Eye Surgeons' Objective Now is Total Transplant

By

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IT is fair to say that human surgery in our time is moving into an age of transplantation. The principles of transplantation, whether of skin, bone, kidney or eye, are the same and must be obeyed by each individual tissue, namely firm, accurate fixation, absolute control of infection, experienced and skilled technique and great respect for the biological responses of living transplants.

It was in 1817 that a young German surgeon named Franz Reisinger visited London to watch the great Sir Astley Cooper perform operations at Guy's Hospital. About that time, ophthalmic surgery had left the chrysalis stage in Europe and was beginning to emerge as a separate speciality, but in England it was still part of general surgery.

On April 9 of that year, Sir Astley amputated the thumb of a young man named Hartfield, and then cut off a piece of healthy skin from the amputated part and fixed it to the stump. This was incidentally, the first free graft of autogenous skin performed in England, and later it was clearly shown that the skin was viable, since it bled when pricked and sensation had returned. Sir Astley probably had in mind the early free grafts his teacher, John Hunter, had performed on chickens, such as the transplantation of the cock's spur to the comb, with subsequent union.

The operation on Hartfield, and the principles involved, made a great impression on the young German Surgeon, and the fact that a small piece of tissue could be freely cut off and then reattached to the body with healthy union held his attention. On his return to Germany he wrote: "This case gave me excellent encouragement to attempt similar experiments with the cornea."

Thus was the idea of a living transplantation of corneal tissue born.

Although it is true that in 1797 Pellier de Quengsy had speculated on the idea of replacing opaque corneal scars by a piece of glass supported in a circlet of silver, no successful results were obtained. Yet, here again, this French surgeon had the vision that there was a future to the possibility of replacement of eye tissues by surgery:

"Serait-il possible de supplier une cornee artificielle en place de la naturelle ?". (Will it be possible to replace the natural cornea with an artificial one ?) Pellier de Quengsy, 1789.

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The news of Reisinger's experiments was slowly disseminated throughout Europe, since means of communication at that time were irregular and slow, but, nevertheless, many attempts to perform grafts in animals and in man were carried out, in Germany during the 19th century, and then later farther afield. Unfortunately, however, such pioneer attempts were almost always failures on account of infection, crude instruments, poor selection of material and shaky experimental techniques.

It was not until the advent of anaesthesia and application of the antiseptic principles of Lister and Pasteur that such theoretical ideas as corneal grafts became practical propositions. In December, 1905, Edward Zirm an obscure oculist in Moravia, followed the technique of von Hippel and showed that a living corneal graft could restore some degree of sight in man, provided that the correct instruments were used, that the donor graft material was fresh, and that infection could be kept at bay.

Zirm used the von Hippel circular trephine for cutting the graft, and treated the wound with iodoform. The donor graft was taken from a young boy's eye which had received a penetrating foreign body and had to be removed to avoid the scourge of sympathetic ophthalmia, which was so rampant at that period.

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He is a pioneer of corneal graft surgery and a frequent lecturer at international ophthalmological congresses in many countries. He has been President of the Section of Ophthalmology at the Royal Society of Medicine, Hunterian Professor of the Royal College of Surgeons of England and the Doyne Memorial Lecturer of the Oxford Ophthalmological Congress.

Since 1905 the corneal graft operation has been practised in many parts of the world with success, and has restored sight to many patients who hitherto had been considered hopelessly blind through an opaque corneal scar.

As yet, eye surgeons cannot transplant the whole eye, though many attempts have been made (those of the American surgeon, C.H. May in 1886 are remembered), but all attempts have hitherto failed. Yet, when a part of the eye, the cornea, is transplanted, 90 per cent. of these transplants are successful and remain clear.

The reason for this sharp difference in the behaviour of the whole eye and the cornea is that there are no blood vessels in the cornea and, therefore, tissue antagonism is not provoked, whereas if the whole eye is grafted the blood vessels of the grafted eye and the recipient cause hostile tissue responses with rejection of the graft.

In addition to the cornea, pieces of the protective coat of the eyeball, the sclera, are readily transplanted with success; so also is the jelly which fills the eyeball—the vitreous humour. Neither of these structures has blood vessels. It is the presence of blood vessels which still defeats total eye transplants.

Therefore, attention has again turned to the use of inert materials to circumvent tissue reactions and, as has been seen, this is no new idea for it dates from the end of the 18th century.

Recently the insertion of plastic lenses in the cornea has been tried and for a few months they appear to be successful. As time passes, however, they are extruded, since there is no firm union between the plastic material and the tissues. Another complication is the growth of membranes which obscure and bury the plastic implant.

Professor Strampelli of Rome conceived the idea of fixing the plastic implant in a ring of the patient's own tissue, from one of his teeth. The tooth ring heals into the cornea and the plastic implant is thus held in place. Certainly early results by this technique are full of promise.

If blindness is caused by an opaque scar on the cornea, or window, of the eye, it is necessary to remove that scar and replace it by transparent material if the patient is to see again.

The experience of a century of trials has shown that the replacement must come from another individual of the same species if it is to remain clear. For example, in man the transparent graft must come from another man; if it is taken from an animal the graft may or may not be accepted and heal in place, but it will certainly not remain clear. It is not just a case of getting the graft to heal, since this will happen even with dead material; it is essential that the graft should remain alive and permanently clear.

To achieve this end the graft should be taken from a corpse within twelve hours of death, and used within four days.

In exceptional circumstances, the other eye of the same patient may provide the graft, but such happy combination of events is rare; when it does occur, however, such cases always succeed since there is no possibility of adverse tissue reactions.

In the past there has been great difficulty in obtaining fresh grafts to fulfil these criteria, but in the United Kingdom this problem has been solved by effective national propaganda for the bequest of eyes and by the alteration of the law. Some other countries, however, are not yet so well organised and meantime they have to be helped either by the export of fresh eyes from the United Kingdom, as is now frequently done to Pakistan, India, Iraq, and other places, or by the use of preserved material which is certainly not as good as fresh, but is better than nothing.

It is to be hoped that every country where there is blindness which can be cured by corneal grafts will eventually set up its own system for collection and distribution of eye graft material. Meanwhile, temporary help is always available from the Regional Eye Bank at East Grinstead in England for those countries in need.

Scars which are suitable for replacement by grafts are caused by inflammation, such as ulcers, keratitis and trachoma; by burns from fire, chemicals or metals, and from congenital defects of the cornea, such as distortion of shape (conical cornea) and congenital scars (dystrophies). Conical cornea and corneal dystrophies give very satisfactory results in the restoration of sight when corneal grafts are used.

The modern corneal graft varies in size from four to ten millimetres. In the early days of pioneer technique the grafts were small, since they gave rise to fewer complications, but in recent years the size has been increased with safety and much advantage to the patient.

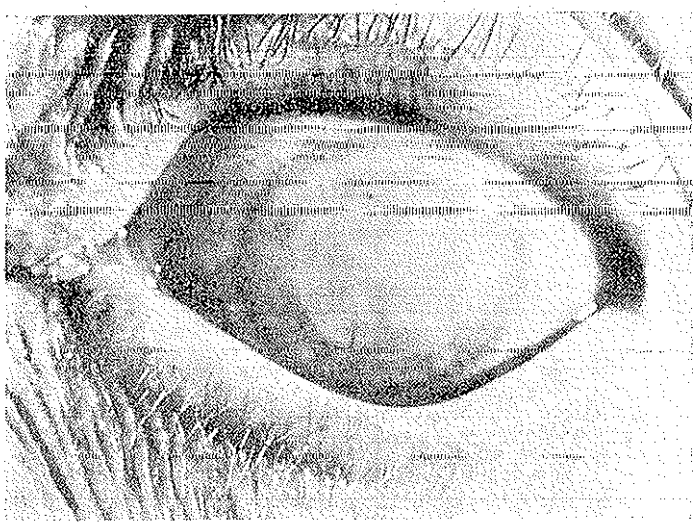
The instruments of today are superb. A graft is cut with a sharp trephine of suitable diameter, and fixed in place with silk of 2-fire thickness. Such silk is inserted on a 4-mm. needle of exquisite manufacture, and 12-16 minute stitches fix the corneal graft securely in place. The operation is usually performed under general anaesthesia and takes about 40 minutes.

Complications now-a-days are few in skilled hands. The menace of infection has been almost obliterated by the use of modern antibiotics and a careful laboratory screen of the patient before operation.

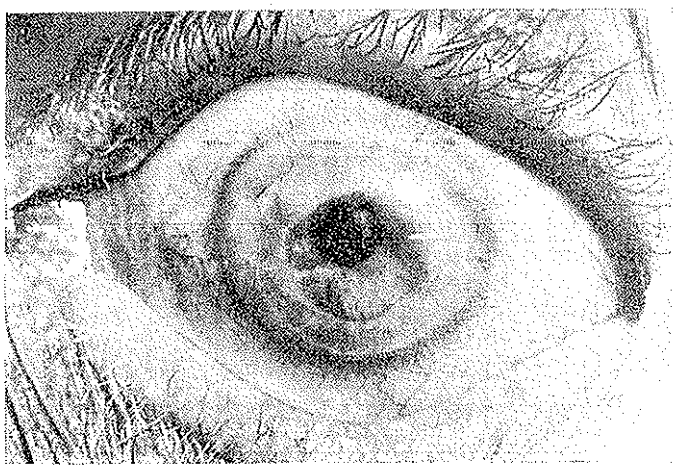
The main problems which remain to be solved lie in the realm of biology, and include the invasion of grafts by new blood vessels, and by fluid from the interior of the eye. Nevertheless, the use of cortico-steroids and Beta radiation have become valuable controls against these unwanted blood vessels. Fluid invasion, or oedema, of the corneal graft, remains the major problem for research.

It has been stated that for a human corneal transplantation the graft must be taken from a human being. At East Grinstead a Regional Eye Bank has been at work for 15 years, charged with the duty of collecting donor eyes, their documentation and subsequent distribution to surgeons who require them for corneal graft operation.

Such eyes are bequeathed or provided by consent of the nearest relative (Human Tissues Act, 1962). A special van equipped with surgical, bacteriological and storage facilities is available to visit homes and hospitals, in order to collect

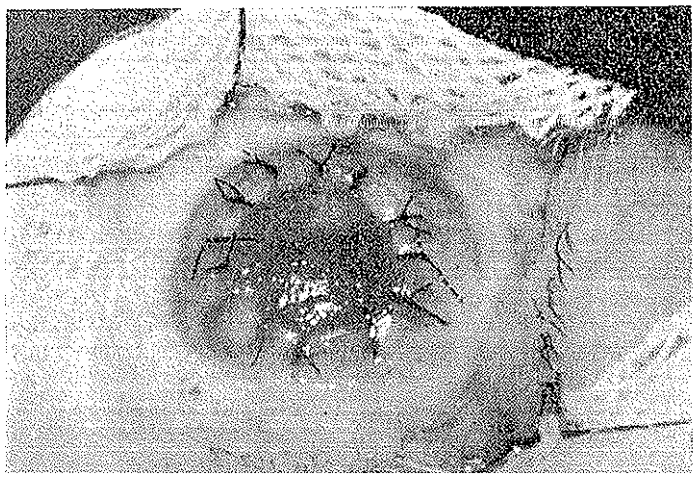


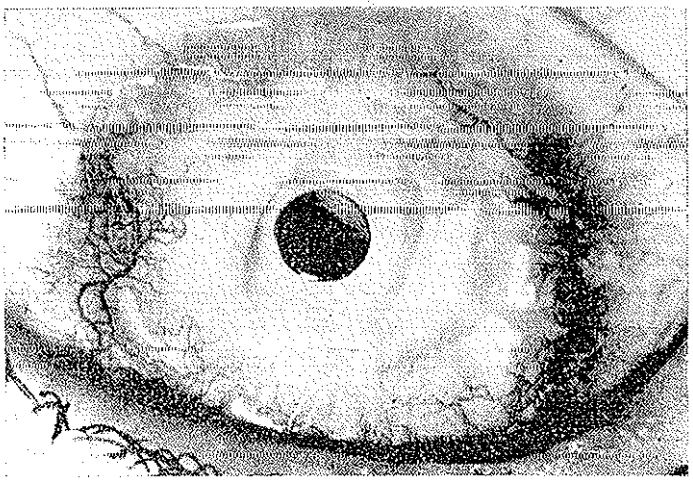
This illustration shows the failure of a corneal graft. It can be seen that although the graft has healed in place, it is completely opaque.



The same eye as in the previous picture, after a repetition corneal graft has been performed. The second graft has been placed inside the area of the first and is completely clear. Vision in this eye was restored to normal.

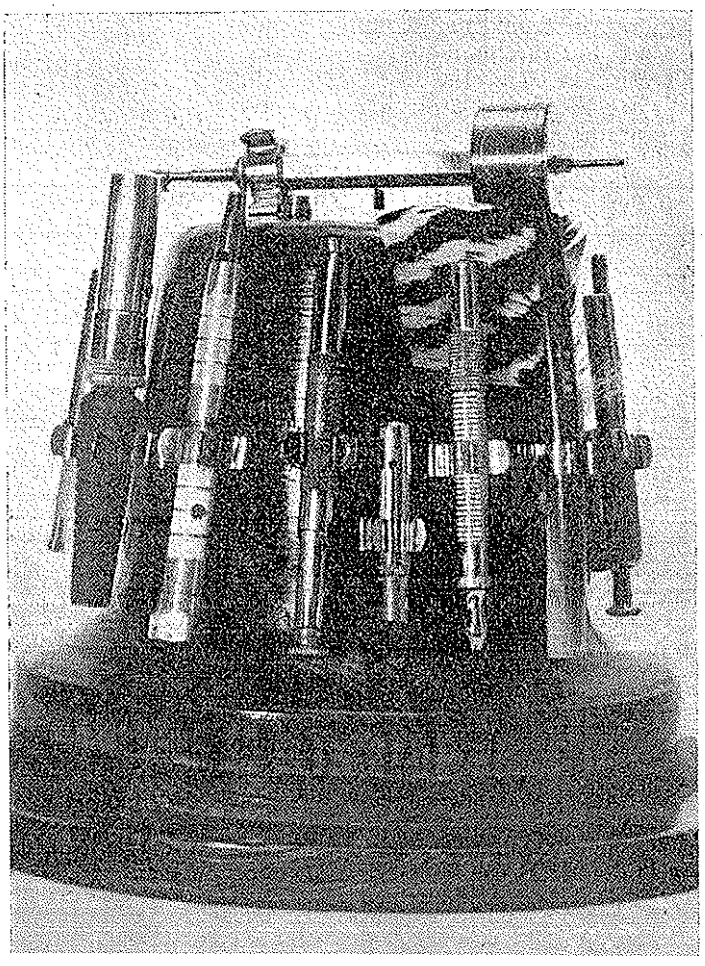
A penetration corneal graft photographed at the end of the operation. As can be seen, the graft is fixed in place by many minute fine black silk stitches.





A plastic graft is seen embedded in a surrounding piece of tooth which itself is grafted into an opaque cornea. The cause of the dense scar in this case was a severe lime burn. This is the type of prosthesis (the fitting of new parts to the human body) which is used in dense scar tissue where no living graft will remain transparent, and it is reserved for extreme cases. It is the idea of Strampelli.

On the stand are types of corneal trephine. Across the top is the clockwork model of von Hippel, while in front are Swiss, American and Spanish examples. The crow quill illustrates the first attempt at the construction of a trephine for corneal graft work in 1797.



eye bequests, and in this way much material is taken to the Eye Bank as speedily as possible. In 1965 more than 200 eyes were obtained in this way ; 30 per cent. came from domestic bequests.

The results of corneal graft surgery have continued to improve with increased skill, experience and the use fresh donor material.

Yet, in severe burns a living graft will certainly heal in place, but it will not remain clear and is, therefore, useless to the patient. This is why the idea of Strampelli to implant a pastic lens in an autograft of tooth tissue is so full of promise for these desperate cases which, hitherto, have always failed to maintain the transparency of a living graft.

Donor eyes are maintained at the Eye Bank in several forms :

1. In storage at 4 degrees Centigrade in vapour for use within four days. This is the method devised by Academician Filatov and is in universal use today.

2. In liquid paraffin at 4 degrees Centigrade. Burki suggested that such eyes could be used up to one week, but this method has the disadvantage that the oil clings to the graft, and it is difficult to dissolve antibiotics in it.

3. In glycerin, as suggested by King. This material is easily portable and is stored at room temperature ; it is most valuable for lamellar grafts where only a thin graft is required. It is not suitable for penetration or thick grafts.

4. The long-term preservation of corneal graft material by deep freeze technique in liquid nitrogen is not yet established as a safe or routine procedure, but this method is under intensive research.

Nevertheless, it must be remembered that, thanks to the co-operation of the International Air Transport Association and speedy air travel, fresh eyes can reach almost any part of the world in a suitable condition for immediate use in penetration grafts. Thus, the need for elaborate methods of long-term preservation is less acute, but may still be needed in emergent countries until local arrangements can be made.

It may be said that the average success of corneal grafts depends on the type of scars for which the operation was carried out. For example, for distortion, such as conical cornea, the rate of success—meaning a clear graft and good vision—is about 95 per cent. In the usual type of corneal scar the rate is about 70 per cent. But in scars from metal burns or from lime, it remains at 10-15 per cent.—with the hope, however, that if the new plastic graft is used this percentage will surely rise.

Thin, or lamellar grafts, are playing an increasing part in the treatment of acute eye diseases, such as resistant ulcers and the future will see a great expansion in their use for therapeutic, as well as for optical, purposes.

Thus, in our time, has come the defeat of another example of blindness, that due to corneal scars, and so the causes of blindness are being gradually eliminated. The modern surgery of retiunal detachment marches alongside the surgery of corneal grafts and uses such advanced techniques as the laser beam to spotweld the retina, and vitreous transplantation to restore the volume of the eyeball. Sillicone products are under intensive research as replacement material both in retinal and corneal graft surgery.

Also, cancer of the retina, or retino-blastoma, is being attacked with success by the laser beam which will obliterate small growths, or by the cobalt application which is used for more extensive invasion.

So will ophthalmic surgery, thanks to advances in other disciplines and sciences, continue to restore sight to more and more of the blind population of the world as the years pass on. "...The science of ophthalmic surgery is as vast as the oceans..." (Susruta, 500 A.D.)

WANTED

Hindustan Steel Limited
DURGAPUR STEEL PLANT
Advt.-No. EMP-15/66 dated 1966

Applications are invited for the undernoted post in the Medical & Health Organisation under Durgapur Steel Plant from women candidates on the following terms and conditions :—

Name of the post & Scale of pay. Home Sister Rs. 260-10-290-15-395/-

Qualification and experience required Must possess Sr. Certificate (A Grade) in General Nursing & Midwifery. Training in Nursing Administration, previous employment as a Home Sister Preferable.

Age Limits :—Unencumbered ladies of 40-45 age group would be preferred.

Basic pay on the scale plus Dearness allowance and other allowances if any as admissible under the rules of Hindustan Steel Limited in force from time to time. Higher initial pay on the scale noted above may be granted to candidates on the basis of exceptional qualification, experience and present pay. Candidates will also be entitled to benefit of contributory Provident Fund after one year's satisfactory service.

Age limit relaxable in case of exceptionally qualified candidates.

Application should be made on plain papers stating the following particulars (1) Name in full (2) Father's Name and occupation (3) Present & Permanent address (4) Exact date of birth (5) Religion and Caste (6) If Schedule Caste/Tribe (7) Nationality (8) Educational qualification stating names of Institution where studied. Examination passed, year of passing and subjects taken in different examinations (9) Experience stating names and address of employer, period of service, Designation, Nature of duties and pay under each of the employers (10) Names and address of three referees.

Attested copies of certificate & testimonials in support of statements must be accompanied with the application along with the Crossed Postal Order for Rs. 2/- (0.50 p. for Schedule Caste/Tribe candidates) endorsed to H.S.L., A/C Durgapur Steel Project payable at P.O. Durgapur-3. Candidates applying through Employment Exchange are exempted from submission of application fees in the form of Postal Orders.

Candidates now in service under Govt./ Quasi Govt. /Govt. undertaking department & other Steel Industries must apply through proper channel. Preference will be given to qualified Scheduled Caste and Scheduled Tribe Candidates. other things being equal.

Candidates to be selected for interview will be allowed actual 2nd Class Railway Fare both ways for appearing at interview.

Applications must reach the office of the Personnel Manager, Durgapur Steel Plant P.O. Durgapur-3, Dist. Burdwan on or before 16.8. 1966.

Wanted an experienced Nursing Superintendent for the C.S.I. Hospital, Karimnagar. A.P. A.N.M./Training school with 120 beds. Salary according to years of service. Apply to the Superintendent.