

Rotational Autokeratoplasty

PETER J. McDONNELL and MICHAEL G. FALCON

London

Summary

The results of sixteen patients who had undergone ipsilateral rotational autokeratoplasty are presented. Thirteen patients obtained significant visual improvement, and eight patients achieved an acuity of 6/12 or better. There were no significant pre-operative or post-operative complications. The principles of pre-operative assessment and surgery are discussed.

Most corneal transplants performed today are penetrating allografts, but these are not without disadvantages, particularly the long term risks of rejection and endothelial failure which can lead eventually to the post-operative state being worse than the pre-operative; moreover healing of the graft/host interface is protracted because of the essential long term postoperative steroid therapy. In certain situations other forms of corneal transplant surgery may be less hazardous to the patient and at the same time produce a good visual result, and we reported on lamellar grafts in this context a year ago.¹ We now discuss how rotational autokeratoplasty may help in the management of the patient with a limited corneal opacity involving the visual axis. This procedure involves a rotation of the patient's own cornea to move opacity out of the visual axis and replace it with clear cornea. Modern microsurgical techniques have considerably improved the ease with which this may be done, but success depends on careful pre-operative assessment of the patient. It requires exact measurement of the configuration and position of the corneal opacity and the size of the remaining area of clear cornea, to determine whether a rotational graft is feasible, and to locate it precisely.

Because of the relative infrequency of rotational autokeratoplasty, little has been published recently on the visual results following the procedure. We therefore reviewed a group of patients who had undergone this operation at St. Thomas' Hospital since 1981.

Patients and Methods

The records of all patients under the care of MGF who had undergone a rotational autokeratoplasty since 1981 were reviewed. The most recent patients were seen both pre- and post-operatively after the start of the study.

Careful pre-operative assessment consisted of detailed slit-lamp examination with measurements taken of the relative size and position of the corneal opacity and the remaining clear area of cornea using the calibrated variable length slit beam on the Haag Streit slit-lamp. A pre-operative scale drawing of the cornea was then made to facilitate the determination of trephine size and position of the planned rotation. During this planning process we attempted to adhere to the following guidelines.

- (1) Use the maximum area of available clear cornea (this usually meant making the peripheral edge of the graft very near the limbus).

Presented at the Inaugural Congress of the College of Ophthalmologists, April 1989.

Correspondence to: Mr P. J. McDonnell FRCS FCOphth, South Wing Eye Dept., St. Thomas' Hospital, London SE1 7EH.

- (2) Try to ensure that the opacity to be rotated is as near the edge of the graft as possible; this allows maximum movement of the opacity by the rotation and its replacement with the maximum area of clear cornea.
- (3) Make the central edge of the graft at least 3 mm away from the visual axis. This ensures clear cornea at the visual axis and minimises the affect of the suture.
- (4) If possible rotate the opacity under the upper lid.

These criteria usually require a graft of between 8 and 9 mm in diameter and a clear area of cornea of at least 4 mm in diameter.

Where visible the corneal endothelium was carefully assessed, although it was felt that modern microsurgery is sufficiently atraumatic that there should be no significant further endothelial damage from the surgery. Other features assessed included visual acuity, presence of relative afferent pupillary defect, the condition of the iris and lens, and examination of the fundus if this was possible: where no view was obtained a B scan ultrasound examination was performed. As most of these patients had suffered ocular trauma the possibility of extensive posterior segment damage or a retained intraocular foreign body had always to be borne in mind.

All surgery was performed in a similar fashion under general anaesthesia. 7/0 silk overlay sutures were positioned at the start of the

procedure in all cases, and a scleral supporting ring was used whenever the patient was aphakic or when lens surgery was anticipated. The trephine selected on the basis of the pre-operative assessment was used to mark out the area of the cornea that was to be rotated. The trephine mark was deepened vertically, with a Beaver blade no. 7515, almost to Descemet's membrane, then the anterior chamber was entered and the dissection completed with corneoscleral scissors. Any attachment of iris, lens remnants, or vitreous to the back of the cornea was carefully separated using Healon and fine microsurgical scissors. The corneal disc was then lifted out with two fine-toothed forceps and either rotated immediately if no further surgery was planned or placed epithelial surface down in a small dish and covered with Healon while further surgical procedures were performed. These procedures included pupilloplasty, the use of 10/0 prolene suture on a round-bodied needle to close iris defects, extracapsular cataract extraction, insertion of posterior chamber implant, and anterior vitrectomy. The anterior chamber was then filled with Healon and the corneal disc was placed in the rotated position and initially held with the 7/0 silk overlay sutures. Four temporary stay sutures of 10/0 nylon were used to fix the rotated cornea and the overlay sutures were removed. Continuous 10/0 nylon was then used as the definitive suture.

Table I Patient details

Case	Diagnosis	Sex	Age	Best Post-op VA
1	trauma	m	3	—
2	trauma	m	8	6/9
3	trachoma	m	48	6/9
4	trauma	m	40	6/12
5	trauma	m	5	CF
6	trauma	m	25	HM
7	trauma	m	54	6/6
8	trauma	m	30	6/9
9	trauma	f	35	6/24
10	trauma	m	25	6/9
11	trauma	m	12	6/9
12	trauma	m	31	6/18
13	trachoma	m	63	CF
14	trauma	m	20	6/18
15	trauma	m	20	6/18
16	trauma	m	27	6/12

Results

Surgery

Sixteen patients who had undergone rotational autokeratoplasty since 1981 were identified (Table I). Follow-up varied from a minimum of two months to a maximum of 83 months, with a mean of 27 months. Age at the time of surgery ranged from 3 to 63 years with a mean of 24 years. There were fifteen males and one female in the study.

The corneal opacity was due to trauma in fourteen patients and old trachoma in two patients.

The size of the trephine ranged from 7 mm to 10 mm in diameter, with a median size of 8 mm.

All grafts remained clear and 8 patients

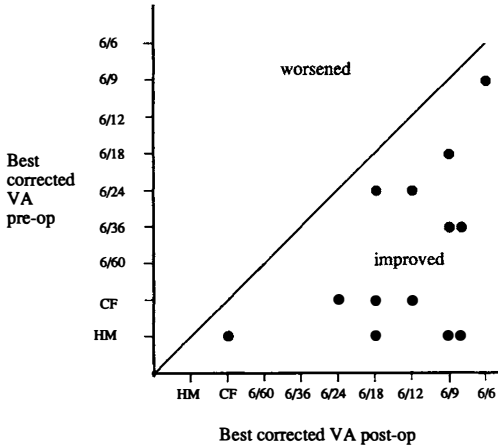


Fig. 1 Graph comparing best corrected pre-operative with best corrected post-operative visual acuity for the thirteen patients in whom it was possible to measure visual acuity. All these patients showed improvement in acuity.

achieved 6/12 or better. Figure 1 shows the best corrected visual acuity with either spectacles or contact lenses before and after surgery: the visual acuity improved in the thirteen patients in whom it could be measured. The details of the post-operative refraction, however, were only available in the records of 6 patients (Table II). Two of these needed no astigmatic correction. The four remaining patients needed cylindrical correction ranging from 1.25 to 4.0 dioptres. All patients except one had additional surgery to the anterior segment at the time the rotational graft was performed (Table III). Four patients needed surgery to adherent iris and lens remnants to fashion a pupil, and a further seven patients needed the placement of iris sutures to close large defects in the iris. Four patients had extracapsular cataract extraction (Fig. 2) and in three of these patients a posterior chamber intraocular lens was inserted. An anterior vitrectomy was required in three patients.

Complications

There were no major complications during the surgery. The post-operative course was remarkably quiet in all cases. Two patients developed a loose suture, one at two months and one at six months after surgery; both sutures were removed without problems.

Most patients had stopped topical steroid therapy by the third post-operative month. There were no problems with post-operative inflammation, graft vascularisation, epithelial defects or raised intraocular pressure.

Discussion

The potential advantages of using the patient's own cornea for corneal transplantation were appreciated early in this century; the procedure could be either ipsilateral or contralateral. The first account of an ipsilateral rotational autokeratoplasty was in 1914.² This procedure was occasionally performed during the first half of this century as either a lamellar or full thickness graft. A number of subsequent authors suggested variations of the basic technique such as a rectangular graft,³ a triangular graft⁴ or a figure-of-eight graft⁵ but none of these suggestions has superseded the standard circular graft.

In the past twenty years there have been only a few reports of rotational autokeratoplasty. Gundersen and Calnan,⁶ Stocker,⁷ Bourne and Brubaker,⁸ and Casey and Mayer⁹ all report rotational grafting in individual or small numbers of cases. There are only two recent papers which report a series of patients who have undergone ipsilateral rotational autokeratoplasty: Naumann, Volker and Gackle¹⁰ who reported fourteen cases, and Groden and Arentsen¹¹ who reported ten cases. The details of all these patients were very similar. Most patients were young males and the corneal opacity was usually due to trauma and there was frequently other anterior segment damage that needed surgical attention. Both series stressed that there were no serious intra-operative or post-operative complications. The visual results were moderately good: in Naumann's series 11 of the 14 cases

Table II Refraction details

Case	Refraction
3	-0.50 DS
7	-4.00 DS/-4.00 DC at 80
8	+1.00 DS/+3.50 DC at 40
9	+5.00 DS/+3.00 DC at 180
11	+10.00 DS/+1.25 DC at 90
12	+1.25 DC

Table III Details of additional surgery

Case	Surgical procedures
1	P
2	IS
3	ECCE, IOL
4	P
5	P
6	no additional surgery
7	IS
8	IS
9	IS, ECCE
10	P, VTY
11	VTY
12	IS
13	ECCE, IOL
14	VTY
15	IS
16	IS, ECCE, IOL

P: pupilloplasty; IS: iris suture; ECCE: extracapsular cataract extraction; IOL: posterior chamber implant; VTY: vitrectomy.

had detailed follow-up and eight of these had significant visual improvement although no refraction details were given. Groden and Arentsen reported visual improvement in eight out of 10 cases and the refraction details in 5 patients were described as comparable to routine penetrating keratoplasty.

The findings in the series of 16 patients that we present are similar to those previously reported. All of our patients except one were male and trauma was the commonest cause of the corneal scarring. All the patients except one needed additional anterior segment surgery. There were no major complications. The two patients who had loose sutures did not develop any other problems and the eyes settled quickly after the suture was removed. The visual results in this present series showed significant improvement in the 13 patients in whom it was possible to assess acuity and 50% of the patients saw 6/12 or better. The three patients in whom significant visual improvement was not documented were cases 1, 5 and 6. Cases 1 and 5 were very young children in whom it was impossible to obtain an accurate visual acuity, but the clinical impression was that the vision had improved. Case 6 had a densely amblyopic eye and the surgery was performed to improve the cosmetic appearance of the eye, a cosmetic shell having failed. The five remaining patients whose vision was

6/18 or worse were cases 9, 12, 13, 14, and 15. Case 9 had reduced vision because of retinal pigment epithelial changes at the macula related to myopia. Cases 12 and 13 had reduced vision because of some residual corneal opacity affecting the visual axis. Case 14 had considerable posterior segment damage and had needed retinal detachment surgery combined with removal of an intraocular foreign body. Case 15 had only recently had surgery and is awaiting fitting of a contact lens. The incidence of post-operative astigmatism did not seem particularly high in this present series although this has been mentioned as a possible problem.⁹

There are a number of important advantages to autokeratoplasty. The most important is that there can be no possibility of rejection of the graft, and this can be a very important factor in some patients. The post-operative course is usually much quieter with less anterior segment inflammation than comparable allograft surgery and the absence of any rejection risk means that little post-operative steroid is required: healing consequently proceeds rapidly and the sutures can be removed earlier; in addition the risk of steroid-induced glaucoma will be minimal. Furthermore, vascularisation of the graft does not seem to occur. Other advantages are that the surgery can be performed as an elective procedure as there is no wait for suitable material, and there is no risk of transmission of infection such as human immunodeficiency virus or hepatitis.

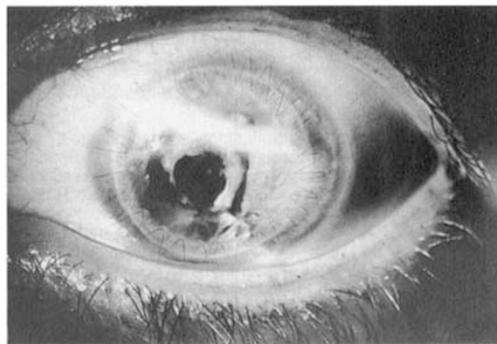


Fig. 2 The post-operative appearance of patient No. 9 who had an extracapsular cataract extraction and placement of an iris suture in addition to the rotational graft.

The main indication for a rotating autokeratoplasty is the presence of a non-progressive central corneal opacity with sufficient remaining clear cornea to allow a successful rotation. The advantages related to the lack of allograft reaction mean that this operation is particularly suited to certain groups of patients: in traumatised eyes with extensive corneal vascularisation, in children or young adults, in those whose follow up is difficult, in only eyes, in patients where one 'safe' eye is required before an allograft in the other eye, and as a low risk procedure to improve the cosmetic appearance of an eye. In many of these patients an acuity of 6/24–6/12 is preferable to the potential 6/6 from a conventional allograft that could become counting fingers if rejection occurs.

Careful preoperative assessment of the cornea is necessary to determine whether a rotational graft is a feasible way of giving a clear visual axis. We have outlined our simple guidelines above. It has been suggested⁸ that a mathematical formula to calculate the best size of graft might be helpful but like other authors¹¹ we have not found this necessary.

A number of new techniques and materials have greatly improved the safety of rotational grafting. The use of viscoelastic substances allows safe manipulation of the cornea and other anterior segment structures, fine prolene suture with a round-bodied needle facilitates repair of iris defects, extracapsular techniques and posterior chamber implants improve the management of lens opacity, and microsurgical cutting/aspiration instruments allow safe management of the vitreous.

This study has shown that ipsilateral rotational autokeratoplasty is a low-risk procedure which is capable of giving substantial visual improvement to the majority of patients who have a localised non-progressive opacity affecting the central cornea. This operation should be especially considered in situations where penetrating keratoplasty using an allograft would have a higher chance of failure than normal. We believe the success rate is maximised by careful preoperative assessment and scrupulous surgical technique.

References

- ¹ McDonnell PJ and Falcon MG: The lamellar corneal graft for optical indications. *Eye* 1988, **2**: 390–4.
- ² Kraupa E: Transposition durch Lappendrehung, eine neue Methode der Keratoplastik. *Zbl Augenh* 1914, **38**: 132–3.
- ³ Mortada A: Rectangular autogenous penetrating keratoplasty. *Am J Ophthalmol* 1965, **59**: 795–9.
- ⁴ Forster AE: A review of keratoplastic surgery and some experiments in keratoplasty. *Am J Ophthalmol* 1923, **6**: 366–75.
- ⁵ Vasco-Posada J: Ipsilateral autokeratoplasty. *Am J Ophthalmol* 1967, **64**: 717–21.
- ⁶ Gundersen T and Calnan AF: Corneal autografts, ipsilateral and contralateral. *Arch Ophthalmol* 1965, **73**: 164–8.
- ⁷ Stocker FW: Rotating autokeratoplasty. *South Med J* 1969, **62**: 1183–4.
- ⁸ Bourne WM and Brubaker RF: A method for ipsilateral rotational autokeratoplasty. *Ophthalmology* 1978, **85**: 1312–6.
- ⁹ Casey TA and Mayer DJ: Corneal Grafting, Principles and Practice. London, WB Saunders 1984.
- ¹⁰ Naumann GOH, Volcker HE, Gackle D: Ipsilaterale Rotations-Autokeratoplastik. *Klin Mbl Augenheilk* 1977, **170**: 488–93.
- ¹¹ Groden LR and Arentsen JJ: Ipsilateral rotating keratoplasty. *Ann Ophthalmol* 1983, **15**: 899–901.