Outcomes of Penetrating Keratoplasty for Macular Corneal Dystrophy

Farid Karimian, MD; Ali-Reza Baradaran-Rafii, MD; Sepehr Feizi, MD
Mohammad Zare, MD; Mohammad-Reza Jafarinasab, MD; Mohammad-Ali Javadi, MD
S. Ali Mirdehghan, MD; Bahram Einollahi, MD

Labbafinejad Medical Center, Shahid Beheshti University, MC, Tehran, Iran

Purpose: To report the outcomes of penetrating keratoplasty (PKP) in patients with macular corneal dystrophy (MCD).
Methods: This retrospective case series includes consecutive patients with MCD who underwent PKP from 1986 to 2006 with at least 6 months' follow-up. Main outcome measures included best spectacle-corrected visual acuity (BSCVA), postoperative astigmatism and graft survival.
Results: Sixty-two eyes of 39 patients with mean age of 34.0±10.5 (range 13-58) years at the time of keratoplasty were included for analysis. After a mean follow-up period of 52.0±47.3 (range 6-190) months, BSCVA improved from 1.4±0.4 logMAR (4/100) preoperatively to 0.2±0.3 logMAR (20/32) at final follow-up (P<0.001). Mean postoperative BSCVA was 0.15±0.40 logMAR in patients (36 eyes) aged less than 35 years at the time of surgery as compared to 0.26±0.25 logMAR in subjects (26 eyes) older than 35 years (P=0.005). Final astigmatism was comparable with different suturing techniques including separate, continuous, and combined sutures (P=0.9). All grafts were clear at final follow-up except a single case of MCD with visually insignificant recurrence. Episodes of immunologic graft rejection occurred in 12 eyes (19.4%) but none led to graft failure.
Conclusion: PKP for MCD entails favorable outcomes in terms of graft survival and visual improvement. Final visual acuity seems to be better when transplantation is performed before the age of 35 years.

Key words: Keratoplasty, Penetrating; Corneal Dystrophies, Hereditary; Graft Rejection

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Correspondence to: Farid Karimian, MD. Associate Professor of Ophthalmology; Ophthalmic Research Center, No. 5, Boostan 9 St., Amir Ebrahimi Ave., Pasdaran, Tehran 16666, Iran; Tel: +98 21 22585952, Fax: +98 21 22590607; e-mail: karimianf@yahoo.com

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INTRODUCTION

Macular corneal dystrophy (MCD) is an autosomal recessive condition and the least common of the three classic corneal stromal dystrophies.[1] However, It is the most common corneal dystrophy leading to penetrating keratoplasty (PKP) in Iran.[2] The reason for the high prevalence of MCD in our country may be a high rate of consanguineous marriages which are still common in rural areas. MCD begins earlier than granular and lattice corneal dystrophies; the corneal opacity starts centrally and superficially during first decade of life and then gradually extends to the posterior and peripheral cornea. Eventually, the opacity involves the entire corneal stroma leading to visual impairment and even blindness.[1,3] In

addition to stromal corneal deposits, the central cornea also becomes typically thin because of collagen fiber compaction[1]. Patients usually need corneal transplantation due to severe visual loss during the third decade of life.[3] Mild and superficial forms of MCD may be treated by superficial keratectomy or phototherapeutic keratectomy,[4] however in advanced cases the definite treatment is penetrating keratoplasty (PKP).[5] Recurrence of MCD in the transplanted cornea is rare but may occur very late.[5] Therefore, the prognosis of corneal transplantation in this dystrophy is better than others.[6] Herein, we report the outcomes of PKP in patients with MCD at Labbafinejad Medical Center, a tertiary referral eye care center in Tehran, Iran.

METHODS

This retrospective case series includes consecutive patients with MCD who had undergone PKP from 1986 to 2006. Medical records of patients were extracted through a computerized filing system based on international classification of diseases (ICD-10).[7] Patients with at least 6 months' follow-up were recalled for an ophthalmologic examination. Subjects with inadequate information and those who did not attend the follow-up examination were excluded.

The diagnosis of MCD was based on clinical findings as previously described[4,8,9] and was confirmed by histopathological examination of the recipient corneal button. Preoperative examinations consisted of determination of refractive error when feasible, best spectacle corrected visual acuity, slitlamp examination, tonometry and dilated fundus examination. Data related to the last examination included uncorrected visual acuity (UCVA), refractive error, best spectacle-corrected visual acuity (BSCVA), intraocular pressure (IOP) and graft clarity. Episodes of endothelial graft rejection during follow-up, graft failure and recurrence of MCD in the transplanted cornea as well as operative data such as trephination size, donor-recipient disparity, suturing technique and intraoperative complications were also recorded.

All patients provided written informed consent preoperatively. Intravenous mannitol serum 20% (1 to 2 mg/kg) was administered preoperatively to lower IOP and vitreous pressure during the operation. PKP was performed under general anesthesia in all cases using a Hessburg-Barron suction trephine (JedMed Instrument Co, St. Louis, Missouri, USA). Circular trephine blades (Storz Ophthalmics, St Louis, Missouri, USA) ranging from 7.5 to 8.5 mm in diameter were used to punch the donor from the endothelial side of the corneoscleral button. The donor button was 0.5 mm oversized in all cases and was sutured to the recipient rim with 10-0 monofilament nylon sutures. Suturing technique consisted of interrupted (16 separate sutures), single running (with 16 bites), and combined (8 separate sutures and a 16-bite running suture). At the end of the operation, subconjunctival gentamicin (20 mg) and betamethasone (4 mg) were injected.

Patients received topical betamethasone 0.1% and sulfacetamide 10% eye drops 4 times a day postoperatively. Antibiotic eye drops were discontinued after complete epithelialization and steroid eye drops were gradually tapered off over 4 months. Selective suture removal was performed for any suture-related problems and for control of astigmatism, based on topography from 4 months onward. Suture removal was completed between 12 and 18 months postoperatively. Postoperative examination were scheduled 1, 2, 3 and 7 days after surgery, every week up to one month, every 2 weeks up to 2 months, monthly up to 4 months, and every 2 months up to complete suture removal. Patients were re-evaluated three months after complete suture removal. Graft survival was defined as the duration of graft clarity or the interval between the first and second graft in case of regrafts.

Mean values were compared using paired (intragroup) or unpaired (intergroup) *t*-tests or ANOVA (for more than two mean values). Frequency values were tested using Chi-square test. Graft survival was evaluated by the Kaplan-Meier method. Significance level was set at $P<0.05$.

RESULTS

Over a 20-year period (from 1986 to 2006), 71 eyes of 45 patients with MCD underwent PKP.

Of these, 62 eyes (53.2% right eyes) from 39 patients (61.5% male) fulfilled the study criteria and were enrolled for data analysis. At least one relative was affected with MCD in 33 (70%) patients while family history was negative in the remaining 30%. Thirty-six (92.3%) patients presented with low vision, 2 (5.1%) cases complained of reduced vision associated with photophobia and one (2.6%) subject suffered from photophobia and ocular pain. MCD was associated with keratoconus in 2 (5.1%) patients. Table 1 demonstrates preoperative patient data.

Table 1 Preoperative patient characteristics

	Mean±SD	Range
Age (years)	34±10.5	13-58
BSCVA (logMAR)	1.40±0.40	1.30-0.48
IOP (mmHg)	12.3±2.6	8-20

SD, Standard deviation; BSCVA, best spectacle-corrected visual acuity; IOP, intraocular pressure.

Table 2 summarizes the findings on final examination. Mean BSCVA improved from 1.4±0.4 logMAR (4/100) preoperatively to 0.2±0.3 logMAR (20/32) postoperatively (P<0.001). Mean postoperative BSCVA was 0.15±0.40 logMAR in patients younger than 35 years (36 eyes) versus 0.26±0.25 logMAR in patients older than 35 years (26 eyes) (P=0.005). These 2 subgroups had no significant difference in terms of spherical equivalent refractive error, refractive astigmatism, keratometric astigmatism and mean keratometry.

Suturing technique was assessable in 54 eyes which included single running in 13 eyes, separate in 21 eyes and combined in 20 eyes. Suturing technique did not affect refractive or keratometric astigmatism: refractive astigmatism was 3.5±1.8 D in the single running group, 3.7±2.4 D in the separate suture group, and 3.4±1.7 D in the combined suturing group (P=0.9).

During the follow-up period, 12 (19.4%) eyes developed episodes of immunologic graft rejection which were endothelial in 6 (50%) eyes, subepithelial in 3 (25%) eyes and combined endothelial and subepithelial in 3 (25%) eyes at the first episode. Graft rejection reactions occurred once in 8 (66.7%), twice in one (8.3%) and 4 times in 3 (25%) eyes. All eyes maintained clear grafts by treatment with topical and/or systemic corticosteroid therapy. Mean interval between PKP and the first rejection episode was 6.1±3.5 (range 2-14) months. There was no correlation between patient age and graft rejection (P=0.33). No significant change occurred in IOP during the follow-up period.

Table 2 Findings on final examination

	Mean±SD	Range
Follow-up (months)	52±47.3	6 to 190
BSCVA (logMAR)	0.2±0.32	1.00 to 0.10
SE (diopters)	-2.25±3.25	-10.75 to +5.75
Refractive astigmatism (diopters)	3.4±2.0	0.0 to 9.0
Keratometric astigmatism (diopters)	4.0±2.7	0.0 to 12.0
Central keratometry (diopters)	45.5±3.3	39.0 to 56.2
IOP (mmHg)	13.3±3	6 to 20

SD, standard deviation; UCVA, uncorrected visual acuity; BSCVA, best spectacle-corrected visual acuity; SE, spherical equivalent; IOP, intraocular pressure.

All except one (98.4%) transplanted corneas remained clear at final follow-up; one eye (1.6%) developed traumatic graft dehiscence and cataract formation 10 years after corneal transplantation. Graft resuturing and cataract extraction together with intraocular lens implantation were performed but after a while, the graft failed. Four eyes underwent keratorefractive surgery for high amounts (>4.0 diopters) of astigmatism. One eye underwent scleral buckling and deep vitrectomy for retinal detachment. Two other eyes received barrier laser treatment for peripheral retinal degenerations. In three eyes, cataract extraction and intraocular lens implantation were performed at the time of PKP.

DISCUSSION

MCD is the least common of the three classic stromal dystrophies. Despite autosomal recessive inheritance, a high prevalence of MCD in Iran can be explained by the considerable rate of consanguineous marriages. In the study by Kanavi et al[2] reporting indications for PKP in Iran over a 10-year period, corneal dystrophies ranked fourth after keratoconus, corneal opacities and scars, and pseudophakic bullous keratopathy. Among corneal dystrophies, MCD was the most common indication for PKP accounting for 3.1% of all PKPs performed in the country. In the current study, mean UCVA improved to 0.6 logMAR (20/80) after PKP, while mean BSCVA improved to 0.2 logMAR (20/32). Therefore it seems that patients with MCD probably enjoy the excellent visual outcomes as other non-vascularized corneal dystrophies such as keratoconus.[10] MCD usually progresses in the second and third decades of life with little risk of amblyopia, therefore the visual outcomes are good. In our study, patients younger than 35 years had better visual acuity as compared to older subjects. One reason for this observation may be age related vitreoretinal changes with a negative impact on vision. Further studies are required to confirm this hypothesis.

Mean postoperative SE refractive error was -2.25±3.25 D; there is no similar study on MCD but considering the results of studies on other types of dystrophies such as the study by Lim et al[10] in which mean SE after PKP for keratoconus was -0.33 D, the amount of myopia in our study seems to be much higher. This finding may be attributed to donor-recipient disparity of 0.5 mm used in our series which could induce myopia. Anteroposterior globe diameter has been shown to be increased in 32 eyes with MCD, but further studies are required to resolve this issue. Factors such as age, sex, donor age, donor size, suturing technique, pre-existing amount of astigmatism and that at the time of suture removal had no effect on final astigmatism in Lim et al[10] study which is in line with our series. It seems that the aforementioned factors have no influence on final astigmatism and visual acuity provided that suture adjustment and selective suture removal are performed properly.

Vail et al[11] studied 2358 corneal grafts and observed that stromal dystrophies ranked second after keratoconus in terms of preservation of graft clarity. Risk factors for loss of graft clarity in the mentioned study included operation before 10 years of age, presence of deep corneal vascularization, and non-optical indications for transplantation. These factors are typically absent in MCD patients and explain the excellent outcomes for PKP in the current series and others.

Recurrence of MCD in transplanted corneas is rare. Marcon et al[12] evaluated 14 eyes of 8 patients over 17 years and reported no case of recurrence. Meyer[6] followed 14 transplanted eyes of patients with MCD for 22 years and reported only 2 cases of recurrence. He concluded that MCD has better prognosis than granular and lattice corneal dystrophies. Akova et al[9] reported 2 cases of recurrence out of 6 corneal transplants and Klintworth et al[13] reported 2 cases of recurrence 18 and 19 years after PKP and lamellar keratoplasty, respectively. Our findings revealed absence of visually significant MCD recurrence in transplanted corneas with mean follow-up period of 52 months which is in accordance with the abovementioned studies.

In conclusion, graft survival is excellent following PKP in patients with MCD, recurrence is rare and visual improvement is significant. Higher age at the time of surgery is associated with less favorable visual outcomes, but does not significantly affect graft survival. Refractive errors after PKP for MCD are skewed toward significant levels of myopia. Suturing technique has no effect on final post-PKP astigmatism as long as selective topography guided suture removal is performed appropriately.

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