

PHOTOREFRACTIVE KERATECTOMY IN MYOPIC ASTIGMATISM†

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SUMMARY :

Purpose: To assess the results of photorefractive keratectomy (PRK) in compound myopic astigmatism. **Methods:** PRK was performed in 89 eyes with myopic astigmatism by using Aesculap Meditec Mel 60 laser. Eyes were grouped in two according to preoperative total refractive error. Eyes with preoperative total refractive error below -6.00 D were included in group 1 and those above -6.00 D were included in group 2. Mean preoperative sphere was -3.14 ± 1.17 D in group 1 and, -6.88 ± 1.53 D in group 2. Mean preoperative cylinder was -1.40 ± 0.77 D in group 1 and, -1.76 ± 0.83 D in group 2. Pre and postoperative visual acuity, refraction, corneal topography, intraocular pressure and slit lamp findings were recorded for all patients. **Results:** Postoperative results were assessed after 4-23 (mean: 9.2 ± 4.2) months follow up period. In group 1, mean postoperative sphere was -0.01 ± 0.08 D and, mean cylinder was -0.02 ± 0.12 D. Emmetropia was achieved in 91.6% of cases and no line loss of best-corrected vision was observed in this group. In group 2, however, mean postoperative sphere was -0.34 ± 1.35 D and, mean cylinder was -0.14 ± 0.52 D. Emmetropia was achieved in 62.2% of cases and there was line loss of best-corrected visual acuity in 8 eyes (15%) (2 eyes because of haze and others because of decentration). **Conclusion:** In this study we observed that myopic astigmatic PRK results are similar to myopic PRK results in that haze and myopic regression increase in concordance with total ablation depth. The PRK results in eyes with total refractive error below -6.00D are very satisfactory.

Key Words: Astigmatism, Myopia, Laser Surgery.

INTRODUCTION

It was shown by many authors that myopic astigmatism can be treated successfully with photorefractive keratectomy (PRK), as well as simple myopias (1-5). Myopic correction is achieved by radial symmetrical ablations which flattens the central cornea and astigmatic correction is possible with special masks which is

used for toric ablations.

Dausch has shown that hyperopic and mixed astigmatism can also be treated successfully with PRK (6).

In this study, PRK was performed in 89 eyes with compound myopic astigmatism and the results of lower and higher dioptric ablations are

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compared.

PATIENTS AND METHODS

This study was based on 89 myopic astigmatic PRK procedures performed between March 1995 and October 1996 at Gazi University Medical Faculty Ophthalmology unit. Our patient selection criteria included ; age 20 years old or older, the refraction stable for at least 12 months, the cornea free of topographic anomalies like keratoconus, contact lens warpage, superior ectasia and any history of keloid.

Patients were first informed about the procedure and prognosis of PRK and then, generally one eye was treated first. Fellow eyes were treated one month later in patients with a favorable initial outcome and the desire to have the other eye treated. PRK was performed on both eyes at one session in 11 of 78 patients (%14.1) upon the patient's request. Patients with total spherical and cylindrical refractive errors above -6.00 D were informed about the risks and complications of the procedure and had the laser treatment of their own desire.

Eyes were grouped in two according to preoperative total refractive error. Eyes with preoperative total refractive error below -6.00 D were included in group 1 and those above -6.00 D were included in group 2. The mean cylindrical and spherical values for both groups are shown in table 1. Preoperative sphere ranged between -1.00 and -5.00 D (mean: -3.14 ± 1.17 D) in group 1 and between -3.50 and -10.00 D (mean: -6.88 ± 1.53 D) in group 2. Preoperative cylindrical values ranged from -0.50 to -3.50 D (mean -1.40 ± 0.77 D) in group 1 and from -1.00 to -4.00 D (mean -1.76 ± 0.83 D) in group 2. Thirty six of 89 eyes were in the group 1 and the remaining 53 were in group 2.

Preoperative best-corrected visual acuity was 8/10 or lower in 36 eyes, because of ambliopia, myopic degenerative changes or minifying effect of myopic glasses.

All patients were instructed to use topical nonsteroidal antiinflammatory drops (Diclophenac Na 4 times daily) and oral Vitamin E tablets (atocopherol 500 mg tablet) one day before the operation. We performed PRK with 193 nm excimer laser (Aesculap Meditec, Mel 60, Jena, Germany). The fluence at the cornea was 250 mj/cm², with a repetition rate of 20 Hz. Following

topical anesthesia with oxybuprocain, patients were asked to focus on the target light mounted inside the laser microscope. The corneal center was pointed and 6 mm of central corneal epithelium was removed mechanically by means of a Kimura spatula. A suction probe was fixed to the eye to prevent involuntary eye movements during the procedure. The laser operated on slit mode, each slit corresponding to 1 μ of ablation level. A special rotating mask designed for composed myopic astigmatism, having a bow tie shaped opening, was placed on the appropriate meridian so as to increase ablation depth in that desired meridian. Consequently a toric ablation zone was obtained.

A few drops of tobramycin were instilled after completion of ablation and a thin layer of viscoelastic substance was applied over the cornea before the placement of a therapeutic contact lens. The application of a therapeutic contact lens instead of patching allowed patients to go on with their social activities and made bilateral applications possible. All patients received topical tobramycin 7 times/day, nonsteroidal antiinflammatory drops (diclophenac-Na) 4 times/day, Vitamin-E tablet (atocopherol) 500mg/day and oral analgesics (naproxen-Na tablet) as needed postoperatively until the completion of reepithelization. They were all given information about the therapeutic contact lens on their eyes. Reepithelization was completed by the fourth postoperative day in all patients and the contact lenses were then removed. After completion of reepithelization all other topical drugs were stopped and fluorometholone was prescribed 7 times/day. Fluorometholone was tapered slowly and stopped by the sixth month in most patients.

All patients had a full ophthalmic examination preoperatively and they were examined for visual acuity, tonometry, haze, and topographic changes at postoperative visits. After completion of reepithelization patients were examined at the first week, first month, 2nd month, 4th month, 6th month and 12th month and yearly thereafter.

Table - 1 : Preoperative mean refraction values.

| | Group 1 | Group 2 |
|----------------|--------------------|--------------------|
| Number of eyes | 36 | 53 |
| Sphere | -3.14 ± 1.17 D | -6.88 ± 1.53 D |
| Cylinder | -1.40 ± 0.77 D | -1.76 ± 0.83 |

RESULTS

Patients were followed for 4 to 23 months (mean 9.2 ± 4.2 months). Results for refraction, visual acuity and haze were assessed separately as follows:

Refraction.

Group 1: Postoperative mean sphere was -0.01 ± 0.08 D and mean cylinder was -0.02 ± 0.12 D. Spherical refractions were within the range of ± 0.50 in 36 eyes (100%) and there was only one patient with a residual cylinder (-0.75 D) postoperatively. Emmetropia was achieved in 33 eyes (91.6%) in this group (Table 2).

Table - 2 : Postoperative overall results.

| | Group 1 | Group 2 |
|----------------------------|--------------------|--------------------|
| Postop. mean refraction | | |
| Sphere | -0.01 ± 0.08 D | -0.34 ± 1.35 D |
| Cylinder | -0.02 ± 0.12 D | -0.14 ± 0.52 D |
| Haze | 0% | 15% |
| Line loss of visual acuity | 0% | 15% |
| Emmetropia (± 0.50 D) | 91.6% | 62.2% |

Group 2: Postoperative mean sphere was -0.34 ± 1.35 D and mean cylinder was -0.14 ± 0.52 D. The number of eyes which had a postoperative spherical refractions within the range of ± 0.50 was 30 (56.6%) and 41 eyes (77.3%) were within the range of ± 1.00 D and, $+2.00$ D in 3 eyes (5.6%). Cylindrical values were within the range of ± 0.50 D in 49 eyes (92.4%), -1.00 D in 1 eye, -2.00 D in 2 eyes and -2.50 D in 1 eye postoperatively. Emmetropia was achieved in 33 eyes (62.2%) in this group (Table 2).

No intraoperative complication occurred and we assumed that this was due to immobilization of eyes by means of a vacuum mechanism.

Visual acuity.

Group 1: Postoperative uncorrected visual acuity was the same as the preoperative best-corrected visual acuity in 23 eyes (63.8%), there was line gain of best-corrected visual acuity in 3 eyes (8.3%). There was no case with line loss of best-corrected visual acuity (Table 2).

Group 2: Postoperative uncorrected visual acuity was the same as the preoperative best-corrected visual acuity in 23 eyes (43.3%). Line

gain of best-corrected vision was seen in 6 eyes (11.3%), while line loss of vision was seen in 8 eyes (15%) (2 eyes because of 3+ haze and, others because of decentration on topography) (Table 2).

Haze.

Group 1: Only transient minimal haze was observed in this group of patients. Haze did not cause any decrease in visual acuity (Table 2).

Group 2: Haze was 2(+) or more in 8 eyes (15%) and others had only minimal transient haze. The patient with 3(+) haze in both eyes had stopped fluorometholone after. The 15th day and did not come to any postoperative visits. He has a visual acuity of 7/10 with a large regression (-7.00 -2.00 180) now and we prescribed eye glasses for him. Other patients (55.5%) had only minimal transient haze.

Complications related to Fluorometholone.

No intraocular pressure increase or local toxicity related to Fluorometholone usage was seen in our patients.

Subjective symptoms.

All patients experienced different degrees of pain and photophobia during the early postoperative period.

DISCUSSION

Patients with compound myopic astigmatism demand excimer laser treatment more than simple myopics. This may be because of compliance problems related to toric or gas permeable contact lenses or the necessity to undercorrect the cylinder values in eye glasses.

The effectiveness of this procedure can be assessed by evaluating the safety and efficacy:

Decrease in best-corrected vision and vision threatening complications can be used as an indicator of safety of PRK for myopic astigmatism. There was no decrease in best-corrected vision of any patient in group 1 and there was line loss of best-corrected vision in 8 eyes (15%) in group 2. Two of these eight eyes had 3+ haze and others had decentration on topography. Emmetropia rate was 91.6% in group 1 and 62.2% in group 2.

The goal of refractive surgery is to improve the patient's uncorrected vision. Hence uncorrected visual acuity can be used as a measure of efficacy of

this procedure (6). If the results are evaluated in this respect, the rate of uncorrected visual acuity above 5/10 was 100% in group 1 and 79.2% in group 2.

The results of this study are in accordance with previous PRK results and this study shows that compound myopic astigmatism can be treated with excimer laser PRK as well as simple myopias (1-4, 7). In a study of Kremer et al, patients with compound myopic astigmatism were grouped in three according to cylindrical values as low, moderate and high and PRK was found to be less effective in the low astigmatism group as compared to moderate and high astigmatism groups (7). The results seem to contradict our study but this may be because we grouped the patients according to the total refractive error but not the cylindrical values. We agree with Taylor et al. in that results of PRK for myopic astigmatism are similar to that for simple myopias.

Although we do not know much about corneal wound healing after PRK procedures, it is accepted that excessive wound healing may be the cause of myopic regression and corneal haze after ablations. There is a positive correlation between the amount of haze and myopic regression (11). Histopathologic examination of rabbit corneas after PRK demonstrates an increase in subepithelial fibroblasts and focal areas of subepithelial scarring (12).

In clinical practice, the results of PRK for low to moderate myopias (up to -6.00D) are predictable and ablation depth for this amount of correction is about 50 µm. For higher myopic corrections deeper ablations are necessary. We have recently demonstrated in an animal study that there was a positive correlation between the depth of corneal photoablation and aqueous Transforming Growth Factor β1 (TGF-β1) concentration (8). TGF-β is known to be a multifunctional growth factor and causes a dose related inhibition of epithelial cell proliferation by inhibiting the stimulatory effects of Epidermal Growth Factor (13). Higher concentrations of TGF-β tends to inverse this effect (9) and wound healing becomes more aggressive. Recently, in another animal study, it was shown that topical anti-TGF-β1 antibody may help to reduce development of stromal haze after PRK (14).

We also demonstrated a thermal increase in the corneal endothelium during photoablation and changes in the free oxygen radical balance of

aqueous humor after deeply performed excimer laser photoablation (10). We found a positive correlation between the depth of corneal ablation and the thermal increase in the corneal endothelial surface in this study. All of these findings prove that, "if you hit the corneal tissue deeply, it will fight back extensively". So thermal increase in corneal endothelium and higher TGF-β1 levels in aqueous humor after deep ablations may be the cause of regression and haze formation.

In this study, since the patients were grouped according to total refraction we are able to compare higher and lower dioptric ablations. The results were better and the complications were lower in group one (up to -6.00 D).

The results of this study suggest a parallelism between the results of PRK for simple myopia and myopic astigmatism. Haze and regression increased in accordance with total ablation depth and the best results were obtained for patients with total refraction up to -6.00 D.

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