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CORNEAL GRAFTING IN CLASSICAL CORNEAL DYSTROPHY

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Classical heredo-familial corneal dystrophy was first described by Arthur Groenouw in 1890. He termed this condition "noduli corneal". Since then there were numerous reports until Bucklers in 1938 reviewed and classified this condition. It is a degenerative condition of the cornea of unknown etiology. Characteristically the bilateral opacities affect the corneal stroma centrally, manifesting at the first or second decade of life.

Heredo-familial macular dystrophy of the cornea (type II of Groenouw) is a type of classical dystrophy, with recessive transmission. It presents with irregular spots with ill-defined borders appearing in the diffuse corneal opacity which involves the whole corneal thickness and extends towards the limbus.

Visual acuity is severely diminished between 20-40 years of age. There is no effective medical treatment. The only effective way to improve visual acuity is corneal grafting.

The following is a description of the first case treated with penetrating corneal grafting in Singapore:-

CASE REPORT

A.R., 28 years, male, was first seen at General Hospital in 1964 with a history of progressive diminishing vision for the last ten years. Besides the loss of vision he had no other ocular complaints. During the last 5 years, his vision became so poor that he was unable to find his way around nor could he do his usual work.

He was found to be suffering from heredo-familial macular dystrophy.

The condition was bilateral affecting the full thickness of both cornea with a diffuse haze. More superficially were irregularly arranged white dots of varying sizes especially marked at the centre. These dots had rather indistinct margins which seem to merge into the diffuse haze of the cornea. The haze extended almost to the limbal region, although the cornea in the extreme periphery especially above and below were relatively clear (Fig. 1). There was no vascularisation. The corneal sensation was diminished. There was no family history of similar illness and there were no signs of inflammation.

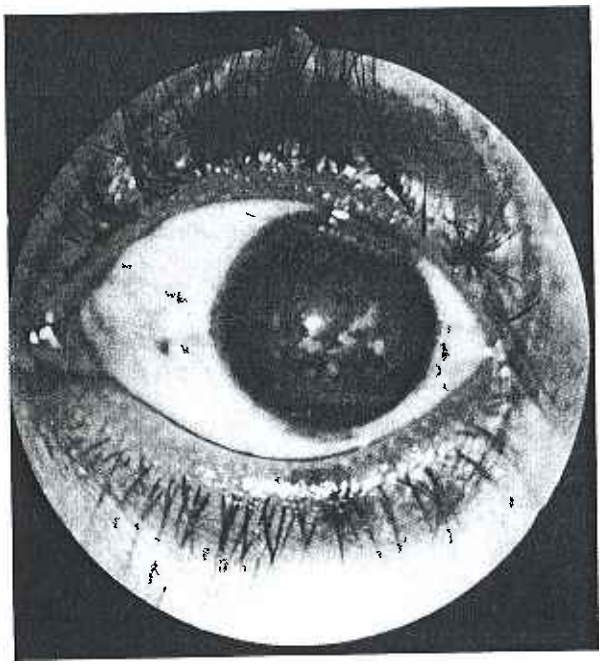

Fig. 1. Shows classical macular corneal dystrophy. The irregular white dots with indistinct margins in the diffuse corneal haze extend almost to the limbus.

Because of the depth of the corneal opacities which extended down to Descemet's membrane it was decided that he would require a full thickness graft.

In April 1965, the East Grinstead Eye Bank of England sent a pair of eyes.

Penetrating corneal grafting with a 5 mm graft was done on his right eye under general anaesthesia on the 11th April 1965.

Unfortunately by the time the graft was used it was already 9 days old but the patient was willing to accept the donor material.

The operation was uneventful and the result was successful anatomically. There was post-operative uveal inflammation which subsided with local and systemic steroid therapy. Unfortunately, the graft did not clear (Fig. 2). His vision did not improve, although he could see a little better in the temporal field. He still could not carry on his usual work as a newsagent and he remained legally blind.

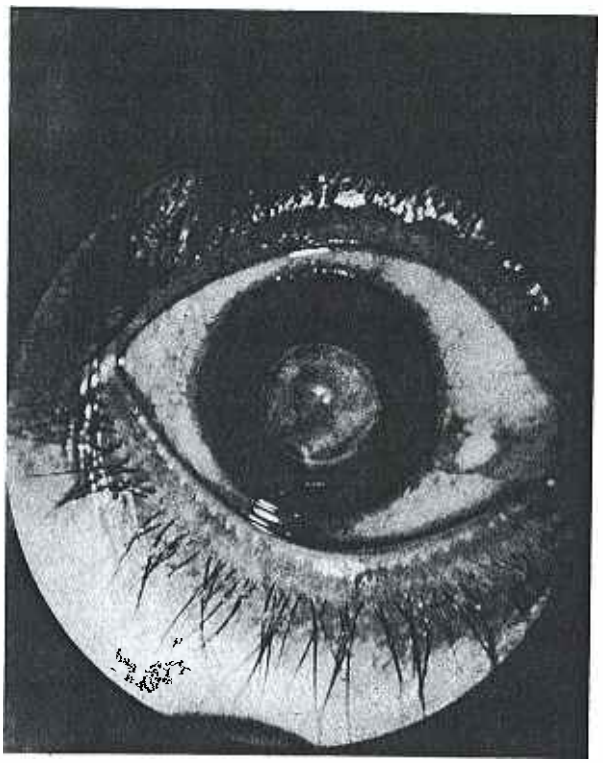

Fig. 2. Shows opaque donor graft of right eye. Donor graft was 9 days old when used.

HISTOPATHOLOGY

Section shows mucoid degeneration of the corneal lamellas. This mucoid substance has accumulated into two oval-shaped parts just beneath the Bowman's membrane. Most of the mucoid material has been washed out during the preparation of the histological section, and only subepidermal bullae are seen in the final product (Colour Plate 1b). However, the remaining mucoid substance in the bullae stains positive with colloidal iron, Alcian blue and Periodic Acid-Schiff (Colour Plate 1c and 1e). It is also hyaluronidase resistant, and it does not pick up the red stain with Masson's Trichrome (Colour Plate 1d).

Throughout the rest of the cornea, slits containing mucoid material are seen between the collagenous fibres (Colour Plate 1c) and they also pick up the colloidal iron and PAS stains.

In these areas of disintegrating collagenous fibres, there is also a loss of normal birefringence.

With all the above features, the diagnosis is unmistakably that of Macular Dystrophy of the Cornea.

The problem was to obtain "good graft material" and he was accordingly told that he would be given priority if fresh graft material was available.

LEFT EYE

In August this year, the International Eye Bank at Colombo, sent a pair of eyes.

The donor eye was from an 89 year old male, who died of bilateral pneumonia on 29.8.66 at 2.30 p.m. It was used (at 11.00 a.m. on 31st August 1966) within 48 hours after death.

A 6 mm penetrating corneal graft operation was done under local anaesthesia with deep sedation, on his left eye. The patient was given phenergan 25 mg. and largactil 25 mg. an hour before surgery. Just before surgery he was given 50 mg. of pethidine intravenously. One hour before surgery, he was given tetracaine 0·5% every 5 minutes and at operation he was given facial akinesia with 2·0% lignocaine and adrenaline. No retrobulbar anaesthesia was given. At operation the patient was very quiet and restful.

OPERATIONAL PROCEDURE

The donor eye was removed from the bottle where it was kept in sterile paraffin. After washing the eye in sterile saline to remove the paraffin, it was soaked in 1% framygen for 15 minutes, after which it was again rinsed in sterile normal saline. The donor eye was then wrapped in gauze and held firmly with the left hand. A 6mm trephine was used and the graft was removed without difficulty.

The graft was kept in a watch glass with the endothelial surface facing upwards, after a 7/0 black silk suture with eyeless needle (Davis and Geck) was inserted.

The eyelids were retracted with 3 lid sutures: 2 above and 1 below. As the patient was very quiet and the cornea was in the central position with good exposure, no fixation sutures were placed. As the corneal lesion was largely below and nasal to the centre of the cornea, the graft was centred accordingly. The trephine cut through the cornea without difficulty, except for a third of the circumference which was com-

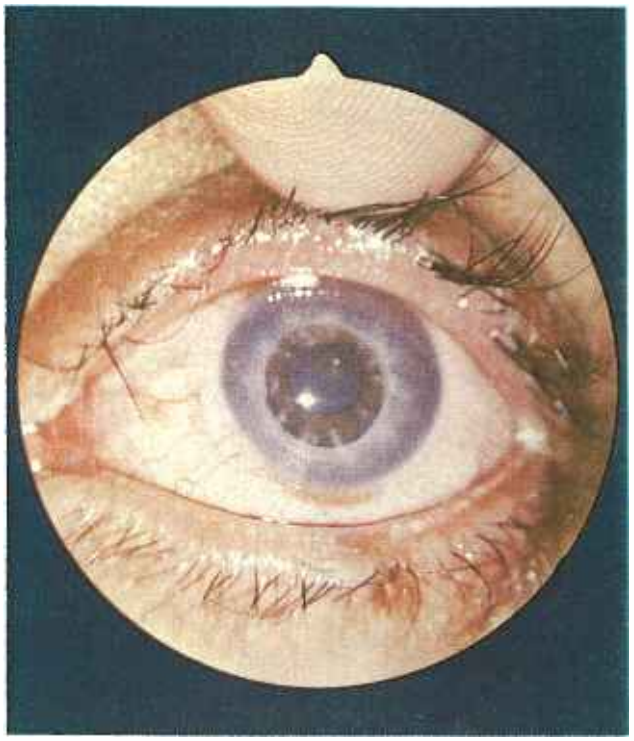

Fig. 1a. Note the successful clear donor graft, 6 weeks after operation in this case of macular corneal dystrophy. Visual acuity improved from counting fingers at 1 metre to 6/6. (Normal with glasses.)

Fig. 1b. Note the subepidermal bulla is filled with mucoid material, most of which was washed out during the preparation of the slide.

H & E X40.

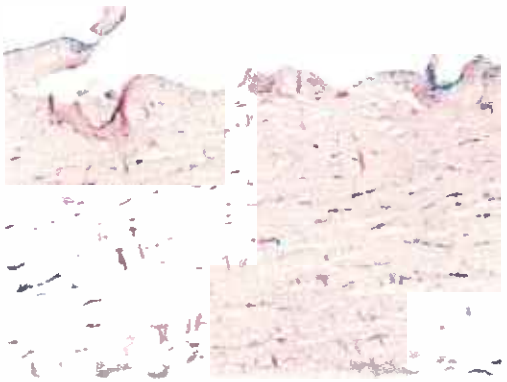

Fig. 1c. Note the remaining mucoid material still lines the lower wall of the bulla and stains blue. The degenerated corneal lamellae between the normal fibres have also picked up the colloidal iron stain.

Colloidal iron X40.

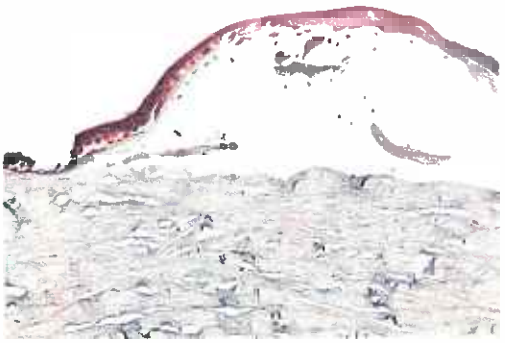

Fig. 1d. The mucoid substance does not take up the red colour as in the granular and lattice types.

Masson Trichrome X40.

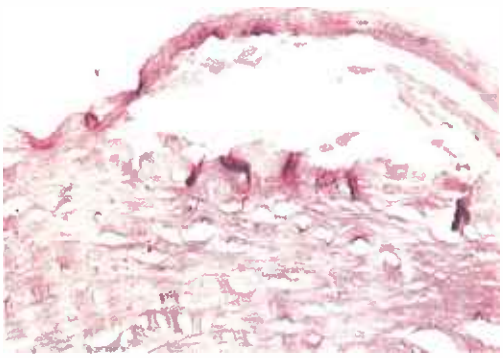

Fig. 1e. The mucoid material in the bulla is seen to have taken up the PAS stain. Unfortunately, the normal fibres have taken up just as much PAS stain and the differentiation is not too startling.

PAS X40.

PLATE I

pleted with corneal scissors. The donor graft was then placed in position and 8 direct corneal sutures with 7/0 black silk with eyeless needle (Davis and Geck) were placed. Extra sutures were inserted in the supero-temporal, supero-nasal and infero-nasal quadrants. At the end of the operation, sub-conjunctival injection of 150 mg. of framygen was given and both his eyes were padded and his operated eye bandaged. He was put on chloromycetin 250 mg. 6 hourly for 4 days and prednisolone 5 mg. 3 times daily.

POST-OPERATIVE FOLLOW-UP

The first dressing was done on the third post-operative day and was entirely satisfactory. The graft was partially clear and anterior chamber was well formed. During the first week the graft was clear, the pupil was well seen, and the anterior chamber was formed.

On the 12th post-operative day the patient was examined with the binocular slit lamp microscope. There were no complications: the wound was healing well, the graft was in good position, the anterior chamber was formed, and there was no evidence of vascularisation. The patient at this time could count fingers at 4 metres.

On the 21st post-operative day, the eye was essentially the same (Fig. 3).

On the 30th post-operative day, the stitches were removed with Vannas scissors under local anaesthesia with tetracaine 0·5% and facial

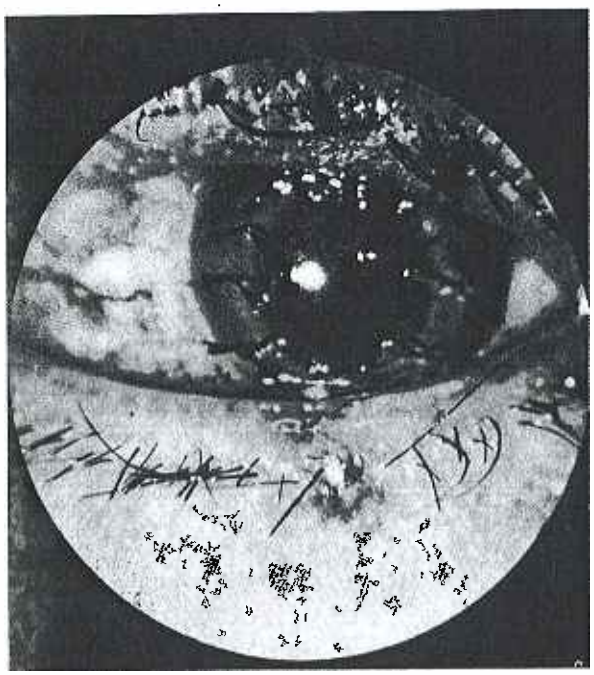

Fig. 3. Shows donor graft with direct stitches of left eye on the twenty-first post-operative day.

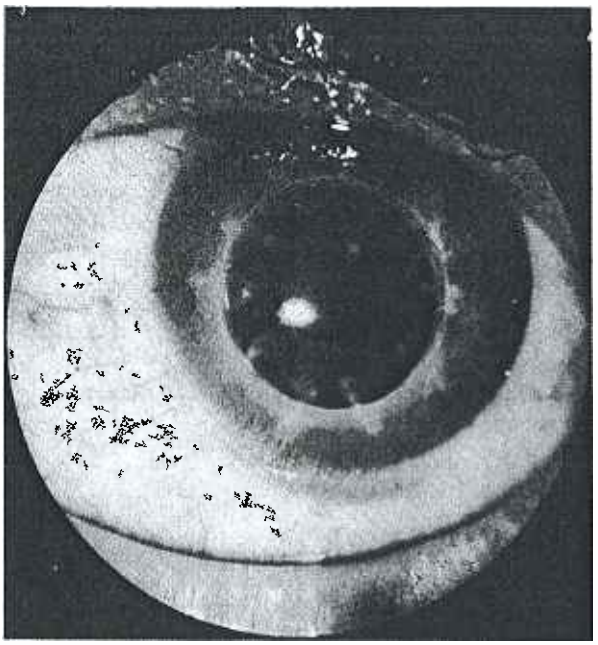

Fig. 4. Shows a clear donor graft of left eye 6 weeks after surgery. Visual acuity of this eye improved from counting fingers at 1 metre to 6/6 (normal with glasses).

akinesia by O'brien method, with 2% lignocaine in adrenaline.

Further post-operative follow up was uneventful and entirely satisfactory. The graft remained clear, and from the 8th October 1966, the patient had visual acuity of 6/18 uncorrected. On 12th October 1966, he could read the smallest print in the English newspapers. His interior chamber was now almost clear with minimum flare and occasional cells. And his prednisolone was reduced to 5 mg. daily.

On the 18th October, the graft was clear (Fig. 4 and Colour Plate 1a). With glasses he could see 6/6 and he could read J1without difficulty with glasses.

DISCUSSION

Heredo-familial macular dystrophy of the cornea is a relatively uncommon condition affecting the cornea which results in blindness. As the pathology usually affects the full thickness of the cornea, lamellar corneal grafting (Fig. 5) is generally inadequate and penetrating grafting (Fig. 6) is necessary for visual improvement.

The availability of fresh donor material for penetrating corneal grafting is a big problem in Singapore. Our newly formed Eye Bank will take some time before it can supply sufficient eyes for local surgeons: until then, we will have to depend on International Eye Banks for our supply of donor eyes. In this respect, the International Eye Bank at Colombo appears the most

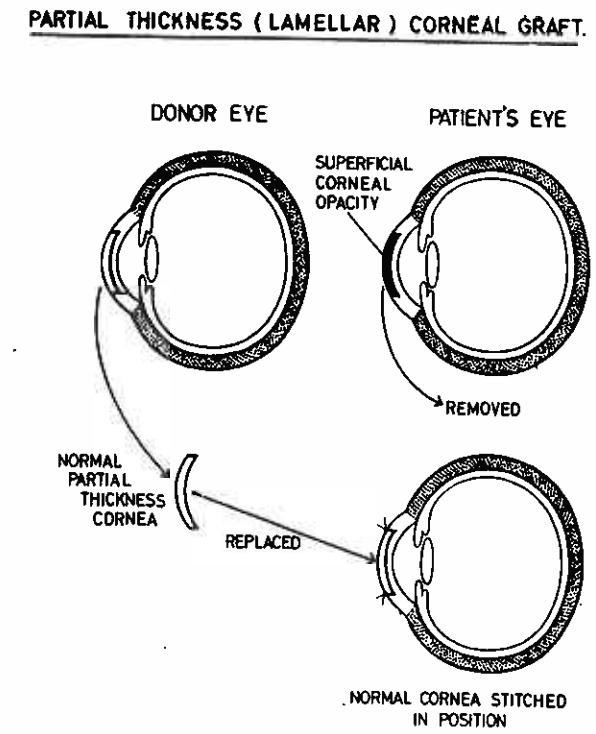

Fig. 5. Illustrating the principle of lamellar corneal grafting.

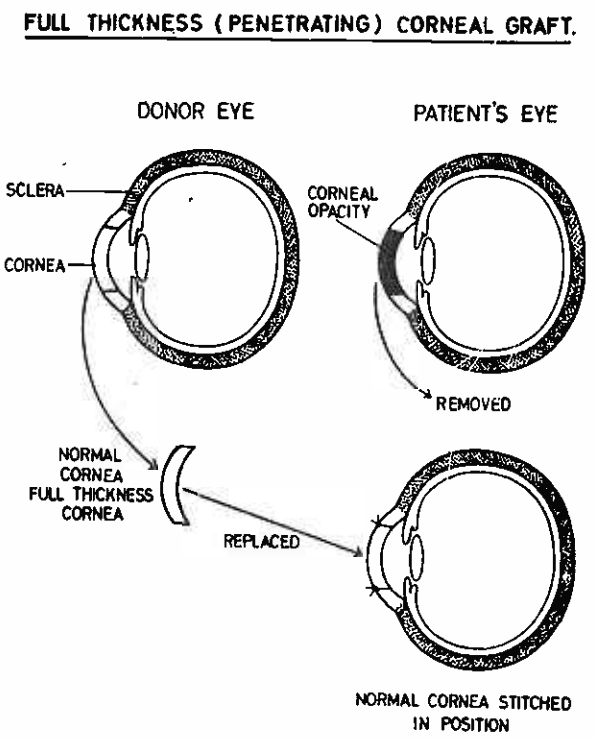

Fig. 6. Illustrating the principle of penetrating corneal grafting.

suitable because of its relative proximity to Singapore (only 3 hours by air).

If penetrating grafts are to improve visual acuity, not only must the graft be successful anatomically but it must also be optically clear. One of the most important factors determinating the clarity of a graft is the quality and freshness of the donor eye. This is well illustrated in this case, where the donor material used for his right eye was 9 days old compared to the one used for the left eye which was used within 48 hours! The result was an anatomical success for the graft to the right eye but it remained opaque (Fig. 2): the result of the graft to the left eye was not only anatomically successful, but the graft was also optically entirely clear (Fig. 4). The patient who was blind could read the smallest English newsprint with glasses.

The classification of classical heredo-familial corneal dystrophy was confused until Bucklers in 1938 reclassified them into 3 main types, the Granular dystrophy (Groenouw I), Macular dystrophy (Groenouw II), and Lattice dystrophy. These 3 types are generally easily distinguished clinically and histologically. (Refer table I).

(1) Granular dystrophy (Groenouw I)

Granular dystrophy (Groenouw type I) is characterised by white irregular dots of various patterns in the superficial stroma just beneath Bowman's membrane in the central part of the cornea. The borders are well-defined and the surrounding cornea is apparently clear. The periphery (2 mm.) is always entirely clear. The lesions gradually become more numerous and extend deeper into the stroma.

The dystrophy starts in the first decade and is very slowly progressive with no symptoms except for the defective visual acuity. The vision is good up to the 5th decade. Only occasionally will treatment be necessary.

The inheritance is dominant although frequently sporadic cases are seen.

(2) Macular dystrophy (Groenouw Type II)

Macular dystrophy (Groenouw Type II) is less common and is characterised by irregular white dots with indistinct borders which seem to merge into the surrounding hazing stroma. These opacities are more superficial at the central cornea, but are deeply placed towards the periphery. The haze extends deeply towards the Descemets' membrane and laterally towards the limbus.

The dystrophy begins in the first decade, and by 30 years the patient usually has no useful vision. Attacks of inflammation and photophropia are not uncommon. Penetrating grafting is usually necessary for visual improvement.

The inheritance is recessive, with consanguinity sometimes found in pedigrees.

TABLE I

CHIEF DIFFERENCES OF THE CLASSICAL CORNEAL DYSTROPHY

	Granular (Groenouw I)	Macular (Groenouw II)	Lattice
Transmission	Dominant	Recessive	Dominant
Shape of lesions	Irregular discrete grey-ish dots in clear cornea	Numerous irregular spots with ill-defined borders in deep diffuse corneal opacity.	Interlacing lattice pattern of lines and dots.
Description of lesion	superficial	full thickness	later full thick-ness
Periphery of corneal	2 mm always clear	affected	usually clear
Visual acuity	Visual acuity often good till old age	Severely diminished from 20-40 years	Severely diminished at 40 years
Symptoms other than defective vision	Generally nil	later	character-istically early in-flammatory attacks.

TABLE II

HISTOCHEMICAL AND BIREFRINGENT DIFFERENCES OF THE 3 TYPES OF CORNEAL DYSTROPHIES

Type of Dystrophy	Masson Trichrome	PAS	Colloid Iron	Birefringence
Macular	—	+	+	—
Granular	+	—	—	less than normal
Lattice	+	+	—	more than normal

(3) **Lattice dystrophy**

Lattice dystrophy is characterised by irregular pattern of lines situated in the superficial central corneal stroma. The corneal periphery is clear. These lines frequently present with a double contour within which is a clear zone filled with firm punctate opacities. Independent nodule formations are seen. Initially these opacities are superficial and the cornea remains relatively clear. Ultimately the opacities involve the whole thickness of the stroma and may become so dense that the lattice pattern is obscured. Changes begin at the first decade and vision is sometimes lost at the age of 40. Another characteristic of lattice dystrophy is the recurrent attacks of inflammation and pain. If severe, vascularisation may be marked. The inheritance is dominant.

HISTOLOGICAL DIFFERENTIAL DIAGNOSIS

Macular Dystrophy of the cornea must be differentiated from the other two varieties of corneal dystrophies namely, the Granular and Lattice types. Granular Dystrophy shows a granular type of hyaline degeneration of the fibres which stain red with Masson Trichrome, and it does not take up the colloidal iron and PAS stains. The mucoid material in Macular Dystrophy does not stain red with the Masson Trichrome.

The hyaline degeneration in the Lattice Dystrophy also stains brilliantly red with Masson Trichrome, but does not pick up the colloidal iron stain. They are however much more birefringent than the normal corneal lamellae.

SUMMARY

1. A case of corneal grafting in a blind patient with classical heredo-familial macular corneal dystrophy is described. The graft was successful and remained clear, and the patient had normal vision (6/6) 3 months after surgery.
2. The clinical features, differential diagnosis and pathology are discussed.

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