PENETRATING KERATOPLASTY IN THE WEST BANK AND GAZA

R. DE COCK
East Jerusalem

SUMMARY

Four hundred and sixteen penetrating keratoplasties performed at St John Ophthalmic Hospital, Jerusalem, between January 1988 and July 1992 were reviewed retrospectively. The leading indications were keratoconus, microbial keratitis, trachomatous corneal scarring and herpes simplex keratitis. After a mean follow-up of 12.4 months (>1–48 months) 79.8% of the grafts remained clear. The results in terms of graft clarity and visual improvement varied among the different diagnostic groups. No relationship was found between donor age, cadaver time or storage time and graft survival. This series demonstrates the viability of penetrating keratoplasty in this area of low economic development but highlights the need for strict patient selection to ensure optimal use of scarce donor material.

In a study of eye disease in the West Bank and Gaza, Thomson and Chumbley[1] found a prevalence of binocular blindness of 1.7%, with corneal pathology accounting for a significant 25.2% of blindness. Tabbara and Ross-Degnan[2] obtained similar results in Saudi Arabia and these figures correspond with data from other developing countries.

St John Ophthalmic Hospital is the main centre for eye care for East Jerusalem, the West Bank and Gaza, serving a population of 1.9 million. An assessment of the role of keratoplasty in this region needs to take account of several factors. Average annual income, population growth and infant mortality rates are similar to those of other developing countries.[3] Particularly in rural areas and refugee camps, living conditions are crowded and dusty; running water is unavailable in many households.[4] The level of binocular blindness, some 8 times the prevalence in England and Wales, reflects this economic underdevelopment. Lack of patient awareness in addition to the considerable travel restrictions in this troubled area often result in erratic patient follow-up. For cultural reasons donor corneas are difficult to obtain locally, requiring the use of donor material obtained from overseas with relatively prolonged storage times. Despite these difficulties, keratoplasty has been carried out at this hospital for more than 30 years. Over this time there has been considerable fluctuation in the supply of donor corneas and it is only in the past 4 years that the corneal grafting programme has been substantially revived. This study reviews the indications and results of penetrating keratoplasties performed over this period in order to establish guidelines for the optimal use of scarce donor material given the economic and social conditions that prevail in the West Bank and Gaza.

From: St John Ophthalmic Hospital, East Jerusalem, via Israel.
Correspondence to: Romain De Cock, FRCS, FRCOphth, Moorfields Eye Hospital, City Road, London EC1V 2PD, UK.

METHODS AND PATIENTS

The notes of patients who underwent penetrating keratoplasty at St John Ophthalmic Hospital between January 1988 and July 1992 were retrospectively reviewed. Details obtained were patient age, sex and area of origin, primary diagnosis leading to corneal grafting, details of the procedure performed including graft size and suturing technique, donor details (donor age, cadaver time, storage time and storage medium used) and the outcome of surgery in terms of both graft clarity and visual results.

RESULTS

Between January 1988 and July 1992, 434 penetrating keratoplasties were performed at St John Ophthalmic Hospital. The notes of 13 patients (2.9%) could not be recovered and 5 patients (1.2%) were followed up in clinics outside the hospital. This study therefore reports on 416 grafts performed on 375 patients.

The mean age of patients at the time of surgery was 38 years (range 2 months–90 years). Fifty-seven per cent of the patients were male. All but 7 patients (1.7%) came from East Jerusalem, the West Bank or Gaza.

The indications for keratoplasty are listed in Table I. In 391 (94%) cases the primary aim of surgery was to

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Table I. Indications for keratoplasty 1988–1992

	No.	%
Keratoconus	156	37.5
Microbial keratitis	59	14.2
Trachomatous corneal scarring	45	10.8
Herpes simplex keratitis	44	10.6
Regrafts	29	7.0
Corneal dystrophies (excluding Fuchs')	20	4.8
Trauma	20	4.8
Bullous keratopathy	8	1.9
Congenital glaucoma	4	0.9
Chemical burns	3	0.7
Fuchs' dystrophy	2	0.5
Limbal dermoid	2	0.5
Corneal scar of uncertain cause	24	5.8
Total	416	100

improve vision, while the remaining 25 grafts (6%) were tectonic grafts in eyes with active infection and impending or actual perforation. Strict criteria were used for the diagnosis of trachomatous corneal scarring; this diagnosis was made if diffuse corneal scarring was found in association with Herbert's pits, Arlt's lines on the upper tarsal conjunctiva and in the absence of a history of acute corneal ulceration or trauma.

The details of procedures performed are shown in Table II. In 34 cases, vitrectomy was required. Although a total of 22 surgeons were involved in corneal grafting over this period, 150 (36%) cases were performed by one surgeon (R.DeC.) and five surgeons carried out 64% of the grafts. Donor buttons between 5.00 mm and 10.00 mm in diameter (88% between 7.00 mm and 8.00 mm) were cut endothelial side up by punch trephine. Just over three-quarters of the grafts (75.9%) were secured with interrupted 10/0 Nylon sutures, a reflection of the less than optimal risk category into which many patients fell as well as individual surgical preference. Twelve per cent of the grafts were sutured with combined continuous and interrupted 10/0 Nylon, 6.3% with continuous 10/0 Nylon and 5.8% with 10/0 Prolene.

Details concerning the donor corneas were available in 257 cases and are shown in Table III. Of all the donor corneas 11.5% were preserved in short-term, 80.5% in medium-term and 8% in long-term media. There was no statistically significant correlation between maintenance of graft clarity and donor age, cadaver time or storage time ($p>0.05$), although other relevant variables such as diagnostic group and vascularity of the host bed were not controlled for. Similarly, there was no statistical difference in the outcome of grafts preserved in different media ($p>0.05$).

Table II. Procedures performed

	No.	%
PK	317	76.2
PK + ECCE + IOL	44	10.6
PK + ECCE	43	10.3
PK + ICCE	9	2.2
PK + ICCE + IOL	3	0.7

PK, penetrating keratoplasty; ECCE, extracapsular cataract extraction; IOL, intraocular lens; ICCE, intracapsular cataract extraction.

Mean follow-up was 12.4 months (range <1–48 months). Overall, 332 (79.8%) of grafts were clear at the time of last examination. The Kaplan–Meier survival curves for the series in general as well as the larger diagnostic groups are shown in Fig. 1. In those cases where the graft had failed, the mean time elapsed since surgery was 5.6 months (range <1–36 months). The causes of graft failure are shown in Table IV. There were 5 cases of primary graft failure in this series (1.2%). Of these, 1 was stored in tissue culture medium, one in K-Sol for 11 days and one in Dexsol for 17 days; no details are available for the other 2 cases. Table V shows the maintenance of graft clarity according to the primary indication for keratoplasty.

The pre-operative and post-operative distributions of best visual acuity recorded at the last examination are shown in Fig. 2.

DISCUSSION

Indications for Penetrating Keratoplasty

Keratoconus was by far the leading indication (37.5%) for corneal grafting among 416 cases performed at St John Ophthalmic Hospital over the past 4 years. This is similar to the findings of several other series.[5–8] In 54 patients with keratoconus (34.6% of the keratoconus group) clinical signs of vernal catarrh were also present. The high prevalence of allergic eye disease and the expense and impracticability of contact lens wear in the dry and dusty conditions in the region are factors which account in part for the great preponderance of keratoconus patients in this series. The keratoconus patients tended to be young, with a mean age of 21.4 years (range 7–81 years) compared with 49.1 years (range <1–90 years) for the other diagnostic groups.

Fifty-nine (14.2%) grafts were performed for corneal scarring related to microbial infection. This is considerably more than found in other large series from developed countries[5,7,8] but corresponds with data from Pakistan[9] and Saudi Arabia.[10] Twenty-five of these cases were done as emergency grafts to maintain the structural integrity of the globe.

Although trachoma is no longer hyperendemic in this population, its sequelae are still very evident. Forty-five grafts (10.8%) were performed for trachomatous scarring of the cornea. Clinical signs of previous trachoma infection were present in more than this number of patients and may well have been an additional risk factor in the pathogenesis of corneal disease leading to grafting, for example in suppurative keratitis. Thus the importance of previous trachoma is underestimated in this series.

Herpes simplex keratitis varies in importance as an indication for corneal grafting among the many reported series, ranging from 36%[7] to 3.2%.[5] In this study, 44 patients (10.6%) underwent keratoplasty for herpetic keratitis.

Bullous keratoplasty following intraocular surgery was not a common indication for keratoplasty (1.9%) – in contrast to other surveys in which this was the leading

Table III. Donor material storage media, storage times, cadaver times and donor age

	No. (%)	Mean storage time (days)	Mean cadaver time (hours)	Mean donor age (years)
Short-term storage media				
Moist chamber	2 (0.6)	0.5 (0–1)	3.0 (1–5)	20 (10–30)
M–K	39 (10.9)	5.6 (1–14)	7.8 (2–20)	64.8 (10–82)
Intermediate-term storage media				
CSM	14 (3.9)	7.6 (6–10)	8.4 (2–15)	62.4 (49–74)
K-Sol	29 (8.1)	8.1 (3–18)	7.8 (2–16)	65.3 (21–79)
Optisol	70 (19.6)	11.7 (3–19)	7.1 (1–20)	65.0 (26–81)
Dexsol	79 (50.2)	11.9 (1–27)	6.7 (<1–21)	61.5 (1–86)
Long-term storage medium				
Organ culture	24 (6.7)	30.5 (4–36)	6.6 (2–25)	65.1 (3–88)

indication.[11,12] The change from intracapsular to extracapsular cataract surgery occurred in this hospital at a time when the importance of the corneal endothelium had already become apparent, with posterior chamber intraocular lenses and viscoelastic material routinely used from the start. This may be responsible, at least in part, for the low incidence of post-surgical keratopathy.

Fuchs' endothelial dystrophy appears to be rare among

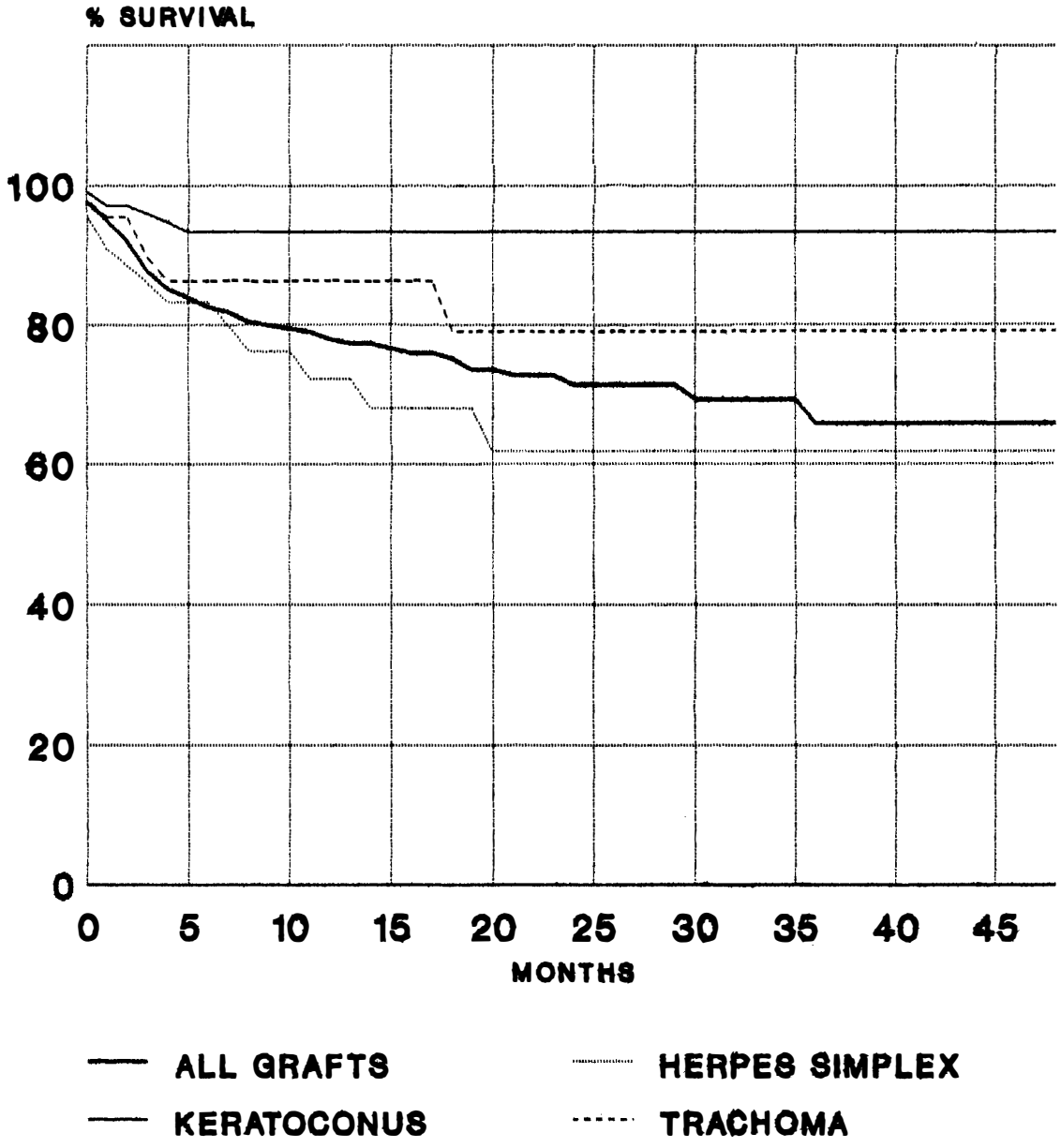

Fig. 1. *Kaplan–Meier survival curves for all the grafts and for the major diagnostic groups.*

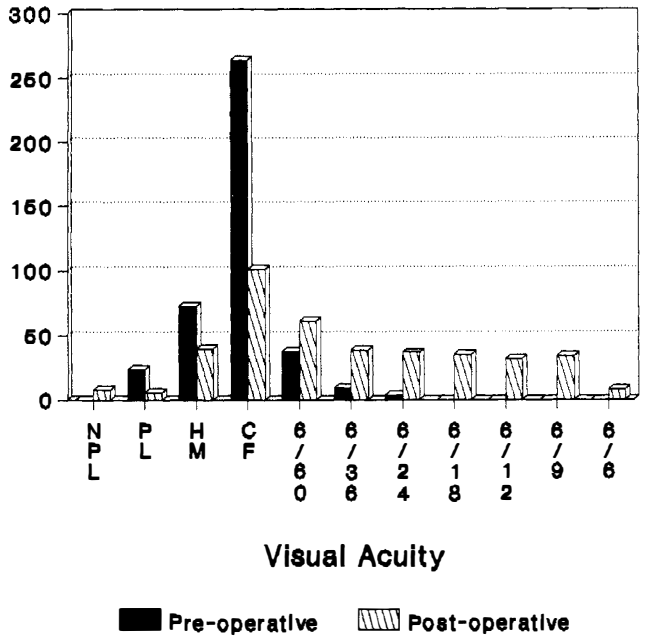

Fig. 2. *The pre-operative and post-operative distributions of visual acuity recorded at the last examination. NPL, No Perception of Light; PL, Perception of Light; HM, Hand Movements; CF, Counting Fingers.*

Palestinians and is similarly relatively less common as an indication for corneal grafting: 0.5% as compared with a range of 6.2%[5] to 23%[13] in other studies.

Graft Clarity

As expected, the success rate in terms of graft clarity varies with the primary diagnosis (Table V). A high rate of graft clarity was obtained both in patients with keratoconus (94.1%) and in those with keratoconus and vernal catarrh (94.4%). In Saudi Arabia, Cameron *et al.*[14] reported 80% graft clarity in a series of 15 grafts in patients with keratoconus and vernal catarrh after a mean follow-up of 19.6 months. The failures were all related to bacterial keratitis in the graft. In this series, patients with vernal catarrh did show a tendency to develop punctate epithelial keratopathy in the graft at times of active vernal disease and 5 such patients developed bacterial ulcers which were treated medically with maintenance of graft clarity. Rejection episodes were also more common among the patients with vernal catarrh but they responded well to prompt steroid treatment. This increased risk of ulceration and rejection among patients with vernal catarrh did not reach statistical significance ($p>0.05$). The excellent prognosis for penetrating keratoplasty in keratoconus is confirmed in this series.

Those patients undergoing keratoplasty for corneal dystrophies, excluding Fuchs' syndrome, also did well, with 95% of the grafts remaining clear at the time of last examination.

Graft clarity was surprisingly good in grafts done for trachomatous corneal scarring (86.6%), considering the poor ocular environment that results from the disease. Treatment of any blepharitis, dry eye or trichiasis is essential before proceeding to keratoplasty and these patients required close supervision to maintain the integrity of the graft epithelium.

Of the grafts performed for herpetic keratitis, 72.7% were clear at the end of this study, a figure which corresponds with those in other studies.[15,16] This number is expected to drop as graft survival in herpes simplex keratitis has been shown to level out only after a mean follow-up of around 6–10 years.[17] Economic reasons preclude the use of long-term systemic acyclovir in these patients.

In contrast, those patients with corneal scarring due to microbial keratitis maintained graft clarity in 61.7% of cases done after medical control of the keratitis and in only 36% when surgery was performed in acutely inflamed eyes. Although in the latter the globe was retained in all cases, in terms of graft survival these results were not as good as those obtained by Hill[18] and Kirkness *et al.*[19] Continuing infection, rejection and glaucoma were the main complications encountered. These patients typically presented late after multiple antibiotic therapy and only rarely was an organism recovered. In the grafts done after control of infection, the main cause of graft failure related to problems with epithelialisation.

Visual Results

Coster[20] has pointed out the difficulties in quantifying the outcome of corneal graft surgery, particularly with regard to its impact on visual disability. His observations are particularly relevant to retrospective analyses of patients operated upon and managed by many surgeons. It is never-

Table IV. Reasons for graft failure

	No.	%
Graft rejection	24	28.6
Infection in graft	17	20.2
Epithelial failure	15	17.9
Glaucoma	11	13.1
Late graft failure	10	11.9
Primary graft failure	5	5.9
Trauma	1	1.2
Cause uncertain	1	1.2
Total	84	100

Table V. Graft clarity according to primary diagnosis

Diagnosis	No.	No. clear grafts	% clear grafts
Keratoconus	156	147	94.2
Microbial keratitis	59	30	50.8
Trachomatous scar	45	39	86.6
Herpes keratitis	44	32	72.7
Regrafts	29	21	72.4
Dystrophies (excluding Fuchs')	20	19	95.0
Trauma	20	17	85.0
Bullous keratopathy	8	6	75.0
Congenital glaucoma	4	1	25.0
Chemical burns	3	1	33.3
Fuchs' dystrophy	2	1	50.0
Limbal dermoid	2	0	00.0
Corneal scar (?cause)	24	18	75.0
Total	416	332	79.8

theless of interest to look at the results in terms of Snellen acuity and to compare these with other published series.

Pre-operative visual acuities ranged from perception of light to 6/24. Following surgery in all patients, including those operations done for tectonic purposes, 27.2% had a visual acuity of 6/18 or better (range No Perception of Light to 6/6). Because of a widespread reluctance to wear glasses for social reasons, a feature also noted by Al Faran in Saudi Arabia,[21] only 215 patients (51.7%) had a post-operative refraction. Among these patients, 46.1% achieved a best-corrected acuity of 6/18 or better, which approaches the results reported in the Australian Corneal Graft Register 1989.[8]

Some diagnostic groups obtained a greater improvement in Snellen acuity. Patients with keratoconus and corneal dystrophies showed the biggest change, with 54.4% having an acuity of 6/18 or better. This figure improves to over 70% if only refracted patients are considered. In contrast, only 24.2% of patients grafted for herpes simplex keratitis and none of the trachoma group achieved 6/18 or better (refracted and unrefracted results combined). The reason for the poor visual results in these two groups could not be clearly identified by a retrospective review of patients' notes and requires further study.

Among 60 patients with corneal grafts, Coster[20] reports an acuity of 6/18 or better in about 65% (48% were keratoconus patients). Claoue *et al.*[7] found 64% of 96 non-keratoconus patients and 100% of 20 keratoconus patients to have a post-operative acuity better than 6/12.

Although visual acuities achieved are less favourable in patients with trachomatous corneal scarring, these must be judged in the light of particularly low levels of pre-operative acuity and the bilateral nature of this blinding disease. Visual acuity of Counting Fingers or worse was recorded in 95% of pre-operative trachomatous eyes, and in 80% of the contralateral eyes. Post-operatively, 54.6% saw 6/60 or better.

Donor Material

All but 3 of the donor corneas were obtained from the United States or the United Kingdom. The use of organ-cultured donor material has been shown to be effective over long distances and has the advantage of allowing greater flexibility in the scheduling of surgery.[22] The majority of the grafts in this series, however, were carried out with donor material stored in short-term or medium-term storage media (Table III). For administrative and transportation reasons, the donor material was often used towards the end if not beyond the recognised storage time limits of the different media. Thus 49% of the grafts were stored in Dexsol and these had a mean storage time of 11.9 days (range 1–27 days). No relationship between storage time, donor age or cadaver time and maintenance of graft clarity was found in this series.

Despite the relatively long overall storage times, the rate of primary graft failure (1.2%) is no higher than in other series. The correlation between endothelial cell loss and donor preservation time is well established[23] and argues for the earliest possible use of the donor corneas. Nevertheless, this series demonstrates the feasibility of using intermediate-term as well as long-term storage media in this setting.

CONCLUSION

Any assessment of these results must be made in the context of a socioeconomic background which does not match that found in Europe or in the United States, from where most reports on corneal grafting originate. Despite sub-optimal conditions, the results in this series confirm the viability of a corneal grafting programme. However, the undiminished need for keratoplasty together with the scarcity of donor corneas and the obstacles to close post-operative supervision, make it imperative that patient selection be stringent.

Selection criteria must be based on the primary aim of restoration of vision rather than achieving binocularity, with priority given to the best prognostic groups. The resources available at present are insufficient to include those with good vision in the contralateral eye. Grafts should be considered only for those with unacceptable acuity in the other eye in patients with herpes simplex or inactive bacterial keratitis, chemical burns and other high-risk groups. Given the very low pre-operative binocular acuities found among patients with trachomatous corneal scarring, the relatively modest visual results obtained after keratoplasty represent considerable improvement in terms of mobility and independence.

A different rationale for surgery applies in the case of tectonic grafts in which, if the globe is not saved, the potential for vision in that eye is permanently lost.

Clearly, the dependence on charitable donation of donor material from outside the region cannot continue indefinitely; a sustained campaign to encourage local organ donation needs to be organised. At the same time, it is evident that much corneal blindness is preventable. Primary health care measures need to be actively promoted in this area with particular emphasis on trauma prevention, correct treatment of lid disease and infection at primary level and prompt referral of those who require specialist care.

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Key words: Infectious keratitis, Keratoconus, Penetrating keratoplasty, Trachoma, Underdevelopment, West Bank/Gaza.

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