

Use of split-thickness dermal grafts to repair corneal and scleral defects – a study of 10 patients

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Abstract

The use of split-thickness dermal grafts for successful repair of corneal and scleral defects is reported in 10 patients (11 eyes) who had non-infectious, impending, or overt ocular perforation. In all patients, traditional methods of reconstruction were deemed inappropriate or had already failed. Corneoscleral defects occurred after various operations: pterygium excision, retinal detachment repair, insertion of a keratoprosthesis (Cardona implant) into an opaque, vascularised cornea, and penetrating keratoplasty. Other causes of corneoscleral defects were scleromalacia perforans, idiopathic systemic vasculitis, alkali burn, ocular cicatricial pemphigoid, and band keratopathy with recurrent erosion following intraocular metallic foreign body. We propose the use of split-thickness grafts: (1) when adjacent conjunctiva is inadequate to cover a corneoscleral defect owing to its large size or great depth or to conjunctival scarring from previous operations, injury, or ocular cicatricial pemphigoid; or (2) as an alternative to autogenous grafts such as conjunctiva, cartilage, fascia lata, tibial periosteum, or mucous membrane as well as to homologous scleral and lamellar grafts. Dermal grafts are advantageous in that they are autogenous, non-antigenic, survive on avascular surfaces, and self-epithelialise and, thus, need not be covered by conjunctiva. Furthermore, they are pliable, have excellent tensile strength, provide ample tectile support, and are abundantly available. Dermal grafts are harvested from the dermal bed of the thigh after an epidermal flap is hinged at one end.

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Split-thickness dermal grafts may be employed to repair any non-infectious impending, or overt corneoscleral perforation or defect where self-epithelialisation, tectonic support, and a relatively thin, pliable graft are required. They were first used in ophthalmology to line the orbital bone of the exenterated orbit and later to repair full thickness corneal and/or scleral defects resulting from severe alkali burns and scleromalacia perforans, respectively.^{1,2} More recently, dermal grafts were used to cover a painful cornea in a patient suffering from band keratopathy in a situation where conjunctival scarring precluded mobilisation of a thin conjunctival (Gunderson)

flap; the patient was fitted postoperatively with a cosmetic scleral shell.³ We report the use of split-thickness dermal grafts in 10 patients with corneoscleral defects for whom traditional methods were thought to be unsatisfactory or had already been attempted and failed.⁴⁻¹¹

Methods

INDICATIONS FOR DERMAL GRAFTING

Indications for dermal grafts included: (1) small (1-2 mm) corneoscleral perforations, (2) areas of corneoscleral thinning too large or of too great a depth to be covered by other types of grafts or by adjacent conjunctiva, and (3) severe conjunctival scarring which precluded mobilisation of a conjunctival flap over the corneal or scleral defect. For the above reasons alternative methods such as cyanoacrylate tissue adhesive and bandage contact lens and other autogenous grafts such as conjunctiva, cartilage, mucous membrane, fascia, and tibial periosteum as well as homologous scleral and lamellar patch grafts were not used. In some patients such grafts were not employed because they were too bulky or did not contain epithelium.⁹⁻¹¹

SURGICAL TECHNIQUE

In all 10 patients, split-thickness dermal grafts were harvested from the outer aspect of the thigh using a power-driven Brown dermatome (Fig 1).



Figure 1 (A) Harvesting of split thickness dermal graft with Brown dermatome from upper thigh. Epidermal graft is hinged superiorly.

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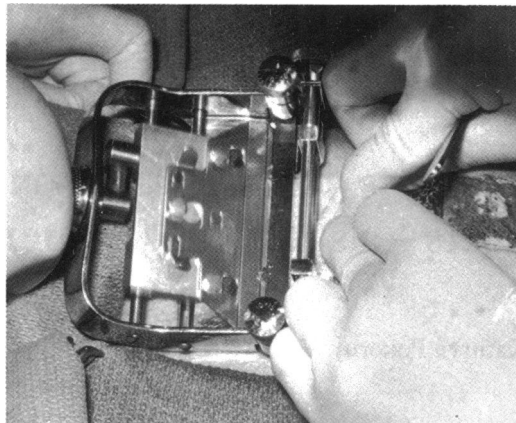


Figure 1 (B) Dermal graft is harvested with Brown dermatome. Note epidermal hinged flap to the right.

A 0.0015 inch thick epidermal flap was hinged superiorly.¹² The dermal graft of similar thickness was then similarly harvested from the dermal bed of the thigh. Perforations were made in the epidermal hinged flap at the donor site to allow for egress of blood and fluid. The flap was repositioned and closed with 4-0 chromic sutures; the wound was dressed with iodoform gauze and the leg wrapped in 4 inch gauze.

In all cases the conjunctiva at the periphery of the defect was undermined for 3-4 mm. In patients whose central cornea was thinned or perforated, a limbal peritomy was performed and the graft was placed over the entire surface of the de-epithelialised cornea. Conjunctival dissection was facilitated by local infiltrative anaesthetic containing adrenaline. The corneal epithelium was denuded with a number 15 blade after application of 4% cocaine. The circular-to-oval dermal grafts were 1-2 mm larger than the corneal or scleral defect. Care was always taken to maintain the surface orientation of the graft; this task was accomplished by placing the graft on a moist 4x4 inch gauze pad immediately after it was harvested. The edge of the graft was sutured to the healthy cornea at the perimeter of the defect with interrupted 10-0 nylon sutures of mid-corneal stroma depth and to the conjunctival edge with 7-0 (polyglactin 910) Vicryl and plain sutures. When necessary, bites included the episclera in order to anchor the graft to the recipient bed.

In case 4, the dermal graft was used to support and cover the exposed base of the keratoprosthesis (Cardona implant). The inferior aspect of the graft was sutured to that portion of the conjunctival edge covering the inferior aspect of the Cardona implant. In case 5, another patient with retracted conjunctiva from the base of a Cardona implant, a 360 degree peritomy was performed after de-epithelialising the scarred conjunctival remnants from the base of the implant. The entire cornea including the implant was then covered with an appropriately sized graft sutured to the conjunctival edge; a small buttonhole was made in the graft to expose the visual cylinder.

Bipillar temporary suture tarsorrhaphies were maintained for 2-3 weeks after surgery. Broad spectrum oral antibiotics were prescribed for 2 weeks. The lids were examined at 1, 2, and 3 weeks intervals.

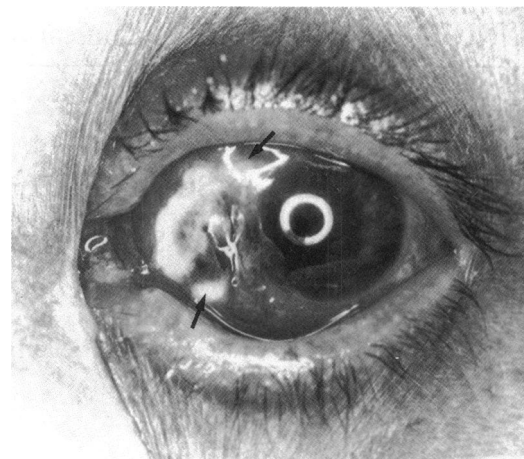


Figure 2 (A) Enlarging corneal scleral defect after earlier pterygium surgery from nasal limbus of left eye (arrows). Note whitened appearance of necrotic sclera with adjacent perilimbal thinning with exposed uvea; the distorted pupil is drawn nasally and anterior chamber is narrowed.

Patient histories before grafting

CASE 1

A 42-year-old male presented with a persistent enlarging scleral defect at the nasal limbus of the right eye after pterygium excision 20 years earlier. On examination, the best corrected vision was 20/30 in each eye with an intraocular tension by applanation tonometry of 18 mm Hg in each eye. The thinned sclera and adjacent conjunctiva were not inflamed. General physical examination and the remainder of the ocular examination were unremarkable.

CASE 2

A 52-year-old male had uneventful nasal limbal pterygium excision in the left eye. He was treated with topical mitomycin as well as a topical combined antibiotic and steroid medication for 2 weeks postoperatively, but was then lost to follow up for the next 8 months by which time the patient had developed pain and decreasing vision in that eye. The best corrected vision was 20/30 in the right eye and hand motion in the left eye. The left eye showed corneoscleral melting at the nasal limbus from the 7 to the 11 o'clock position, eccentric pupil, and narrowed anterior chamber angle. The conjunctiva was markedly injected (Fig 2). A systemic vasculitis investigation including sedimentation rate, antinuclear

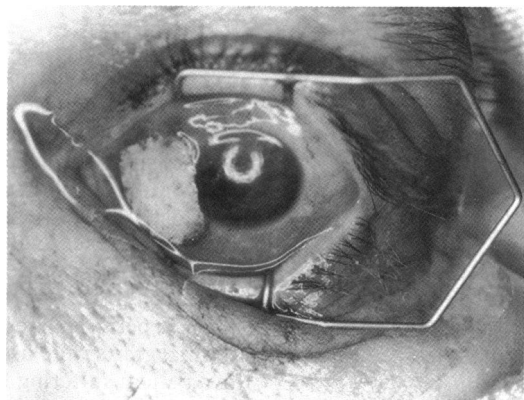
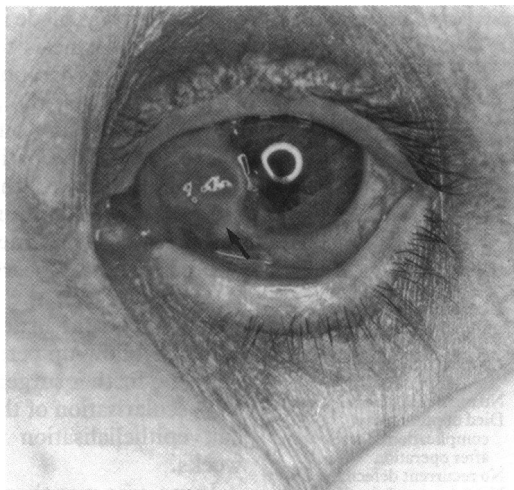


Figure 2 (B) Appearance of split-thickness dermal graft immediately postoperatively.

Figure 2 (C) Note repaired corneal scleral defect with large pyogenic granuloma (arrow) at limbus 3 months after surgery.



antibody titres, and rheumatoid factor was normal.

CASE 3

Following multiple retinal detachment operations, a 68-year-old female developed an enlarging equatorial staphyloma in the left eye which

Figure 3 (A) Base of extruding implant (arrows) shown. (B) 3 months later covered by dermal graft (case 5).

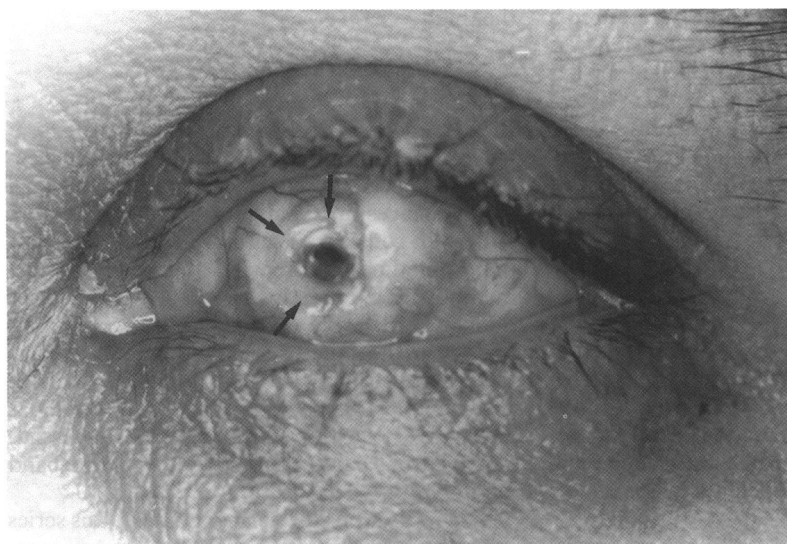


Fig 3A



Fig 3B

extended anteriorly from the corneal limbus from the 12 to 4 o'clock position. Her vision was 20/30 in the right eye and 20/400 in the left eye. A previous attempt to cover the defect with a conjunctival flap was unsuccessful, and enucleation had been advised elsewhere because of the progressive scleral thinning.

CASE 4

A 7-year-old boy with bilateral sclerocornea had undergone insertion of a keratoprosthesis (Cardona implant) in the right eye. Vision was hand motion in both eyes with normal intraocular pressures. The superior aspect of base of the implant was exposed despite two previous procedures performed to advance retracted conjunctiva over the base of the implant.

CASE 5

A 41-year-old male had a failed penetrating keratoplasty after perforating, bacterial corneal ulcer in the left eye 17 years earlier. Because of severe corneal scarring he had undergone a Cardona implant. The first implant extruded and a second one was inserted, approximately 10 years after which the nasal base of the implant was exposed as a result of conjunctival retraction and scleral thinning. A third graft, a mucous membrane graft harvested from the lower lip also retracted. Vision was 20/20 in the right eye and 20/70 in the left eye; intraocular pressures were normal (Fig 3).

CASE 6

A 79-year-old male with ocular pemphigoid and severe glaucoma had no light perception in the right eye and light perception only in the left eye. He had undergone three previous penetrating keratoplasties in the left eye after which he developed progressive corneal thinning that resulted in an inferior corneal perforation.

CASE 7

An 89-year-old male with rheumatoid arthritis developed ischaemic necrosis of the right lower leg, secondary infection, and gangrene. The right foot was amputated. He also had bilateral scleromalacia perforans that led to corneal perforation and endophthalmitis; the left eye was subsequently eviscerated. Medical consultants believed that the patient would not tolerate systemic steroids or immunosuppressive therapy. He developed severe superior corneal melt of the right eye with impending perforation; his vision in the right eye was hand motion.

CASE 8

A 63-year-old male had previously been diagnosed with systemic vasculitis that was unclassifiable by consultants at the National Institutes of Health. He entered hospital for a course of systemic steroids and immunosuppressive therapy for unhealed leg ulcers. He developed precipitous diffuse, marked central corneal thinning that was believed to be secondary to

Table 1 Clinical characteristics of patients undergoing split-thickness dermal grafts for repair of corneal and scleral defects

Case no/ age	Previous surgery or underlying pathology	Type/location of defect	Result/follow up
1/42	Pterygium excision	Sclera/nasal limbus	No recurrent defect/5 years
2/52	Pterygium excision	Corneosclera/nasal limbus	No recurrent defect, pyogenic granuloma/2 years
3/68	Multiple retinal operations	Sclera, 12×14 mm/temporal equator	No recurrent defect, moderate graft thinning/2 years
4/7	Cardona implant/sclerocornea	Sclera/superomedial and inferior base of implant	Graft retracted inferiorly/2 years
5/45	Cardona implant/two failed penetrating keratoplasties for perforating ulcer	Sclera/superolateral base of implant	No graft retraction/3 years
6/79	Penetrating keratoplasty/ocular pemphigoid	Inferior descematocele	No recurrent defect/2 years
7/89	Scleromalacia perforans	Superior corneal melt	No recurrent defect/2 years
8/63	Unknown systemic vasculitis	Bilateral diffuse corneal stromal melt	Died of pulmonary complications 3 weeks after operation
9/51	Lye burn	Central epithelial defect	No recurrent defect/2 years
10/23	Removal of intraocular foreign body, retinal detachment repair and vitrectomy	Paracentral, recurrent erosion	No recurrent defect/3 years

ischaemic vasculitis. The vision was hand motion in each eye.

CASE 9

A 51-year-old male with severe corneal melt in the right eye owing to an alkali burn required a lateral tarsorrhaphy. Best corrected vision was hand motion in the right eye and 20/40 in the left eye. He had a persistent central corneal defect with minimal anterior stromal thinning for 2 years. A temporary medial tarsorrhaphy improved the epithelial defect by only 30%. The conjunctiva was too scarred to mobilise a thin conjunctival (Gunderson) flap.

CASE 10

A 23-year-old male had a perforating intraocular metallic foreign body. Despite multiple vitreoretinal procedures, he developed a pre-phthisical globe with corneal vascularisation, band keratopathy, and recurrent painful corneal epithelial erosions, and hand motion vision. He was unable to wear a scleral lens.

Results

In eight of 10 patients with 1–5 year follow ups, the grafts survived successfully in that the corneal or scleral defect was repaired with the following exceptions in two patients (Table 1). Firstly, one patient with an unknown systemic vasculitis (case 8) who had bilateral impending corneal perforations owing to idiopathic systemic vasculitis died of pulmonary complications 3 weeks after the operation. At that time, the graft had not fully vascularised. Secondly, in the patient with sclerocornea (case 4), only the inferior edge of keratoprosthesis (Cardona implant) was covered by the dermal graft; the graft significantly retracted 2 months after the operation. Graft retraction stabilised 6 months after this operation. No further operations were performed during a 2 year follow-up period. However, in another patient (case 5), at the time of operation, the entire base of the Cardona implant was covered by the graft and a small

perforation was made in the centre of the graft to allow the prosthesis to protrude; no retraction occurred after operation, with 3 year follow-up.

In all patients, the graft appeared thicker at the time of surgery but thinned and contracted over time. In the patient with multiple retinal procedures (case 3), the rather large 12×14 mm scleral defect had not enlarged although the graft has significantly thinned but remains unchanged approximately 2 years later. In two patients (cases 6 and 9), the graft thinned such that anterior segment structures could be visualised, yet with follow-up periods 5 and 2 years respectively, no further surgery was necessary.

Vascularisation of the grafts took 4 to 6 weeks and epithelialisation was complete in 2 to 3 weeks.

In no case was there evidence of infection or graft rejection either at the donor or recipient site. In one graft (case 10) hairs, identified on slit-lamp biomicroscopy, caused irritation which subsided after four epilation sessions over a 1 year period. The patient with a narrowed anterior chamber after pterygium excision (case 1) developed a pyogenic granuloma; additional anterior segment reconstruction for visual rehabilitation is anticipated. In one patient (case 5), a raised hyperpigmented scar developed on the thigh.

Discussion

In this report, split-thickness dermal grafts provided tectonic support in the repair of corneoscleral defects caused by a variety of unusual circumstances in 10 patients (11 eyes) who were either not considered candidates for more traditional methods of repair or in whom such methods had already failed. Split-thickness dermal grafts were originally used in ophthalmology to line the exenterated orbit and later to repair corneoscleral perforations in two patients.^{1,2} Khan employed dermal grafts as alternative to a thin conjunctival (Gunderson) flap to cover a painful cornea resulting from band keratopathy.³

The indications for dermal grafts in this series included patients with small (1–2 mm) corneoscleral perforations and patients with areas of corneoscleral thinning too large or of too great a depth to be covered by other types of grafts or by adjacent conjunctiva. In several patients, conjunctival scarring because of previous injury, surgery, or ocular cicatricial pemphigoid limited the ability to mobilise a conjunctival flap. In other patients, the depth of the corneal sclera was of such a degree that conjunctiva alone would not afford sufficient tectonic support to maintain globe integrity.

Dermal grafts have several positive features. They are able to survive on the relatively avascular cornea, sclera, and bone.^{1,2} They epithelialise from adnexal epithelium as well as from the surrounding conjunctiva; they are supple and not bulky, have excellent tensile strength, and are autogenous and non-antigenic.^{4,7}

Alternative methods for repair of corneal and scleral perforations, extremely effective in appropriately selected patients, include: (1) use

of cyanoacrylate tissue adhesive and bandage contact lens, (2) conjunctival flaps as discussed above, (3) autogenous grafts such as conjunctiva, cartilage, mucous membrane, fascia, and tibial periosteum, and (4) homologous scleral and lamellar patch grafts. While cartilage, fascia lata, tibial periosteum, and homologous scleral and lamellar grafts provide support they do not contain epithelium. In addition, these grafts may not survive as well on avascular surfaces, especially dermal grafts when they are not covered by adjacent conjunctiva which is not always available. Moreover, these grafts may be too bulky to cover large areas and may undergo necrosis because of their large size and poor vascularisation. Mucous membrane and conjunctival autografts contain epithelium but they may not always survive, provide little tectonic support, especially in the repair of large defects, and may retract.⁹⁻¹¹ Another potential disadvantage of conjunctival autografts is that surgery may be required on the other eye.

Dermal grafts should be avoided in the repair of corneal perforations resulting from infections or in corneal disease, where good vision is anticipated after surgery, since penetrating keratoplasty has not been reported after dermal grafting. Since dermal grafts undergo vascularisation, they may need to be excised before penetrating keratoplasty to prevent vascularisation and immune-mediated compromise of the transplanted cornea.

Periosteal-temporalis fascia pedicle flaps have also been used to support extruding keratoprostheses by Spoor and coworkers.¹² This technique provides ample coverage and support of the implant. Because the flap is so vascular, however, it may induce significant tissue growth; trephination of the optic of the keratoprosthesis may be necessary in some cases every 6–8 weeks.¹²

The main complication of dermal grafts in this series was their postsurgical thinning. Control of underlying corneal and scleral inflammation by systemic therapy would enhance graft survival.

In addition, dermal graft thickness may be increased at the expense of a thinner epidermal flap when relatively large surfaces are covered, as in case 3. In children and older patients, in whom the dermis is not as thick as in middle-aged patients, graft thickness must be limited in order to prevent sloughing of the epidermal flap at the donor site. Because the graft is vascularised from adjacent conjunctiva, the thickness of the healed graft would theoretically be enhanced by burying the graft either partially or totally under the conjunctiva. While the use of a power-driven dermatome helps to ensure the appropriate thickness of the graft, a 'free-hand' harvesting technique may also be used.³

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- 1 Mauriello JA Jr, Han KH, Wolfe R. Use of autogenous split-thickness dermal graft for reconstruction of the lining of exenterated orbit. *Am J Ophthalmol* 1985; **100**: 465–7.
- 2 Mauriello JA Jr, Fiore PM, Pokorny KS, Cinotti DJ. Use of split-thickness dermal graft in the surgical treatment of corneal and scleral defects. *Am J Ophthalmol* 1988; **105**: 244–7.
- 3 Khan JA. Dermal graft. Alternative to Gunderson flap allows fitting scleral shell over sensitive cornea. *Ophthalmic Plast Reconstr Surg* 1990; **6**: 260–4.
- 4 Putterman AM. Conjunctival flap-cosmetic shell-ptosis procedure: treatment of blepharoptosis in severe keratopathy. *Arch Ophthalmol* 1989; **107**: 1816–8.
- 5 Reed G, Zafra E, Ghyselen A, Goldstein J, Robinett W. Self-epithelialization of dermal grafts. *Arch Otolaryngol* 1968; **87**: 518–22.
- 6 Davis J, Traut M. The production of epithelial lined tubes and sacs. An experimental study. *JAMA* 1926; **86**: 339–41.
- 7 Thompson N. The subcutaneous dermis graft: a clinical and histologic study in man. *Plast Reconstr Surg* 1960; **26**: 1–22.
- 8 Peer LA, Paddock R. Histologic studies on the fate of deeply implanted dermal grafts. Observations on sections from one week to one year. *Arch Surg* 1937; **34**: 268–90.
- 9 Renard G, Lelievre P, Mazel J. Scleromalacie perforante. *Bull Soc Ophthalmol Fr* 1953; **66**: 243–51.
- 10 Torchia RT, Dunn RE, Pease PJ. Fascia lata grafting in scleromalacia perforans. *Am J Ophthalmol* 1968; **66**: 705–9.
- 11 Merz EH. Scleral reinforcement with aortic tissue. *Am J Ophthalmol* 1975; **57**: 766–70.
- 12 Spoor TC, Ramocki JM, Cowden JW. A periosteal-temporalis fascia pedicle flap for repairing impending ocular perforations and extruding keratoprostheses. *Am J Ophthalmol* 1989; **108**: 704–8.