

WAVEFRONT ABERRATIONS ANALYSIS IN OPERATED PRIMARY CONGENITAL GLAUCOMA EYES USING A RAY TRACING ABERROMETER

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Introduction

Primary congenital glaucoma(PCG) is a rare genetically determined disease of the anterior chamber angle that results in elevated intra ocular pressure (IOP) with no ocular or systemic association. It has three variants according to the age of onset (newborn, infantile and late onset). There is also another variant which is the spontaneously arrested type. The "clinical triad" of symptoms including epiphora, photophobia and blepharospasm. The main clinical signs of PCG include elevated IOP >21 mmHg, corneal edema and/or enlargement of the eye with buphthalmos, and Haab striae. Medical treatment has a limited role in controlling the IOP in PCG, reducing IOP effectively in less than 10% of PCG patients, making surgery the mainstay of treatment of PCG. Visual prognosis depends on the degree of corneal scarring, anisometropia, refractive or deprivation amblyopia, and optic nerve damage. Wavefront mapping is a technology that makes custom laser eye surgery possible by precisely measuring and diagramming the aberrations of an optical system (e.g. the human eye). These aberrations are divided into lower-order aberrations (such as myopia, hyperopia, and astigmatism) and higher-order aberrations (such as trefoil, coma, and spherical aberration) that affect contrast sensitivity and night vision. The iTrace Device is an analyzer of visual functions and the optical system of the eye. This class 1 laser instrument is used to determine refractive errors, wavefront and corneal topography data of the optical system of the eye.

Aim of the work

The aim of this study was to report on the wavefront analysis in eyes operated for PCG and to compare it to age-matched normal control children.

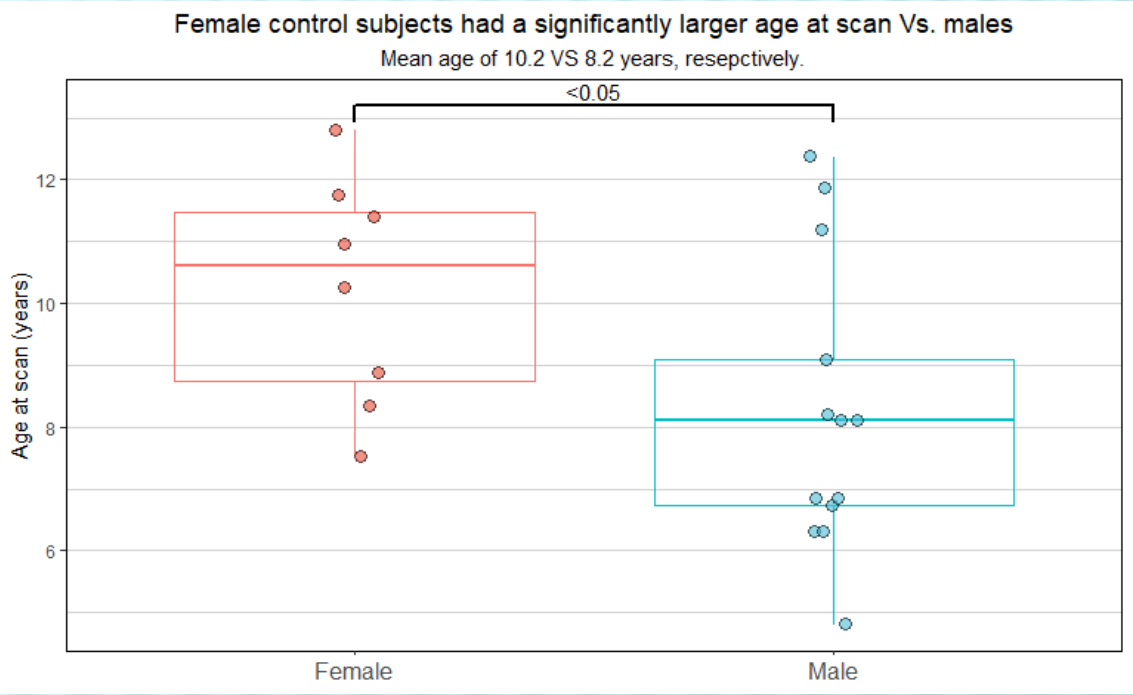
Patients and Methods

The is a prospective study that has been conducted on all patients presenting with and operated for PCG in Alexandria Main University Hospital coming for routine follow up in the period from January to June 2023 and a cohort of normal age-matched control children. Inclusion criteria were Children subjected to combined angle and filtering surgery for PCG whose previous medical records are available and whose condition is stable and Children able to cooperate with i-trace testing irrespective of their age and Control children who have minimal refractive errors and able to cooperate with i-trace testing. Office examination according to the patient cooperation an ophthalmic examination including the best corrected visual acuity, slit lamp examination and fundus examination will be conducted Examination under anesthesia (EUA) if the information obtained from the office examination was not satisfactory, and EUA will be conducted to obtain the necessary objective information. Wavefront analysis will be conducted for patients and controls using the i-tracey (Tracey Technologies Houston, Texas) and compared.

Results

The study also showed that the older the child was at presentation, the lower the average corneal curvature indicating negative correlation. The study also showed that the older the child was at scan, the higher the astigmatism was (p-value: < 0.001). The correlation coefficient is 0.571, indicating a strong positive correlation. The study additionally showed that the older the child was at scan, the lower the sterhl ratio (point spread function) was, indicating better image quality on the retina (p-value: < 0.001). The correlation coefficient is -0.604, indicating a strong negative correlation. The study also showed that the older the child was at scan, the lower the modulation transfer function average height was, indicating worse contrast sensitivity on the retina (p-value: < 0.001). The correlation coefficient is -0.575, indicating a strong negative correlation. The study finally showed that the older the child was at presentation, the older they were at scan (p-value: < 0.001). The correlation coefficient is 0.641, indicating a strong positive correlation. Our study showed that the male group has significantly larger total LOA than the female group. No other significant differences between males and females were noted. The study also showed that the right eyes had higher lens index than the left eyes, significantly different cylinder axis, lower total high and low order aberrations.

Among cases (n= 33 eyes)				
Term	Overall	Right	Left	p-value
Cornea Avg K 0 mm	Avg (SD) 41.2 (2.4)	41.4 (2.1)	41 (2.8)	t: 0.6935
Cornea Avg K 1 mm	Med (IQR) 41.1 (2.6)	41.6 (2)	40.6 (3.4)	U: 0.3825
Cornea Avg K 2mm	Avg (SD) 41.2 (2.4)	41.3 (2.1)	41.1 (2.7)	t: 0.7665
Cornea Avg K 3mm	Avg (SD) 41.2 (2.3)	41.3 (2)	41.1 (2.7)	t: 0.8198
Lens Index	Avg (SD) 5.1 (2.4)	6.2 (2.3)	4 (1.8)	t: 0.0042**
Limbus(mm)	Avg (SD) 12.7 (0.6)	12.7 (0.5)	12.8 (0.6)	t: 0.5864
Scan(mm)	Med (IQR) 5.6 (1.7)	5.3 (1.5)	6 (1.8)	U: 0.7560
Tracey Refraction Sphere(diopters)	Med (IQR) 0.6 (3.2)	0.8 (2)	0.5 (3)	U: 0.5337
Tracey Refraction Cylinder(diopters)	Avg (SD) -2.6 (1.4)	-2.3 (1.2)	-3 (1.6)	t: 0.1981
Tracey Refraction Axis	Med (IQR) 91 (102)	36 (44)	121 (51.8)	U: 0.0232*
HO Total @ D < = Total Eye	Med (IQR) 0.4 (0.3)	0.4 (0.2)	0.5 (0.6)	U: 0.0445*
HO Total @ D < = Cornea	Med (IQR) 0.3 (0.3)	0.3 (0.2)	0.4 (0.5)	U: 0.0870
HO Total @ D < = Internal	Med (IQR) 0.4 (0.4)	0.3 (0.3)	0.6 (0.5)	U: 0.0280*
Angle at ...	Avg (SD) 0.4 (0.2)	0.4 (0.2)	0.4 (0.2)	t: 0.3606
	Med (IQR) 198.5 (141.8)	193 (18)	343 (113)	U: <0.001***
LOA Total	Med (IQR) 3.4 (3.2)	2.9 (2.3)	4.2 (3)	U: 0.0630
LOA Total Defocus	Med (IQR) 1.6 (3.7)	0.5 (2.5)	2.1 (4.4)	U: 0.3825
LOA Total Astigmatism	Avg (SD) 2 (1.2)	1.7 (1)	2.3 (1.3)	t: 0.2048
LOA Total Astigmatism at	Avg (SD) 90.6 (51.4)	116.1 (50.3)	63.6 (37.6)	t: 0.0019**
HOA total	Med (IQR) 0.7 (0.8)	0.7 (0.6)	0.9 (0.9)	U: 0.0187*
HOA Total coma	Med (IQR) 0.4 (0.5)	0.3 (0.4)	0.5 (0.6)	U: 0.0531
HOA Total coma at	Med (IQR) 231 (119)	244 (104)	210.5 (144.8)	U: 0.4493
HOA Total Spherical Aberration	Avg (SD) 0 (0.2)	0 (0.2)	0 (0.2)	t: 0.3876
HOA Total trefoil	Med (IQR) 0.4 (0.6)	0.3 (0.4)	0.6 (0.6)	U: 0.2604
HOA Total trefoil at	Med (IQR) 38 (56)	22 (55)	57.5 (41.8)	U: 0.3128
Point Spread Function	Med (IQR) 0 (0)	0 (0)	0 (0)	U: 0.0942
Modulation Transfer Function	Med (IQR) 0.2 (0.2)	0.3 (0.2)	0.1 (0.1)	U: <0.001***



Conclusion

This study shows the aberration profile of PCG patients, which opens up interesting directions for future research. It demonstrates that, in comparison to control subjects, the eyes of PCG children manifested almost four times the total amount of corneal aberrations and three times the corneal HOAs; coma and trefoil were the most common types of HOAs found among PCG. In PCG eyes, component HOAs from the corneal and internal planes were positively correlated with each other, but were not linked to variations in corneal diameter or refractive error. With the typical visual aids that are currently on the market, patients with higher-order aberrations might not be able to receive full visual rehabilitation. In the future, adaptive optics may be available in these situations, as they have been demonstrated to be helpful in enhancing visual acuity, contrast acuity, accommodation, and amblyopia in eyes with high higher-order aberrations. In light of worldwide research, iTrace has a bright future in addition to being a diagnostic and therapeutic tool. With a range of integrated technological characteristics, it will also function as an educational tool for trainees, ophthalmologists, and patients alike.