Keratorefractive Surgery for Post-Cataract Refractive Surprise

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Abstract: Purpose: To evaluate the safety and efficacy of keratorefractive surgery (LASIK & PRK) to correct clinically significant ametropia following cataract surgery. **Setting**: eye subspecialty center, Cairo, Egypt (from May 2009 to April 2010). **Methods:** prospective randomized study that was performed on 40 eyes of 30 patients with clinically significant ametropia following cataract surgery. The eyes were divided into two groups; group A (treated by LASIK) and group B (treated by PRK). Allegretto blue eyes excimer laser was used (with Moria 90 microkeratome only for LASIK group). Mean age was 43.6 years (range 64-25 years). Mean follow up duration was 10.5 months (range 6-18 months). Mean interval between cataract surgery and LASIK or PRK was 6.5 mm (range 8-6 months). **Results:** For group (A) the mean preoperative spherical equivalent refraction (SEQ) for myopic eyes was -2.89±0.72D (range -4.0 to -2.0 D) and for astigmatic eyes was 2.04±0.84D (range 3.5-2 D). The mean postoperative SEQ was -0.42±0.16D (range -0.75 to +0.25D) in myopic eyes and was 0.29±0.1D (range +0.5 to -0.25 D) in astigmatic eyes. There was a statistically significant improvement in myopic eyes (P=0.002) and in astigmatic eyes (p=0.026). Uncorrected visual acuity (UCVA) improved by a mean of 4 lines in myopic eyes to 0.68 ± 0.15 (range 1.0 to 0.5) (p =0.002) and 3 lines in astigmatic eyes to a mean of 0.63±0.05 (range 0.7-0.6) (p =0.027). For group(B) the mean preoperative SEQ for myopic eyes was -2.32±0.27D (range -2.75to -2.0 D) and for astigmatic eyes was 2.60±0.28D (range 3.0 to 2.25D). The mean postoperative SEQ was 0.46±0.24 (range -1.0 to +0.25 D) in myopic eyes and was 1.80±0.41D (range +2.5 to -1.5D) in astigmatic eyes. There was statistically significant improvement in myopic eyes (p =0.001) while in astigmatic eyes there was no significant improvement (p =0.08). UCVA improved by a mean of 4 lines in myopic eyes to 0.71±0.13 (range 0.9 to 0.5) (p =0.001). No significant improvement in astigmatic eyes (p =0.89). **Conclusion:** LASIK is safe, predictable procedure for correction of post cataract refractive errors including myopia and astigmatism. Also PRK is effective for correction of residual myopia after cataract surgery but not for residual astigmatism. Further studies are needed to assess the long term SEQ and UCVA stability.
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1. Introduction

Refractivesurprise after cataract surgery denotes a significant difference between the postoperative refraction and preoperatively planned result.

Failure to achieve the estimated target refraction is disappointing for the patient and surgeon.

Several options are available for subsequent correction of refractive surprise including prescription of glasses or contact lenses, IOL exchange, implantation of supplementary IOL, or keratorefractivesurgery[1,2].

Spectacles may not be the best option especially with younger patients.

Contact lenses are often inappropriate for older patients as well as infirm elderly patients.

IOL exchange may be associated with increased risk of capsular rupture or zonular dehiscence with vision loss.

Implantation of supplementary IOL has the advantage of predictability and reversibility, however special lenses are needed, and the use of inappropriate lenses results in unpredictable outcomes [3].

Keratorefractive surgery may not be the best solution because of the inherent risks associated with further corneal surgery.

In many instances, such an option may be impossible or unavailable.

Performing LASIK or PRK to treat the residual refractive error has the advantage of being highly accurate and able to correct astigmatism as well as the residual error [4].

Surface laser procedure, PRK or epithelial sparing PRK (LASEK or Epi-LASIK) may be preferred because no stromal flap is required [4].

It may be prudent to avoid further intervention in patients who are satisfied with their postoperative uncorrected visual acuity.

This is especially important after incisional surgery where astigmatism enhancement may cause the axis to change dramatically without much change in cylinder power, and may potentially worsen uncorrected visual acuity [5].

Aim of the Work:

To evaluate the safety and efficacy of keratorefractive surgery to correct clinically significant ametropia following cataract surgery.

2.Patients and Methods:

Prospective randomized study which included 40 eyes of 30 patients with clinically significant ametropia following cataract surgery.

Patient's inclusion Criteria:

Those who were older than 25 years with stable clinically significant ametropia following cataract surgery defined as spherical error (+2-4 diopters with or without astigmatism > 1.5 D). Both aphakic and pseudophakics are enrolled in the study.

Exclusion Criteria:

included:

-The presence of any ocular or corneal surgery older than cataract surgery.
-Patients with ocular surface disease (e.g. severe dry eye),
-Glaucomatous patients.
-Diabetics and keloid formers.
-Auto-immune disease patients.
-Corneal edema or other corneal pathologies.
-Previous retinal surgery.
-Previous HSV.

Patients were divided into two groups:

Group A: included cases who were treated with LASIK.(20 eyes) and this group was further subdivided into 3 sub groups:

Group A1 (myopic eyes) (12 eyes =30% of cases)
Group A2 (hyperopic eyes) (2 eyes =5% of cases)
Group A3 (Astigmatic eyes) (6 eyes =15% of cases).

-Group B: included cases who were treated with PRK.(20 eyes) and this group was further subdivided into 3 sub groups:

Group B1 (myopic eyes) (14 eyes = 35% of cases)
Group B2 (hyperopic eyes) (1 eye = 2.5% of cases)
Group B3 (astigmatic eyes) (5 eyes= 12.5 % of cases)

An informed consent was obtained from all patients after they received detailed description of surgical procedure and its risk.

This study included 12 females and 18 male with mean age of 46.7 years (range 64-25 years).

- The mean follow up duration was 12 month (range 18-6 months).
- The mean interval between cataract surgery and keratorefractive surgery was 7.5 months (range 8-6 months)
- All patients had a complete ophthalmic examination pre and post refractive surgery.
- This included visual acuity (uncorrected and corrected), manifest refraction, slit lamp examination,.applanation tonometry, fundus examination, corneal pachymetry, and corneal topography.
- All patients underwent comprehensive examination to define any degree of tear film problem.
- Patients were examined after 1st day, 1st week, 1st month, 3rd month and 6th month postoperatively.
- Preoperative preparation involved instillation of topical anasthetic of Benoxinate 1% and topical povidone iodine 5%
- LASIK was performed with Allegretto blue eyes excimer laser system. In LASIK group, Moria 90 microkeratome was used.
- The ablations were performed using Argon-fluoride excimer laser (193nm) at a fluence of 160 mj/ cm^2 and reptetion rate of 10 Hz. Ablations were completed with a 6 mm optical zone with blend zone ablation.

The Wire speculum was inserted, the patient was asked to fixate on green flashing light coaxial with the laser beam.

The cornea was marked, the suction ring centered and vacuum activated, the microkeratome was engaged when an IOP> 65 mmHg was attained. The corneal flap was thus created and was retracted toward the ring. The laser beam was centered on the patient's pupil, stromal ablation was performed. The corneal flap was then repositioned.

In PRK group the central epithelial debridment was performed with blade No. 15, dryness of surface was ascertained and laser beam was centered on patient's pupil and ablation was performed and contact lens was applied.

Postoperative treatment for group (A) included:

Fluroquinolone (oflox® 0.3%), prednisolone 1% (predfort®) and tears substitutes. Installed 5 times daily for one week then 3 times daily for another week then stopped.

For group (B) the same treatment was given and contact lens was removed after complete epithelial healing.

For both groups complementary use of topical NSAID was given for pain relief.

3.Results

The mean preoperative spherical equivalent (SEQ) in group A1 (myopic eyes) was - 2.89±0.72D (Range -4.0 to – 2.0 D)

Postoperatively the mean SEQ was -0.42±0.16D (range -0.75 to +0.25 D) showing a statistically significant improvement (p=0.002).

In group A2 (hyperopic eyes) the mean preoperative SEQ was +2.25D, while mean postoperative SEQ was +0.5D with an improvement of +1.75 D

In astigmatic eyes (group A3) the mean preoperative SEQ was 2.04±0.84D (range3.5- 2D) ,while the mean postoperative SEQ was 0.29±0.1D (range +0.5 to -0.25 D).

There is a statistically significant improvement of the mean SEQ (P= 0.026).

The mean preoperative SEQ in group B1 was -2.32±0.27 D (range -2.75 to -2.0 D) while

postoperatively the mean SEQ was -0.46±0.24 (range -1.0 to +0.25 D) showing statistically significant improvement (*P*= 0.001).

In group B2, the preoperative SEQ was +2.5 while Postoperative SEQ was +0.5 with improvement of +2.0 D

In group B3, the preoperative SEQ was 2.60±0.28D (range 3 to 2.25D) while postoperative SEQ was 1.80 ± 0.41 (range +2.5 to -1.5 D)

No statistical significant improvement of the mean SEQ (P= 0.08).

The mean uncorrected visual acuity (UCVA) in myopic eyes (group A1) preoperatively and postoperatively were respectively 0.17±0.12 (Range 0.4 to 0.05) and 0.68±0.15 (range 1.0 to 0.5) which led to an improvement of 4 lines so that the difference between pre and post-operative (UCVA) was statistically significant (*P* =0.002).

In group A2 (hyperopic eyes) the UCVA preoperative and postoperative were respectively 0.3 and 0.6 with an improvement of 3 lines.

In group A3 (astigmatic eyes) the mean preoperative UCVA was 0.30±0.13 (range 0.5 to 0.2) while mean postoperative UCVA was 0.63±0.05 (range 0.7 to 0.6).

Showing improvement of 3 lines which is statistically significant result (*P* = 0.027).

In Group B1 (myopic eyes) mean preoperative UCVA was 0.26±0.15 (range 0.4 to 0.05) and postoperative UCVA was 0.71±0.13 (range 0.9 to 0.5) which led to an improvement of 4 lines so that the difference between pre and post-operative (UCVA) was statistically significant (*P* =0.001).

In hyperopic eyes (group B2) the preoperative and postoperative UCVA were respectively 0.3 and 0.7 with an improvement of 4 lines.

In astigmatic eyes (group B3) mean preoperative UCVA was 0.36 ± 0.15 (range 0.6 to 0.2) while postoperative UCVA was 0.34±0.09 (range 0.4 to 0.2) showing statistically no significant difference between pre and post-operative results (*P* = 0.08).

No vision-threating complications occurred in any eye of both groups.

In comparing group A1 and group B1, no significant difference between postoperative SEQ and UCVA of both groups was found while in comparing group A3 and group B3 significant difference in postoperative SEQ and UCVA was found with better results for astigmatic eyes (group A3) treated with LASIK (*P* =0.005 for UCVA) and (*P* = 0.004 for SEQ).

Table 1: comparison between LASIK group and PRK group for myopic eyes as regards UVCA and SEQ

	The studied groups		Test of significance	*P* value
	LASIK group A1 N = 12	**PRK group B1 N = 14**		
UCVA (Pre)				
X ± SD	0.17 ±0.12	0.26 ±0.15	1.36*	0.17(1)
Median	0.15	0.30		
Range	0.40 – 0.05	0.5 – 0.05		
UCVA (Post)				
X ± SD	0.68 ± 0.15	0.71±0.13	0.47*	0.63(1)
Median	0.70	0.70	3.07**	0.002(2)
Range	1 – 0.50	0.9 – 0.5	3.30**	0.001(3)
SEQ(Di-opter)(Pre)				
X ± SD	2.89 ± 0.72	2.32 ±0.27	2.04*	0.041(1)
Median	2.87	2.25		
Range	4 – 2	2.75 – 2		
SEQ(Di-opter)(Post)				
X ± SD	0.42±0.16	0.46 ±0.24	0.33*	0.73(1)
Median	0.5	0.5	3.07**	0.002(2)
Range	0.75 – 0.25	1 – 0.25	3.31**	0.001(3)

* = Mann Whitney U ** = Wilcoxon signed rank

1 = Comparison between LASIK group and PRK group

2 = Comparison between pre operative and post operative measurement in LASIK group

3 = Comparison between pre operative and post operative measurement in PRK group

Table 2: comparison between LASIK group and PRK group for astigmatic eyes as regards UCVA and SEQ

	The studied groups		Test of significance	*P* value
	LASIK group A3 N = 6	**PRK group B3 N = 5**		
UCVA (Pre)				
X ± SD	0.30 ± 0.13	0.36 ±0.15	0.75*	
Median	0.25	0.30		0.44(1)
Range	0.50 – 0.20	0.6 – 0.2		
UCVA (Post)				
X ± SD	0.63 ± 0.05	0.34±0.09	2.83	0.005(1)
Median	0.60	0.40	2.21**	0.027(2)
Range	0.7 – 0.6	0.4 – 0.2	0.13**	0.89(3)
SEQ (Dio-pter(Pre)				
X ± SD	2.04 ± 0.84	2.60 ±0.28		
Median	2.0	2.5	1.74	0.08(1)
Range	3.5 – 1	3.0 – 2.25		
SEQ(Dio-pter**(Post)**				
X ± SD	0.29 ±0.10	1.80 ±0.41	2.88	0.004(1)
Median	0.25	1.75	2.22**	0.026(2)
Range	0.5 – 0.25	2.5 – 1.5	1.76**	0.08(3)

* = Mann Whitney U
** = Wilcoxon signed rank
1 = Comparison between LASIK group and PRK group
2 = Comparison between pre operative and post operative measurement in LASIK group
3 = Comparison between pre operative and post operative measurement in PRK group

4.Discussion

Post cataract refractive surprise is still a problem for the patients and the surgeons. Many techniques can be used for correction of post cataract refractive errors such as classic limbal relaxing incision or the use of a piggy-back toric intraocular lens for residual astigmatism [5].

Keratorefractive laser surgery is effective and safe for correction of postoperative refractive errors [6,7].Both LASIK and PRK can be performed LASIK proved to be safe and stable procedure for correction of post cataract myopic or astigmatic errors [5,7] .

In our study the majority of cases in group A were myopic (30%) of cases while astigmatic cases represented (15%) and hyperopic cases represented (5%). Also in group B the majority of cases were myopic (35%), astigmatic cases represented (12.5%), and hyperopic cases represented (12.5%).preoperative UCVA in myopic eyes (group A1) was 0.17±0.12 while postoperatively it was 0.68±0.15

In hyperopic eyes (group A2) preoperative UCVA was 0.3 that improved to 0.6 postoperatively.

A preoperative UCVA in astigmatic eyes (group A3) was 0.30±0.13 while postoperatively it was 0.63±0.05.

Postoperative SEQ in all eyes of group A improved to 0.42±0.16D in myopic eyes (group A1) and +0.5 D in hyperopic eyes (group A2) and 0.29±0.1D in Astigmatic eyes (group A3)

Such results go with those found by **Kim*et al.*,2008** who had 83.3% of myopic eyes & 90.9% of hyperopic eyes after cataract surgery within 0.5 D of intended refraction after LASIK[8]

Also our results go with those of **Ayala *etal.*, 2001**who found that SEQ was within 0.5D of intended SEQ in 50% of cases [6]

No eyes in our study lost any line in the postoperative period, this in agreement with results found by **Pinero*etal.*,2010**[10] but not with those found by other studies such as that of **Montes *etal.*,1999** who found that 1.2% of cases lost one line of BCVA due to decentred ablation [9]

For PRK group (group B), preoperative UCVA in myopic eyes (group B1) was 0.26±0.15 and improved to 0.71±0.13 postoperatively.Preoperative UCVA in astigmaticeyes (group B3) was 0.36±0.1while postoperativelyit was 0.34±0.09.

Postoperative SEQ in myopic eyes (group B1) was 0.46±0.24D with significant improvement while in astigmatic eyes (group B3)was 1.80±0.41D with no significant improvement.

Such results are similar to **Artola*etal.*, 1999** and **Li y *etal.*, 2003**studies [11,12]

There was no significant difference between myopic eyes in both groups A1 and B1but a

significant difference between astigmatic eyes in both groups A3 and B3 with better results for those treated by LASIK than those treated by PRK.

Conclusion

Our study proves that LASIK is effective, predictable and safe procedure for correction of post cataract refractive errors including myopia, and astigmatism.

Also PRK is effective for correction of residual myopia after cataract surgery but not for residual astigmatism when indicated.

Recommendations

Further studies are needed to evaluate the effect of LASIK and PRK on hyperopia due to limited number of hyperopic cases in our study.

Further studies are needed to assess long term SEQ and UVCA stability.

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