

# A Comparison of Photorefractive Keratectomy and Radial Keratotomy in Low Myopia : One-year Results

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*The aim of this study is to compare the efficacy and predictability of photorefractive keratectomy (PRK) and radial keratotomy (RK) in low myopia. This study consisted of 40 eyes of 24 patients that were divided into two groups. In group I, comprising 20 eyes, was performed excimer laser photorefractive keratectomy using the Summit excimer laser with a 6.0-mm diameter ablation zone. In group II, comprising 20 eyes, was performed 4 or 6 incisions of radial keratotomy. The range of preoperative myopia was from -1.75 diopters (D) to -3.75 D with astigmatism less than -1.0 D in both groups. At 1 year, the mean refraction was  $-1.02 \pm 0.99$  D (range, -0.12 to -3.25 D) in group I, and  $-1.25 \pm 0.68$  (range, -0.37 to -1.87) in group II. One year postoperatively, in the PRK group, uncorrected visual acuity was 20/40 or better in 95%, 20/25 or better in 65% of eyes, and in 30% of eyes were within  $\pm 0.50$  D of emmetropia, 70% of eyes were within  $\pm 1.0$  D of emmetropia. In the RK group, 75% of the eyes achieved uncorrected visual acuity of 20/40 or better, 45% achieved uncorrected visual acuity of 20/25 or better, and 20% of eyes were within  $\pm 0.50$  D of emmetropia, 55% of eyes were within  $\pm 1.0$  D of emmetropia. No statistically significant differences were detected between two groups in achieved refractive results and visual acuity ( $p > 0.05$ ). One eye in RK group lost two or more lines of spectacle-corrected visual acuity. It was detected that PRK and RK are both effective refractive procedures and give almost similar results in low myopia up to -3.75 D. [Journal of Turgut Özal Medical Center 1997;4(1):63-66]*

**Key Words:** Excimer laser, myopia, photorefractive keratectomy, radial keratotomy

## Düşük dereceli miyopide fotorefraktif keratektomi ve radial keratotominin bir yıllık sonuçlarının karşılaştırılması

*Bu çalışmanın amacı düşük dereceli miyopide fotorefraktif keratektomi (PRK) ile radial keratotomi (RK)'yi etkinlik ve tahmin edilebilirlik bakımlarından karşılaştırmaktır. Bu çalışma kapsamına alınan 24 hastanın 40 gözü iki gruba ayrıldı. Grup I'deki 20 göze 6.0-mm ablasyon zonlu ve summit excimer laser kullanılarak PRK, grup II'deki 20 göze ise 4 ve 6 insizyonlu RK uygulandı. Preoperatif miyopi dereceleri -1.75 dioptri (D) ile -3.75 arasında değişiyordu ve hiçbir gözde 1.0 D'den fazla astigmatizm mevcut değildi. Birinci yılda elde edilen ortalama refraksiyon grup I'de  $-1.02 \pm 0.99$  D, (-0.12 ve -3.25 D arası) ve grup II'de  $-1.25 \pm 0.68$  D (-0.37 ile -1.87 D arası) idi. PRK grubunda 1. yılın sonunda 5/10 üzerindeki tashihsiz görme oranı %95, 8/10 ve üzerinde ise %65 idi. Yine bu grupta  $\pm 0.50$  D emetropi amacına ulaşılan göz oranı %30,  $\pm 1.0$  D emetropi için ise %70 olarak tespit edilmiştir. RK grubunda ise 5/10 üzerinde tashihsiz görme keskinliğine sahip olma oranı %75, 8/10 ve üzerinde ise %45 olarak tespit edilirken, bu gruptaki  $\pm 0.50$  D başarılan emetropi oranı %20,  $\pm 1.0$  D emetropi oranı ise %55 olarak bulunmuştur. Her iki grup arasında ulaşılan refraktif sonuçlar açısından istatistiki anlamlı farklılık tespit edilmedi ( $p > 0.05$ ). RK yapılan gözlerden birinde iki sıra ve üzerinde tashihli görme kaybı olmuştur. Hem PRK hem de RK'nın -3.75 D'ye kadar olan dereceli düşük miyopilerde yaklaşık aynı refraktif sonuçları veren etkili refraktif cerrahi prosedür olduğu sonucuna ulaşıldı. [Turgut Özal Tıp Merkezi Dergisi 1997;4(1):63-66]*

**Anahtar Kelimeler:** Excimer laser, fotorefraktif keratektomi, miyopi, radial keratotomi

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Radial keratotomy (RK) is still one of the most effective refractive procedures for correcting myopia and is believed to have a place in today, as well as in the future for certain diopters of myopia (1,2).

Some earlier studies (3-5) showed that both methods have almost the same degree of efficacy in low to moderate myopia. Salz and colleagues (3) have published that 93% of the eyes achieved uncorrected visual acuity of 20/40 or better and 88% of them were corrected to within  $\pm 1.0$  D of emmetropia after excimer laser PRK. Mc Donald et al. (4) found that 57% of the eyes were corrected to within  $\pm 1.0$  D of emmetropia with uncorrected visual acuity of 20/40 or better in eyes with less than 5.0 D of myopia following PRK. In the other study concerning radial keratotomy, Salz et al. (5) reported uncorrected visual acuity of 20/40 or better in 100% for eyes in low myopia group up to 3.0 D and 97% were within  $\pm 1.0$  D of emmetropia.

In this paper, we compared one-year refractive results of excimer laser photorefractive keratectomy and radial keratotomy in low myopia.

## MATERIALS AND METHODS

It was conducted a study of 40 eyes of 24 patients between January 1995 and August 1995. The patients were divided into two groups according to refractive methods. Group I contained 20 eyes with a manifest spherical equivalent (SE) refraction ranging from -1.75 D to -3.75 D (mean,  $-3.09 \pm 0.49$  D) underwent to PRK using OmniMed excimer laser (Summit Technology Inc., Waltham, Mass.). Group II contained 20 eyes with a manifest refraction ranging from -1.87D to -3.75 D; (mean,  $-3.04 \pm 0.59$  D) underwent 4 or 6 incisions RK. There were 8 women, and 4 men in group I, 7 women, and 5 men in group II. Mean age of the patients was 26.6 years (range, 20 to 46 years) in group I, 26.7 (range, 22 to 33 years) in group II. Informed consent was obtained from all cases. Inclusion criteria for participation in both groups were age of at least 21 years, myopia ranging between -1.75 D and -3.75 D (SE), astigmatism 1.0 D or less, stability of refraction for at least 1 year, absence of ocular disease such as glaucoma, and diabetes. All the patients with contact lenses were requested to discontinue use for at least 2 weeks prior to preoperative examination and surgery. Preoperative and follow up examinations including

a detailed ophthalmologic examination, manifest and cycloplegic refraction, uncorrected visual acuity, slit-lamp microscopy, applanation tonometry, dilated fundus examination, keratometry, pachymetry, and corneal topographic analysis (Tomey TMS) were performed. In PRK group, the epithelium was removed using a Beaver blade and than excimer laser was performed using a fluence of 160 mJ/cm<sup>2</sup>, repetition rate of 5 Hz, and ablation zone diameter of 6.00 mm. In group II, the 4 or 6 radial incisions were performed with the conventional centripetal technique by one surgeon. Casebeer nomogram was used for RK patients. Our reoperation criteria was manifest cycloplegic residual myopia more than -1.25 D at 6 months. Reoperation involved centripetally extending the already existing radial incisions to a smaller optical zone (maximum 3.0 mm). Postoperatively tobramycin drops were instilled into the eye four times a day for 1 week in eyes underwent RK and four times a day until reepithelization in eyes underwent PRK. After reepithelization in PRK group, fluoromethalone drops was started topically four times a day for a month and then tapered and discontinued within 3 months. The follow up period was 1 year.

$X^2$  -test was used to compare differences between two groups. A p-value of  $<0.05$  was considered significant.

## RESULTS

The mean preoperative manifest spherical equivalent refraction was  $-3.09 \pm 0.49$  D (range, -1.75 to -3.75 D) in group I, and  $-3.04 \pm 0.59$ D (range, -1.87 to -3.75 D) in group II. Mean uncorrected spherical equivalent refraction was  $-1.02 \pm 0.99$  D (range, -0.12 to -3.25 D) in group I, and  $-1.25 \pm 0.68$  D (range, -0.37 to -1.87 D) in group II at 1 year postoperatively. Preoperatively, no eyes had uncorrected visual acuity of 20/25 or better and 20/40 or better in group I, no eye had uncorrected visual acuity of 20/25 or better, 1 eye (5%) had 20/40 or better in group II. One year after surgery, 13 eyes (65%) and 19 eyes (95%) of group I was seeing 20/25 or better and 20/40 or better uncorrected, respectively (Table 1). The uncorrected visual acuity was 20/25 or better in 9 eyes (45%) and 20/40 or better in 15 eyes (75%) at the 1-year postoperative examination in group II (Table 2). One year postoperatively, 6 eyes (30%) were within  $\pm 0.50$  D of emmetropia, and 14

eyes (70%) were within  $\pm 1.0$  D of emmetropia in group I (Table 3). In group II, 4 eyes (20%) were within  $\pm 0.50$  D of emmetropia and 11 eyes (55%) were within  $\pm 1.0$  D of emmetropia (Table 3). The difference between two groups in obtained uncorrected visual acuity of 20/25 or better and 20/40 or better postoperatively was not statistically significant ( $\chi^2=0.91$ ,  $p>0.05$  and  $p=0.181$ ). Likewise, no statistically significant differences were detected in  $\pm 0.50$  D and  $\pm 1.0$  D of emmetropia postoperatively ( $\chi^2=0.13$ ,  $p>0.05$  and  $\chi^2=0.43$ ,  $p>0.05$ ), respectively. No reoperation was present in PRK, while the reoperation rate in RK was 5% (1 eye). One eye underwent RK lost two spectacle-corrected Snellen lines. Neither of eyes was noted any complications such as corticosteroid-induced ocular hypertension, keratitis, persistent epithelial defect.

## DISCUSSION

Both refractive procedures have been accepted as effective and safe methods to correct low degrees of myopia (6,7). Previous studies (8-10) showed fairly close refractive outcomes between PRK and RK. Therefore, it is believed that PRK and RK will compete for treatment of myopia up to 3.0 or even 4.0 D in the future. Gartry *et al.* (8) reported 18-

month follow up results of PRK from 120 patients with myopia of 4.0 D or less, patient satisfaction and predictability were very high compared to moderate to high myopia. 2.0 to 3.0 D and 95% to 70% of eyes, respectively, were within  $\pm 1.0$  D of intended refraction. Jory (9) found that 99% of patients were seeing 6/12 or better in the low myopia group following RK. In the other RK study, Salz and coauthors (10), found uncorrected visual acuity of 20/40 or better in 82% eyes, and 90% of them corrected within  $\pm 1.0$  D of emmetropia. In the retrospective comparison of excimer PRK and RK, performed by Hong *et al.* (6), obtained results in the low to moderate myopia were almost equal to each other. In this study, 94% of the eyes saw 20/40 or better uncorrected, 86 of the eyes had a refraction within  $\pm 0.50$  D of emmetropia in the PRK group. In the RK group, 92% of the eyes saw 20/40 or better uncorrected, and 86% of the eyes had a refraction within  $\pm 0.50$  D of emmetropia.

Excimer laser PRK is much preferable technique in moderate myopia (3.0 to 6.0 D) compared to radial keratotomy (2). After 6.0 D, there are some concerns about the predictability and safety of both PRK and RK (11,17). Radial keratotomy gives considerably less effective results in high myopia, thus it is not preferable in this range. In one study performed by Bauberberg *et al.* (11) it was found that 38% of the eyes achieved uncorrected visual acuity of 20/40 or better in high myopia. Photorefractive keratectomy is also not recommended for high myopia due to some unwanted complications such as regression, subepithelial scarring, unpredictability, and in terms of efficacy (12-17). Tengroth *et al.* (13) and Ditzen *et al.* (14) reported more common regression in higher myopes greater than 5.0 D. In the large series study of Brancato *et al.* (15) which were carried out in 1165 eyes, it has been pointed out that the predictability was better up to 6.0 D of myopia than above this numbers of diopters.

In the present study, we compared the refractive results of PRK and RK in low myopia of 1.75 to 3.75 D. In our study, 13 (65%) of the eyes achieved uncorrected visual acuity of 20/25 or better, 19 (95%) of the eyes achieved uncorrected visual acuity of 20/40 or better at 1 year in eyes underwent PRK. Seventy percent (14 eyes) of the eyes in this study was within  $\pm 1.0$  D

**Table 1.** Refractive results of photorefractive keratectomy in 20 eyes

Visual acuity	Preoperative No. of eyes (%)	Uncorrected No. of eyes (%)	Corrected No. of eyes (%)
20/20 to 20/25	0	13 (65)	19 (95)
20/30 to 20/40	0	6 (30)	1 (5)
20/50 to 20/200	11 (55)	1 (5)	0
20/200 or worse	9 (45)	0	0

**Table 2.** Refractive results of radial keratotomy in 20 eyes

Visual acuity	Preoperative No. of eyes (%)	Uncorrected No. of eyes (%)	Corrected No. of eyes (%)
20/20 to 20/25	0	9 (45)	16 (80)
20/30 to 20/40	1 (5)	6 (30)	3 (15)
20/50 to 20/200	9 (45)	5 (25)	1 (5)
20/200 or worse	10 (50)	0	0

**Table 3.** Comparison results of photorefractive keratectomy and radial keratotomy

Achieved VA*	PRK No. of eyes (%)	RK No. of eyes (%)
20/25 or better	13 (65)	9 (45)
20/40 or better	19 (95)	15 (75)
$\pm 0.50$ D (SE)	6 (30)	4 (20)
$\pm 1.0$ D (SE)	14 (70)	11 (55)

\* = visual acuity

of the intended correction, 30% (6 eyes) of the eyes was within  $\pm 0.50$  D of the intended correction. In the RK group, 9 (45%) of the eyes achieved an uncorrected visual acuity of 20/25 or better, 15 (75%) of the eyes achieved an uncorrected visual acuity of 20/40 or better at 1 year. Fifty-five percent (15 eyes) was within  $\pm 1.0$  D of the intended correction, 20% (4 eyes) of the eyes was  $\pm 0.50$  D of the intended correction. Differences between two groups were not statistically significant ( $p>0.05$ ).

In conclusion, our study has shown considerably close refractive results between PRK and RK methods in the low myopia up to 3.75 D. Our results supported earlier studies (7-11) indicated that radial keratotomy is still effective and a safe procedure in the treatment of low degrees of myopia.

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