Comparison of Aspheric and Aspherotoric Elevation Maps in Normal and Keratoconic Eyes Using Placido Scheimpflug Camera

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Intoduction

Accurate corneal elevation measurements are helpful in diagnosing corneal ectatic disorders, avoiding complications of keratorefractive surgery, and monitoring postoperative recovery of the cornea. Increased anterior and posterior corneal elevation is considered an early indicator of keratoconus. Therefore, investigating the elevation maps is critical for the sound detection of any abnormal shape. However, different reference shapes and floats can be used to measure it, which might influence the accuracy of this parameter.

Purpose

To compare the anterior and posterior elevation measurements using the aspheric and the aspherotoric floats in candidates for refractive surgery.

Patients and Methods

This prospective study included 960 eyes of 500 subjects who presented for refractive surgery evaluation. They were examined with the placido-Scheimflug Topographer (sirius, CSO, Italy) The anterior and posterior elevation maps were evaluated in 4 quadrants which were compared between the aspheric and the aspherotoic floats.
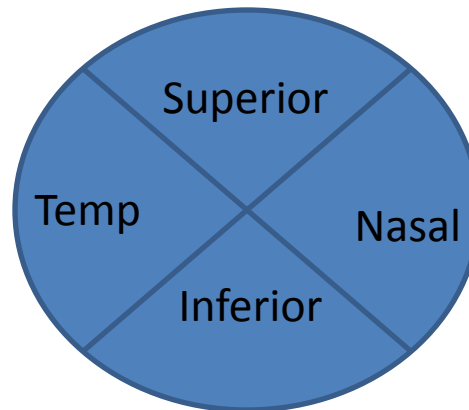
✓Exclusion criteria:

   -Systemic disease e.g.diabetes or connective tissue disease

   -History of intraocular or corneal surgery.

✓ Contact lens–wearing patients were asked to stop wearing contact lenses for at least 3 weeks before the assessment in the case of rigid contact lenses, and 1 week before for soft contact lenses.

✓In accordance with the Declaration of Helsinki, the local ethics committee approved the study and all patients provided written informed consent before the measurements were taken.

✓All patients had a full ophthalmic examination including visual acuity measurement, slitlamp examination, fundoscopy, and corneal topography.

✓Between 2 PM and 6 PM, all participants had 3 sequential measurements and the data were averaged.

✓Measurements were performed using a 9.0 mm diameter. Then maximum elevation for each of 4 quadrants (superior, inferior, temporal, and nasal) were recorded. In clinical practice, decisions are based on the most elevated points on the maps. So the comparison was of the most elevated point in each quadrant rather than a point-to-point comparison, which negated the variability.

✓One investigator performed the measurements.

Statistical Analyses

The measurements derived from both elevation floats were restored and analyzed using GraphPad software. The t test was used to compare Anterior and posterior elevation values obtained using the aspheric and Aspherotoric floats in corneas with keratoconus and in normal corneas. The Pearson coefficient (r) was used to assess the correlation between these methods. A P value less than0.05was considered statistically significant.

RESULTS

Table 1. showing the demographics and characteristics of each group

	Normal Subjects (N=740)	Keratoconus	
		Subclinical (N=143)	Stage I and II (N=77)
M/F	315/425	64/79	31/44
Age (yrs) (Mean ±SD)	26±4.9	25±6.1	25±5
K (max) (D)	44±2.9	47.4±4	50±5.1
Thinnest pachymtry (µm) (mean±SD)	524±33.2	492±31	460±40

	Anterior elevation				Posterior elevation			
	Aspheric	Asphero-toric	*p*	r	Aspheric	Asphero-toric	*P*	r
Normal								
Superior	-0.89 ±0.74	-0.76 ±0.7	0.06	0.84	6.3±0.5	7.4±0.24	0.096	0.81
Nasal	1.87±0.9	1.99±0.83	0.056	0.81	7.9±2.2	8.1±2.6	0.08	0.74
Inferior	1.9±7.3	2.04±0.77	0.06	0.91	2.9±3.2	6.3±4.4	0.02	0.58
Temporal	1.02±5.6	1.09±7.3	0.07	0.88	4.8±2.4	5.8±2.9	0.04	0.59
Subclinical Keratoconus								
Superior	-0.91±2.8	2.9±2.1	0.062	0.82	1.6±2.9	2±2.1	0.066	0.91
Nasal	2.2±2.9	4.1±2.9	0.074	0.88	4.9±3.1	5.4±2.9	0.056	0.82
Inferior	8.9±4.3	12.1±2.9	0.032	0.66	9.7±3.9	11.1±2.2	0.041	0.61
Temporal	6.2±3.9	8.9±4.2	0.05	0.78	7.3±3.18.	8.3±2.9	0.048	0.72
Keratoconus stage I, II								
Superior	2.9±3.1	3.4±2.9	0.059	0.81	5.9±3.9	7.2±4.2	0.066	0.72
Nasal	4.4±2.2	5.1±2.9	0.062	0.84	7.1±2.1	8.6±3.3	0.058	0.78
Inferior	8.3±3.1	10.3±3.2	0.04	0.67	13±4.7	18±4.1	0.03	0.61
Temporal	6.6±2.9	7.3±3.1	0.045	0.69	12±4.4	16±3.3	0.038	0.066

Anterior Elevation

The inferior followed by the temporal quadrants were the highest elevated anatomical location and the superior quadrant the lowest on the anterior elevation map in all groups. There were no statistically significant differences the superior and inferior quadrant measurements in normal subjects unlike in the subclinical ketoconus and the Keratoconus stage I and II.

Posterior elevation

The Inferior quadrant was the highest elevated anatomical location and the superior quadrant the lowest on the posterior elevation map. There were no statistically significant differences between the superior and inferior quadrant measurements in normal subjects unlike in the subclinical ketoconus and the Keratoconus stage I and II.

The mean posterior elevation values in corneas with subclinical keratoconus were on average statistically higher than that in normal corneas, using either the Aspheric or the aspherotoric float.

The correlation between posterior elevation measurements obtained with the 2 floats was statistically significant ($P < 0.05$) and ranged from moderate to high in normal corneas as well as the keratoconus group.

Conclusion

The aspheric and aspherotoric floats give comparable measurements of posterior corneal elevation, but the aspherotoric float has higher efficacy in discriminating corneas with subclinical keratoconus and keratoconus stage I and II than in normal corneas. Although posterior elevation measured by either float is effective in discriminating subclinical Keratoconus from normal, this parameter should be used in conjunction with other variables.