamber details may be clearly seen, indicating the likely improvement of vision in the future. It is this point of technique which requires great experience of judgment.

(b) *After Operation.*—Dislocation of the graft occurred in three cases in this series: all three epithelialized with satisfactory results. Early infection was not seen in any case, but in four there was the late occurrence of a solitary interstitial abscess which occurred from 4 to 6 weeks after operation. The reaction around the abscess slowly subsided but a tiny deep circular scar remained.

Vascularization remains a serious feature with lamellar grafts. Immediate vascularization up to 10 days usually settles, but when it occurs in the 2nd or 3rd week and increases in intensity it is a major problem. This delayed vascularization is of allergic origin and may correspond to the oedema when homo-plastic skin grafts are thrown off: furthermore, repeated grafts from other donors do not necessarily evoke the same reaction as the initial graft. Late vascularity of this type has been noticed in seven out of forty optical grafts in this series, and in five of the seven cases the clarity of the graft was markedly impaired.

EFFECT OF CORTISONE

There is no doubt whatever that local cortisone drops applied every hour from the 8th day have a profound beneficial effect on neo-corneal vascularity at this stage. Possibly this is to be explained by the endothelial proliferation inhibition exerted by cortisone (Ashton and Cook, 1951). In late vascularization, when vessel trunks have been established with fibrosis, cortisone has less effect. When local cortisone is used in the initial stages after keratoplasty, a careful watch should be kept on the healing edges of the graft as deepening of the gutter has been noted. The aetiology of delayed vascularity in lamellar cases is quite different from that in penetration grafts which is usually caused by adhesion of the iris to the graft.

Late observation of lamellar grafts indicates that, once a clear graft has settled and has become established in a white eye, visual improvement can be expected to continue for many months. Where late keratitis has occurred some months after successful keratoplasty, cortisone has been found to be most useful, and threatened opacification of the graft has been averted, the immediate subsidence of vascularity and the disappearance of corneal oedema being quite remarkable.

CLINICAL ANALYSIS

The diseases treated, the number of patients, and the types of graft performed are tabulated below. Altogether 62 grafting operations were performed on 52 patients suffering from 14 different pathological conditions.

Diseases		Patients	Grafts
1.	Pemphigus of conjunctiva and cornea	3	4
	(a) Chemical	7	8
2.	Burns - (b) Thermal	3	3
	(c) Gas	1	1
3.	Recurrent pterygium	1	2
4.	Epithelial dystrophy of cornea	2	2
5.	Band-shaped keratopathy	5	5
6.	Acne rosacea keratitis	8	10
7.	Disciform keratitis	1	1
8.	Neurotrophic keratitis	1	3
9.	Superficial punctate keratitis	—	—
10.	Lipoidosis of cornea	4	7
11.	Interstitial keratitis	3	2
12.	Healed ulcers	8	9
13.	Leucoma adherens	3	3
14.	Active corneal ulcers	2	2
Total		52	62

ANALYSIS OF RESULTS

The results obtained with the four different classes of graft may be tabulated as follows :

Type of Graft	No.	Improved	No Change	Worse	Not Assessed
(1) Optical	41	24	11	4	2
(2) Therapeutic	9	6	3	—	—
(3) Cosmetic	7	7	—	—	—
(4) Preparation	5	4	1	—	—
Total	62	41	15	4	2

(1) OPTICAL GRAFTS

Forty-one cases. The results of the optical grafts are classified according to visual improvement after operation by means of a fractional basis of percentage. Thus improvement of vision from perception of light to 6/5 represents 100 per cent., and each of the ten visual steps in between is equal to 10 per cent.; for example, 6/60 to 6/24 represents two steps and is assessed as 20 per cent. improvement no

matter where this occurs in the visual acuity scale. On this basis the 24 cases in which vision was improved by lamellar keratoplasty may be analysed thus:

Stages of Improvement	Degree of Improvement (per cent.)	No. of Cases
Perception of light to hand movements	10	7
Hand movements to counting fingers...	20	5
Counting fingers to 6/60	30	2
6/60 to 6/36	40	4
6/36 to 6/24	50	5
6/24 to 6/18	60	—
6/18 to 6/12	70	1
6/12 to 6/9	80	—
6/9 to 6/6	90	—
6/6 to 6/5	100	—

In this series of lamellar optical grafts the longest period of donor graft preservation was 21 days in a case where vision was improved from hand movements to 6/36. No direct relationship in the post-operative reaction of the graft to the length of the period of preservation was established. The best visual result was obtained in a case of acne keratitis where vision was improved from perception of light to 6/9.

Failure of Optical Grafts.—It is generally the case that a clear lamellar graft in a white eye 6 weeks after operation will continue to improve as the months go on. Late trouble is not common but it is also quite certain that the condition of the host cornea outside a successful graft will also improve by a steady clarification of adjacent scar tissue. In this series, which it must be emphasized was consecutive and not chosen for the best prognosis, the failures were due to:

(a) Unsuitable type of case for lamellar keratoplasty. If the scar tissue extends to Descemet's membrane a full thickness graft is the method of choice.

(b) Influence of the original corneal disease. Pemphigus has given consistently bad results through late vascularization and xerosis of the graft, and this also applies to penetration grafts. On the other hand, band-shaped keratopathy gives excellent results after lamellar keratoplasty.

Mustard gas cases vary, but on the whole, in our hands, the results have not so far been good.

(c) Unpredictable tissue allergy. This accounts for a proportion of bad results by causing severe vascularization and consequent dense opacification. It is unpredictable but may possibly be prevented or minimized by the use of cortisone, which is said to block the antigen reaction of tissues with prevention of fibrosis. Control experiments with cross skin and corneal grafts are in progress.

(d) Technique in early cases must always play a part. Lamellar keratoplasty demands considerable skill in manoeuvre, and in judgment of the correct plane for separation of the scar. The pre-operative slit-lamp scrutiny of cutting edges and points is absolutely imperative.

(e) Infection did not influence the results to any great extent.

The detailed results in the four cases which were classed as failures are tabulated below:

Case No.	Stage of Deterioration	Degree of Deterioration (per cent.)	Reason
1	6/60 to counting fingers	10	Recurrence of acne keratitis in graft. Subsequently treated by full thickness graft with vision 6/36.
2	6/18 to 6/36	20	Poor selection
3	Counting fingers to hand movements	10	Second lamellar graft in same patient as Case 1
4	6/36 to counting fingers	20	Recurrence of acne keratitis in graft

(2) THERAPEUTIC GRAFTS

Nine cases were operated. The diseases in question are tabulated below:

Disease	No. of Cases	No. of Grafts
Recurrent pterygium	1	2
Neurotrophic keratitis	1	3
Active acne keratitis	3	3
Acute epithelial dystrophy... ..	2	2
Active corneal ulcer	2	2

There is an expanding field for the use of therapeutic grafts in active corneal disease. They have been found valuable for shortening the hospitalization period of chronic corneal ulceration and for the avoidance of median tarsorrhaphy in indolent infections. Moreover, second-class donor material can successfully be used for therapeutic grafts. The principle is the same as that employed when indolent leg ulcers are covered by cross-leg skin flaps.

(3) COSMETIC GRAFTS

When there is a leucoma adherens in a blind eye in a young person a tattoo operation to disguise the white staring appearance is well justified. Normal practice has been used to use the platinum black method and to cover the tattooed cornea with a lamellar graft of equal size. Post-operative discomfort is reduced and the area heals quickly, giving a natural appearance. Whether this combination is more permanent will be decided by future observations.

(4) PREPARATION GRAFTS

There were five cases of this type and five grafts were done.

When the host cornea is widely and densely thickened, as in severe burns, most grafts take successfully, but speedily become opaque since it is difficult to position them so that they adjoin on normal corneal tissue. In such cases the cornea is previously prepared for a penetration graft by one or more lamellar grafts: a more accurate fit and a better site for the penetration graft are thus obtained. A preparation graft can also be employed where there is excessive vascularity of the host cornea. In one case where this was done the vascularity subsided and did not invade the graft: the graft which remained clear thus acted simultaneously as

a preparation, therapeutic, and optical remedy, and vision was improved from hand movements to 6/18 (Mrs. L.).

THE DONOR PROBLEM

The increasing scope of keratoplasty demands that an adequate and regular donor supply of good material should be widely available.

As in many other countries, the donor supply is becoming a problem of increasing and urgent gravity in Great Britain.

Two solutions to this problem come to mind. As a temporary relief all present available donor supplies should be referred to hospitals which have experienced surgeons and the necessary equipment for graft surgery. All eyes which have to be excised for choroidal sarcoma, absolute glaucoma, injury, or in the course of orbital surgery represent a valuable source of donor material which should not be wasted. Such eyes should be placed in liquid paraffin immediately after excision and preserved at 4° C. in the hospital refrigerator before despatch. At East Grinstead such a scheme has worked well for over 2 years with the helpful co-operation of ophthalmic surgeons in the south of England. The Eye Bank has thus received a steady, though inadequate, supply, which has provided many successful grafts. From eyes preserved in this fashion clear optical lamellar grafts have been obtained 21 days after excision, and therapeutic grafts have been used from eyes excised 24 days previously. The permanent solution is to modify legislation by the force of educated public opinion so as to provide British surgeons with the same facilities as are enjoyed by their French colleagues who, thanks to the enlightened Decree No. 472, 057, of 1947, are able to tap a large reservoir of healthy cadaver material.

It is generally agreed that healthy eyes obtained from elderly people who have died a natural death represent the best source of donor material for optical grafts and that this source is better than the pathological material which British surgeons have to use at present.

In British law the body has no property, and, therefore, strictly speaking a person cannot bequeath his or her eyes. He can express during his life a desire to do so, but the implementation of this desire depends on the approval of the nearest relative or executor who can supersede the wish of the deceased if he objects to removal of the eyes.

Cadaver eyes should be removed within 2 hours of death, and it will, therefore, be appreciated that *post-mortem* permission generally arrives too late, and that, even then, removal of the eyes is illegal. Experience has shown that the nearest relatives are most co-operative when eyes have been bequeathed, but it is distasteful for surgeons to press for speedy excision in the presence of recent bereavement. It is good that the legal aspect of donor material has now received the serious attention of Parliament.

The important interval of time in cadaver grafts is that between death and excision: the length of the period of preservation is less important.

The Eye Bank at East Grinstead, which is generally overdrawn, receives eyes in special containers (Fig. 5). The eye is totally immersed in liquid

paraffin in a wide-mouthed glass bottle which is fixed in a copper watertight chamber and surrounded by ice. On arrival at the Bank the eye is registered and placed in a refrigerator at $+4^{\circ}$ C.: along with the eyes is also preserved skin for use in socket surgery and cartilage for contour restoration. For short period preservation saline vapour has been used, but liquid paraffin is better for transport on account of the inertia of the oil which protects the eye.

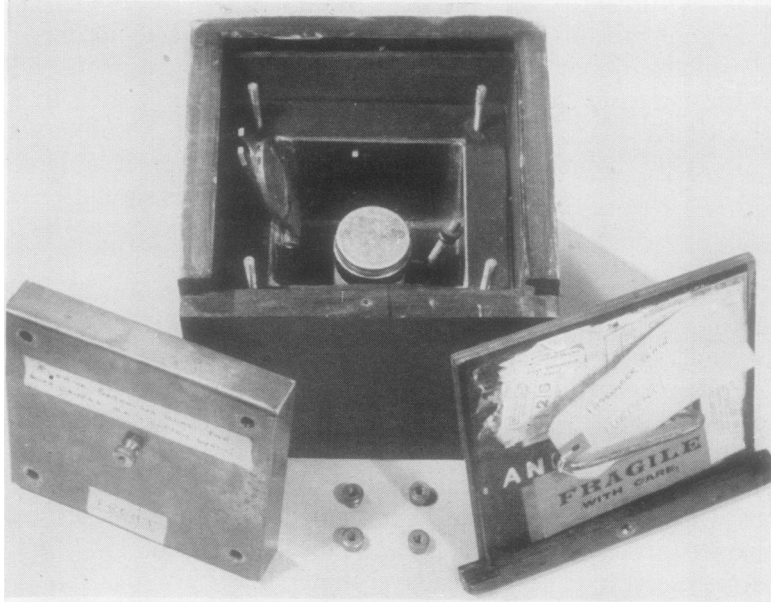


FIG. 5.—East Grinstead container for transport of donor eyes.

USE OF CORTISONE

For the past 6 months cortisone has been under trial in various ways, and thirty graft cases have been treated. It was expected to block the antigen reaction of the donor cornea, to diminish opacification of the graft, and to influence the growth of endothelium of new blood vessels. In two early cases intensive parenteral and local cortisone therapy was employed immediately after operation, but the alarming result of grafts which did not adhere was noted, and parenteral cortisone injections were, therefore, stopped.

When used, however, as local drops by hourly instillations there were two constant effects. The grafted eyes were free from discomfort, and the difference was always noticed by those patients who had had grafts with and without cortisone in the post-operation period. Furthermore, the reactionary neo-vascularization which is a feature one week after operation was constantly reduced, and it is possible that more serious vascularization was prevented.

Cortisone did not seem to affect late corneal vascularity where vessel trunks were seen and considerable fibrosis of the graft had been established, nor did the aetiology of the initial disease make any difference.

Cortisone drops are now begun on the 8th day after operation when the

stitches have been removed, and they are continued hourly for at least a week. In two cases it was thought that the graft line deepened to a gutter after local cortisone and this was taken as an indication that epithelialization was being delayed. The appearance disappeared when cortisone was stopped. There did not appear to be any special advantage of the subconjunctival route of administration over instillations.

SUMMARY

(1) Lamellar keratoplasty has many advantages of safety over penetration keratoplasty, but 30–40 per cent. of cases where defective vision is due to a corneal lesion require the latter procedure or a combination of both.

(2) In this series of sixty lamellar cases, 41 were optical grafts and vision was improved in 24 cases. The best results were those which improved from perception of light to 6/9; no change was seen in eleven; there was deterioration in four, and the change was not assessed in two. No eyes were lost and in some of the cases which were not improved a further graft, either of lamellar or penetration type, will improve vision. Contact lenses have not been used for permanent improvement of vision.

The scope for therapeutic grafts extends rapidly. The use of cosmetic grafts is under observation.

(3) A major problem which remains to be solved is that of tissue allergy. In this series ten cases showed severe vascularity which could be ascribed to antigen reaction between donor graft and host cornea.

(4) The factors which influence success in lamellar keratoplasty are the correct selection of cases suitable for this method, perfect instruments, mature technique, and adequate after-care, together with the use of first-class donor material. Late vascularization and opacification of the graft due to allergy are at present unpredictable.

(5) Cortisone instillations relieve early corneal neo-vascularization and discomfort. They may prevent more serious late vascularization.

(6) In Great Britain legislation should be amended to provide adequate donor material if the wide benefits of keratoplasty are to be fully utilized.

Any surgeon who practices lamellar keratoplasty to-day is deeply in the debt of Professor Louis Paufigue and his colleagues: our share of this debt is great and in addition we wish to acknowledge with gratitude the personal help we have received from Professor Paufigue, René Hugonnier, and Jacques Rougier, both at Lyons and at this Unit.

The interest and encouragement of Sir Archibald McIndoe and our colleagues at East Grinstead have been a great help, and without the skill of our nursing staff it would not have been possible to carry out this work. We are also grateful to those ophthalmic surgeons who have contributed donor material and to Doctor Allott and the authorities of the South-East Metropolitan Regional Hospital Board for making available to us supplies of cortisone. Our thanks are also due to Mr. Gordon Clemetson for his expert photography.

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