Yonsei Medical Journal
Vol. 37, No. 3, 1996

The Effect of Photorefractive Keratectomy in Korea

Hye Young Kim, Eung Kweon Kim, Shin Jung Kang*
Jae Eun Ahn, and Hong Bok Kim

To assess the predictability and accuracy of photorefractive keratectomy (PRK) in myopia, we reviewed the charts of 182 patients who underwent PRK and were followed up for more than 12 months. The mean visual acuity was improved from 0.11 to 0.80 at 12 months postoperatively, and the mean refraction change shows from −7.94D to −0.89D. 47% of the treated eyes achieved final visual acuity of 1.0, and 97% achieved 0.5 or better. In the case of postoperative refraction, 96% of cases who were less than −6 D myopia achieved final refraction within ±1D, while 66% of cases who were more than −6 D myopia did. These results suggest that PRK is a safe and predictable procedure in treating mild to moderate myopia.

Key Words: Photorefractive keratectomy, refractive surgery, myopia

Ophthalmologists have been developing various forms of refractive surgery that alters the corneal curvature. These include astigmatic keratotomy, epikeratoplasty, keratomileusis, keratomileusis in situ, keratophakia and radial keratotomy, but the accuracy and predictability of surgery can be unsatisfactory (Waring *et al.* 1987; Werblin, 1989).

In 1983, Trokel *et al.* first suggested the use of the excimer laser for refractive corneal surgery in animal models. Presently photorefractive keratectomy (PRK) has been widely used for myopic refractive surgery.

Received June 18, 1996
Accepted July 24, 1996
Institute of Vision Research, Department of Ophthalmology, Yonsei University College of Medicine
*Department of Ophthalmology, Inje University, Sanggye Paik Hospital
Supported in part by an intramural research fund (1995) from the Yonsei University College of Medicine
Address reprint request to Dr. E.K. Kim, Institute of Vision Research, Department of Ophthalmology, Yonsei University College of Medicine, CPO Box 8044, Seoul, Korea

The purpose of this study was to assess the predictability and accuracy of PRK. We report herein the clinical results of myopic excimer PRK in 182 patients who received follow-up for more than 12 months.

PATIENTS AND METHODS

We retrospectively analyzed the records of 182 consecutive patients (235 eyes), who underwent myopic excimer laser PRK at Severance Hospital, Yonsei University from Feb. 1993 to Apr. 1994.

All patients underwent complete ophthalmologic examinations, including slit lamp biomicroscopy, manifest refraction, cycloplegic refraction, postcycloplegic refraction and corneal topography. Post cycloplegic refraction was done by one surgeon (EK Kim) who performed every PRK. Cases were subdivided as follows, depending on the preoperative spherical equivalent refraction: group 1, less than −3.00 diopters (D); group 2, from −3.25 to −6.00 D; group 3, from −6.25 to −9.00 D; group 4,

from −9.25 to -12.00 D; group 5, from −12.25 to −15.00 D; group 6, more than −15.25 D.

Before surgery, three drops of 0.5% proparacaine hydrochloride (Alcain®) were instilled for 3 minutes and the lids were retracted with a lid speculum. The epithelium was removed from the central cornea with a Paton spatula about 8 mm in diameter.

The 193-nm excimer laser(Twenty/Twenty Excimer Laser System, VISX, Inc, Sunnyvale, Calif, USA) produced a beam with fluence of 160 mJ/cm², at a firing rate of 5Hz. The laser was calibrated prior to treating each patient. The dioptric change desired for the patient based on the postcycloplegic refraction was entered into the computer that controls the laser. PRK procedure was performed with the guideline of VISX protocol as multipass multizone technique. Ablated areas were 6 mm in diameter. After the ablation, Tarivid, prednisolone ointments and a patch were given until the epithelial defect had healed. After the epithelial regeneration, tobramycin 0.3% eyedrops and prednisolone 0.12% or fluorometholone 0.1% solution were instilled 4 times a day. The frequency was increased or decreased according to the refractive status of the patient and the amount of corneal haziness.

Patients were seen on the first and third day and at the first, third, sixth, nineth and twelfth month respectively. During each follow up examination, uncorrected and corrected visual acuity were measured and slit lamp biomicroscopy was taken.

We graded the density of fibrin formation on the surface of the keratectomy at the first postoperative day.

Table 1. Age distribution

Age	Frequency(%)
20~29	161(68.2)
30~39	59(25.4)
40~49	8(3.4)
50~59	7(3.0)
Total	235(100.0)

Table 2. Groups according to preoperative spherical equivalent refraction

Group	Refractive errors(D*)	No. of eyes(%)
1	−0.50~−3.00	13(5.9)
2	−3.25~−6.00	71(30.5)
3	−6.25~−9.00	67(28.4)
4	−9.25~−12.00	50(21.2)
5	−12.25~−15.00	30(12.7)
6	−15.25~	3(1.3)
Total		234(100.0)

*: diopters

RESULTS

We reviewed the records of 182 patients (235 eyes) who were followed-up for more than 12 months. Of the 182 patients, 58 (72 eyes) were male and 124 (163 eyes) were female patients. The average age was 29 years (range: 20~57, Table 1).

Preoperative visual acuity ranged from 0.01 to 0.90 (mean ± SD, 0.11 ± 0.08) and the best corrected visual acuity ranged from 0.10 to 1.00 (mean ± SD, 0.90 ± 0.16). Preoperative refractive error ranged from −0.50 to −16.75

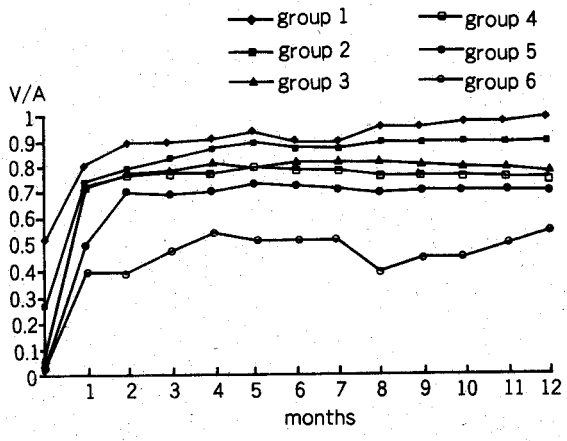

Fig. 1. *Changes of uncorrected visual acuity after PRK.*

Table 3. Changes of mean uncorrected visual acuity after PRK

Group	7 days	1 mon	2 mon	3 mon	4 mon	5 mon	6 mon	8 mon	12 mon
1	0.82	0.87	0.90	0.90	0.91	0.94	0.90	0.96	1.00
2	0.75	0.78	0.80	0.84	0.88	0.90	0.88	0.90	0.91
3	0.71	0.78	0.78	0.79	0.82	0.80	0.82	0.82	0.79
4	0.72	0.73	0.77	0.78	0.78	0.80	0.79	0.77	0.76
5	0.50	0.71	0.71	0.70	0.71	0.74	0.73	0.70	0.71
6	0.40	0.40	0.40	0.48	0.55	0.52	0.52	0.40	0.55
mean	0.73	0.76	0.78	0.79	0.80	0.81	0.81	0.80	0.80

Table 4. Changes of mean refractive error(diopters) after PRK

Group	7 days	1 mon	2 mon	3 mon	4 mon	5 mon	6 mon	8 mon	10 mon	12 mon
1	−0.06	−0.19	−0.16	−0.02	−0.10	−0.37	−0.20	−0.31	−0.45	−0.37
2	+0.22	−0.01	−0.16	−0.23	−0.28	−0.36	−1.05	−0.23	−0.33	−0.41
3	−0.11	+0.02	−0.35	−0.56	−0.40	−0.67	−0.52	−0.60	−0.54	−0.93
4	+0.36	−0.04	−0.53	−0.73	−1.10	−1.02	−0.74	−1.03	−0.68	−1.13
5	+0.30	+0.15	−0.41	−0.91	−0.61	−0.92	−1.35	−1.10	−1.45	−1.71
6	+0.08	+0.08	−0.88	−3.00	−1.88	−2.50	−2.00	−2.50	−2.61	−2.63
mean	+0.10	+0.01	−0.33	−0.53	−0.54	−0.68	−0.66	−0.67	−0.59	−0.89

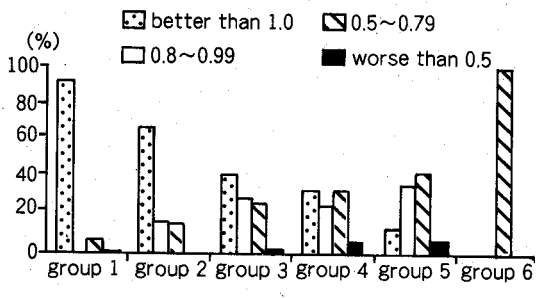

Fig. 2. *Distributions of uncorrected visual acuity at postoperative 12 months.*

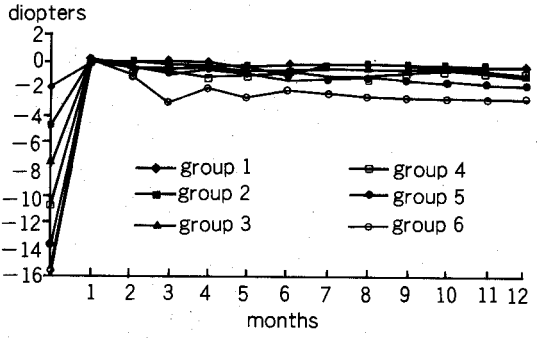

Fig. 3. *Changes in refractive error after PRK.*

D (mean ± SD, −7.94 3.39 D, Table 2). In all cases, the corneal epithelial regeneration was completed within the third postoperative day and no problems associated with the epithelial regeneration developed.

As shown in Table 3, the mean visual acuity was improved from 0.11 to 0.80 at 12 months postoperatively (Fig. 1). 47% of the eyes studied achieved visual acuity of 1.0, and 97% achieved visual acuity of 0.5 or better by the 12 month follow-up visit. In group 1, all patients but 1 had visual acuity of 1.0 (Fig. 2).

The mean refractive error shows from −7.94 D preoperatively to −0.89 D at 12 months postoperatively (Fig. 3, Table 4). Fig. 4 shows the distribution of refractive error at 12 months. The proportions who have final refraction within 1D were 100% (group 1), 81.7 % (group 2), 56.7% (group3), 36% (group 4), 37% (group 5) and 0% (group 6) respectively(Table 5). The predictability of PRK in our series is

Table 5. Distribution of patients according to postoperative refractive errors

Group	≤ ±0.5 D*	±0.75~±1 D*	±1.25~±2 D*	±2.25~3 D*	≥ ±3 D*
1	13	1	0	0	0
2	58	9	3	1	0
3	38	15	9	4	1
4	18	13	12	5	2
5	11	7	4	0	8
6	0	0	1	2	0
Total	138	45	29	12	11

*: diopters

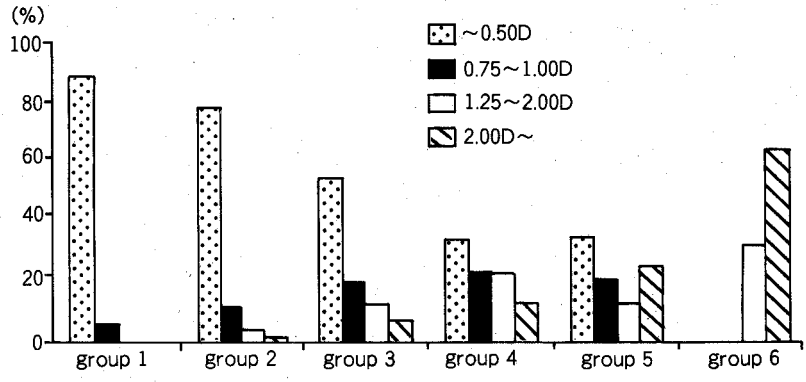

Fig. 4. *Distribution of refractive error at postoperative 12 months.*

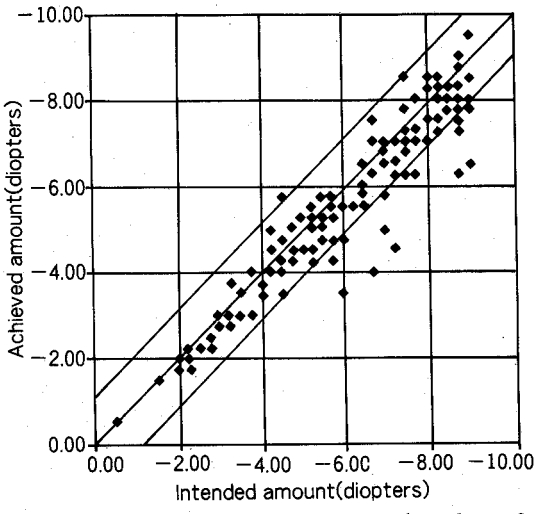

Fig. 5. *Predictability in myopia patients less than - 9 diopters.*

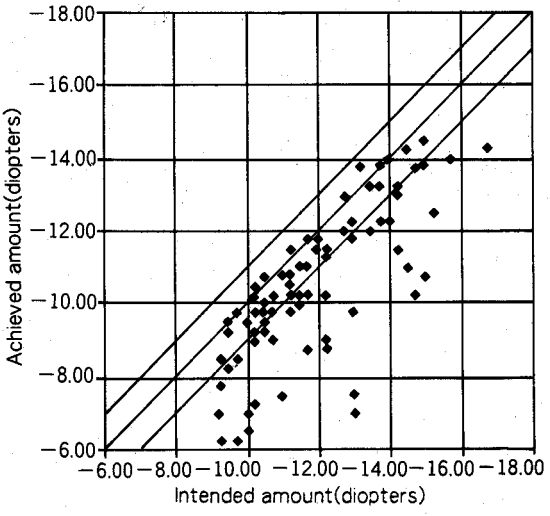

Fig. 6. *Predictability in myopia patients more than - 9 diopters.*

demonstrated in Fig. 5 and 6. In all cases, 138 eyes (59%) were within ± 0.5D and 183 eyes (77.9%) were within ± 1.0D. 96% of the cases who were less than −6 D myopia (groups 1 and 2) achieved final refraction within ± 1D, while 66% of the cases who were more than −6 D myopia (groups 3, 4, 5 and 6) did.

The degree of fibrin formation had no statistically significant association with myopic regression ($p > 0.05$).

DISCUSSION

PRK is known to be accurate and safe refractive surgery since the excimer laser causes precise ablation of corneal tissue without thermal damage.

Seiler *et al.* (1992) reported the visual acuity of PRK at 1 year follow up visit; they achieved the final visual acuity of more than 0.5 in 96%, and more than 1.0 in 48% of their cases. This study has had similar results.

McDonald *et al.* (1987) and Sher *et al.* (1991) stated that the refractive change after PRK shows a unique pattern whereby the eyes are overcorrected by 1 week and then regressed slowly until the third to the sixth postoperative months. In our series, the mean refractive change shows + 0.1 D at postoperative 7th day and then is regressed to less than −1 D in group 1, 2 and 3. Refractive changes after PRK is caused by several factors. Corneal wound healing leads to the contraction of subepithelial fibrous tissues, and this process causes the thin cornea to protrude anteriorly. Elevated IOP which is related to the steroid therapy, is another factor.

Trokel *et al.* (1983) and Del pero *et al.*(1988) reported that the pseudomembrane, which appeared on the surface of keratectomy at the first postoperative day, has an important role in the epithelial healing mechanism along with fibronectin which appeared at the third postoperative week. The results of this study show that the density of the pseudomembrane has no relationship with the degree of postoperative myopic regression.

Seiler and Wollensak (1991) reported the refreactive error, within ± 1D in 92%, and within ± 0.25 D in 58% at postoperative 12 months. Lee *et al.* (1994) reported the refractive error within ± 1 D in 66.7%, and within ± 2 D in 79.5%, while the patients whose preoperative refractive errors more than −10 D shows within ± 1 D in only 18.2%. Lee *et al.* (1993) reported the results of excimer PRK in patients with high myopia more than −6.25 D. The cases were subdivided into groups with moderate high myopia (−6.25 to −10.00 D) and high myopia (more than −10.00 D). 56% of moderate high myopia patients had the postoperative refractive errors within ± 1 D, while 25% of high myopia patients did. In this study, 96% of groups 1 and 2 (less than −6.00 D) were within 1 D and 66% of groups 3, 4, 5 and 6 (more than −6.00 D) were within 1 D.

In comparison with others, we achieved good results in the high myopia group although high myopia patients had more regression than the low to moderate myopia patients. We suppose that steroid therapy is one of the factors but have not proven it.

In conclusion, though excimer laser PRK is accurate refractive surgery, the myopic regression, particularly in high myopia patients, is still an unsolved problem. Additional study will be needed for the effects of steroid therapy on myopic regression.

REFERENCES

Del pero RA, Tayler DM, Roberts AD: Human excimer laser lamellar refractive keratectomy: A clinical study. *Invest Ophthalmol Vis Sci 29 (suppl): 281, 1988*

Lee DK, Koo KL, Song KY, Lee HY: Photorefractive keratectomy by excimer laser for the correction of myopia. *J Korean Ophthalmol Soc 34: 1213-1220, 1993*

Lee JK, Choi WS, Choi YI: Excimer laser PRK for high myopia. *J Korean Ophthalmol Soc 35: 927-934, 1994*

McDonald MB, Beuerman R, Falzone W: Refractive surgery with the excimer laser. *Am J Ophthalmol 103: 469-471, 1987*

Seiler T, Derse M, Pahm T: Repeated excimer laser treatment after photorefractive keratectomy. *Arch Ophthalmol 110: 1230-1233, 1992*

Seiler T, Wollensak J: Myopic photorefractive keratectomy with the excimer laser, one-year follow-up. *Ophthalmology 98: 1156-1163, 1991*

Sher NA, Varda C, Bowers RA, Frantz JM, Brown DC, Eiferman R, Lane SS, Parker P, Ostov C, Doughman D, Carpel E, Zabel R, Gothard T, Lindstrom RL: The use of the 193-nm excimer laser for myopic PRK in sighted eyes. A multicenter study. *Arch Ophthalmol 109: 1525-1530, 1991*

Trokel SL, Srinivasan R, Braren B: Excimer laser surgery of the cornea. *Am J Ophthalmol 96: 710-715, 1983*

Waring GO III, Lynn MJ, Culbertson W: Three-year results of the prospective evaluation of radial keratectomy(PERK) study. *Ophthalmology 94: 1339-1354, 1987*

Werblin TP: Lamellar refractive surgery; where have we been and where are we going? *Refract Corneal Surg 5: 167-178, 1989*