Comparative study between nidek Quest OPDCAT software aspherical ablation and OPA optimized prolate ablation software as regards visual and topographic elements

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Abstract: Aim of the Work: To compare MRSE (mean refractive spherical equivalents) , Q value (corneal asphericity) HOA RMS (high order aberration of root mean square) in patients submitted to lasik using optimized prolate ablation (OPA) and optical path difference custom aspheric treatment (OPDCAT)algorithms for myopia correction. **Site of the Study**: Private practice, EYE CARE CENTER, Maadi, Cairo, Egypt. **Design:** Prospective randomized masked clinical trial. **Methods:** Forty six eyes of 32pt subjected to LASIK using OPA and 46 eyes of 32 patients subjected to LASIK using OPDCAT. OPD (optical path difference) topography and OPD station was done preoperatively, MRSE, Q value and HOA RMS were done preoperatively, one week, one month and six months postoperatively. **Results:** The study enrolled 64 patients.thirty two patients with 64 eyes subjected to LASIK using OPA and 64 eyes using OPDCAT. MRSE was 0.08 G 0.49 D, 0.20 G 0.43 D, and 0.19 G 0.37 D, one week, one month and six months respectively, in the aspheric ablation group and _0.18 G 0.36 D, 0.00 G 0.34 D, and 0.00 G 0.33 D, respectively, in the prolate ablation group.. no significant difference in the mean preoperative root mean square (RMS) At 6 months, the mean ocular HOA RMS increased to 0.500 G 0.132 mm in the aspheric ablation group and 0.398 G 0.100 mm in the prolate ablation group. Preoperatively, there was no statistically significant difference in corneal asphericity (Q value) between the 2 groups. At 6 months, the mean corneal asphericity increased to 0.301 G 0.285 in the aspheric ablation group but remained unchanged (_0.120 G 0.233) in the prolate ablation group **Conclusion:** The prolate ablation algorithm induce fewercorneal HOAs, and conserved more preoperative corneal asphericity than the aspheric algorithm.

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Key words: nidek Quest OPDCAT , aspherical ablation , OPA optimized prolate ablation

1. Introduction:

Night-vision disturbances such as glare, halo, or starburst after LASIK surgery aimed to targeting Low Order Aberration in conventional surgery. Ocular aberrations can be measured, and visual disturbances are correlated with induced higher order aberrations (HOAs) after refractive surgery.Increased HOAs postoperatively (high myopic correction, flap misalignment, and asphrecitity of the cornea) have been associated with decreased visual performance under mesopic and low-contrast conditions (El-Danasouryand Bains 2005.). Many algorithms, including aspheric ablation profiles to decrease induced spherical aberration,eye tracking and registration to minimize cyclotorsional rotation and decentration error,and Q value (corneal asphericity) customized ablation.(OPDCAT), which is based on the wave front profile, minimizes induced HOAs and maintains mesopic contrast sensitivity more thanconventional refractive surgery. (OPA) uses wave front aberrometry and corneal topography to treat preexisting spherical aberrationsand to maintain the preoperative corneal asphericity(Q value) El-Danasoury AM,2009.

Aim of the Work:

To compare MRSE (mean refractive spherical equivalents) , Q value (corneal asphericity) HOA RMS (high order aberration of root mean square) in patients submitted to lasik using optimized prolate ablation (OPA) and optical path difference custom aspheric treatment (OPDCAT) algorithms for myopia correction.

2. Patients and Methods:

128 eyes of 64 patients were subjected to LASIK surgery using 90 µ flap thickness 64 eyes of 32 patients were operated using OPDCAT (optical path difference customized ablation technique) (Venter J,2005) Group I and the other 64 eyes of the 32 patients were operated using OPA (optimized prolate ablation) Group II. Patient inclusion criteria were age older than 20 years and myopia with a manifest refraction spherical equivalent

(MRSE) less than or equal to -8.00 diopters (D) (range -8.00 to-2.00 D). Patients who had active systemic or ocular disease or previous ocular surgery were excluded from the study. All patients had a preoperative ophthalmic examination that included UVA, corrected visual acuity(CVA), biomicroscopic evaluation, tonometry, fundus evaluation, ultrasound pachymetry, pupillometry, corneal topography, and wavefront aberrometry using the OPD-Scan II diagnostic device (Nidek Co. Ltd.). Corneal asphericity (Q value) was measured by corneal topography simulated by the software.

The same examinations were performed at 1week, 1 month, and 6 months after surgery.

Surgical Steps:

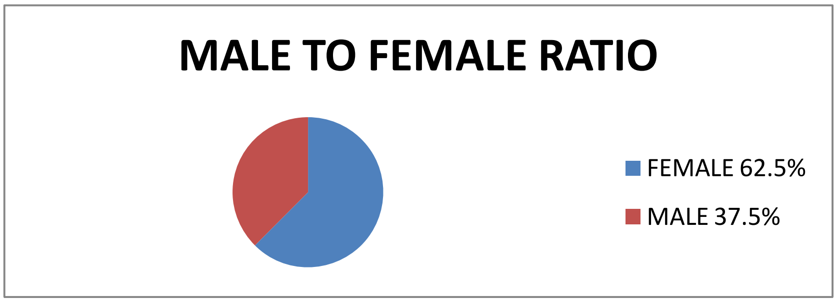
Topical anesthesia, sterilization, application of lid speculum, washing and drying the conjunctival sac, marking the cornea with marker, application of the suction ring, application of the moria N2 microkeratome, making 90 µ flap, elevation of the flap drying the bed, aligning the mires, starting ablation step while protecting the flap by microsponge, washing the bed by BSS, reposioning the flap, drying the edge by air, antibiotic anti-inflammatory eye drops installation, putting contact lens and removing the speculum. Examination of the patient with slit lamp before charging to home.

Postoperative Care:

Antibiotic anti-inflammatory eye drops and tear substitute prescribed 4 times per day and contact lens removed in the second day.

3.Results

The study contained128 eyes of 64 patients. 24 men and 40 women (Figure 1).The mean age of the men was 25.6 ± 5.1years (range 21 to 35 years). The mean age of the women was 24.3 ± 4.2years.



Preoperative MRSE, sphere, cylinder,, corneal and ocularHOAs, and the corneal asphericity (Q value) by group were no statistically significant differences in baseline characteristics between the groups (Table 1).

Table (1): preoperative spherical, refractive and Q value in two groups.

	Group I	Group II	*P* value
MRSE	-5.22 G 1.07	-4.95G 1.65	0.213
Q value	-0.307G 0.107	-0.320G 0.139	0.99
Ocular SA	0.079G 0.105	0.098G 0.113	0.688
Corneal SA	0.250G 0.060	0.248G 0.751	0.711
Coma	-0.223G 0.107	-0.225G 0.138	0.945

MRSE: mean refractive spherical error, SA: spherical aberration

MRSE (Table 2) was 0.08 ± 0.49 D, 0.20 ± 0.43 D, and 0.19 ± 0.37 D, one week, one month and six months respectively, in the aspheric ablation group and -0.18 ± 0.36 D, 0.00 ± 0.34 D, and 0.00 ± 0.33 D, respectively, in the prolate ablation group.

Table 2: MRSE one week one month and 6 months postoperatively

MRSE	1 wk	1 month	6 months
Group I	0.08 ± 0.49	0.20 ± 0.43	0.19 ± 0.37
Groue II	-0.18 ± 0.36	0.00 ± 0.34	0.00 ± 0.33
***P* value**	0.043	0.044	0.043

No significant difference in the mean preoperative root mean square (RMS). At 6 months, the mean ocular HOA RMS increased to 0.500 ± 0.132 µm in the aspheric ablation group and 0.398 ± 0.100 µm in the prolate ablation group. Preoperatively, there was no statistically significant difference in corneal asphericity (Q value) between the 2 groups. At 6 months, the mean corneal asphericity increased to 0.301 ± 0.285 in the aspheric ablation group but remained unchanged (-0.120 ± 0.233) in the prolate ablation group (Table 3).

Table 3: HOA rms (high order aberration root mean square) and Q value six months postoperatively in the two groups.

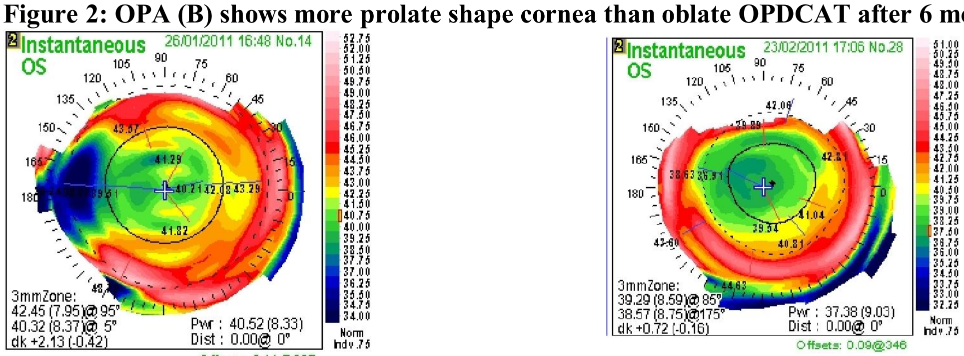
	HOA rms	Q value
Group I	**0.500 ± 0.132 µm**	**0.301 ± 0.285**
Group II	**0.398 ± 0.100 µm**	**-0.120 ± 0.233**
***P* value**	**< 0.05**	**< 0.05**

The meanchanges in ocular spherical aberration, corneal spherical aberration, and corneal asphericity were significantly different (P<0.05) between the aspheric ablation group and the prolate ablation group.
One month postoperatively.

Conclusion

It has been shown that OPDCAT ablation inducesless HOA than conventional refractive surgery.The increase in corneal asphericity in the prolate ablation group was not significant. Corneas in the prolate ablation group maintained a more prolate shape than those in the asphericablation group. This implies that OPD algorithmsmaintain the normal corneal shape more than OPDCAT postoperatively (Figure 2).

Figure 2: OPA (B) shows more prolate shape cornea than oblate OPDCAT after 6 months.



(A) OPDCAT after 6 month (B) OPA after 6 month

4.Discussion

Optimized prolate ablation (OPA) uses a wave front aberrometer and maintains the corneal asphericity (Q value)with the help of corneal topography. These features of optimized prolate reduce the induced HOAs thatmay disturb visual quality and decreasing halo andglare.1-3It has been shown that OPDCAT ablation inducesless HOA than conventional refractive surgery.4-6 The decrease in induced HOAs would improve visualquality and decrease night-vision disturbance. However, **Holladay and Bains, 2005** 7reports that wave front-guided ablations led to significantly increased ocular HOAsand corneal asphericity compared with topography guided ablation.

Wave front analysis has limited resolution. One reason is that tear-film changes increase the range of variations in wave front analysis.8Limited resolution of wave front analysis may increase induced HOAs in patients with lower preoperative HOAs. **Pop and Payette, 2004** 9have found that a greater induction of HOAs occurredin eyes with HOAs of less than 0.3 to 0.4 mm preoperatively,regardless of the algorithm used. The meanpreoperative ocular HOA RMS in this study was lessthan 0.4 mm, and ocular HOA RMS and ocular comaincreased in both groups postoperatively Chen S *et al* 2009. However,the OPA algorithm corrected ocular spherical aberrations to a mean **0.398 ± 0.100 µm**; this is in contrastto the OPDCAT algorithm, which increased ocularspherical aberrations. Preoperative corneal spherical aberrations in the prolate ablation group were notchanged 6 months postoperatively; however, cornealspherical aberration increased in the aspheric ablationgroup. The limitations of wave front analysis might be overcome by the higher resolutionof corneal topography in the OPA algorithm. The normal anterior cornea has a prolate profile, which improves visual quality by reducing theamount of spherical aberration in the whole eye. However,refractive surgery (whether conventional, topography guided, or wavefront guided) makes the corneaoblate, which increases corneal asphericity Thibos LN 2002 .6The mean change in corneal asphericity was **0.301 ± 0.285**inthe aspheric ablation group and **-0.120 ± 0.233**in the prolate ablation group. The increase in corneal asphericity in the prolate ablation group was not significant. Corneas in the prolate ablation group maintaineda more prolate shape than those in the asphericablation group. This implies that OPA algorithmsmaintain the normal corneal shape more thanOPDCAT algorithms postoperatively.In conclusion, the safety and effectiveness wereequal between the groups; however, the refractive outcomesof OPA algorithm were more predictable. TheOPA algorithm induced less HOA than the OPDCATalgorithm without changing corneal asphericity.

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