Original Research Article

Biometric Date Changes after Penetrating Corneal Wounds in Pediatric Eyes

Abstract

Background: Traumatic cataract accounts for a large proportion of monocular visual disability and blindness in pediatric populations, especially in developing countries. This study aims to evaluate the axial length and other biometric data changes after penetrating corneal wound in pediatric eyes.

Methods: This is a prospective comparative control study carried on thirty of children with unilateral penetrating ocular trauma associated with cataract. Patients were classified into 3 groups: Group A (n= 15 eyes) underwent cataract extraction and IOL implantation in same session 6 weeks after trauma, Group B (n= 15 eyes) underwent cataract extraction, and IOL implantation in second session 3 months after trauma and the third one is the control group with 30 contralateral eyes of both groups

Results: Regarding axial length, measures were reported to be was (22.882 ± 0.712) mm in group (A) after 6 weeks from the incidence of trauma, while in group (B) it was (22.568 ± 0.881) mm. P-value was insignificant (0.292). After 12 weeks, mean AL in group A was reported to be 23.199 ± 0.724) mm while in group B it was (22.903 ± 1.008) mm with insignificant p value as well (0.362). After 6 weeks, the mean K-readings for group A were found to be 41.184 ± 2.109 while group B were (42.928 ± 2.433). After 12 weeks, the mean K-readings for group A were 41.491 ± 1.729 while group B were (42.797 ± 2.518).

Conclusion: Early I/A and anterior vitrectomy recommended for cases with free lens in AC for fear of reaction, while IOL implantation is recommended to wait after stitches removal.

Keywords: Axial length, K-readings, Biometric Date, Penetrating Corneal Wounds, Pediatric

Introduction:

Traumatic cataract is the leading cause of monocular vision impairment and blindness in children, particularly in underdeveloped nations (1,2). Despite significant diagnostic and treatment advancements, traumatic cataract resulting from injuries such as corneal perforation, may be complicated by lens subluxation, secondary glaucoma, endophthalmitis, and retinal detachment, and can still cause permanent visual impairment (3).

The vast majority of ocular injuries in children with traumatic cataract occurred between the ages of 2 and 8 years old. This may be due to the fact that children of this age can move freely and their parents are not constantly nearby, resulting in inadequate monitoring. The significant decline in the incidence of traumatic cataract among children older than 8 years can be related to their enrollment in school (4–6).

Axial elongation may be caused by trauma resulting in blindness. Greater axial length elongation is observed in patients who were younger at the time of injury. Greater is the axial length of the traumatised eye the longer the interval between age of trauma and period of manifestation. Rapid rehabilitation of damaged eyes is required to reduce the length of visual impairment. It is impossible to estimate the precise amount of axial length lengthening following trauma or cataract surgery; thus, regular follow-up with appropriate refractive correction will assist to prevent amblyopia in these circumstances (7).

In young toddlers and newborns, it might be difficult to measure the axial length of the eye without anaesthetic, since the eye is often unable to cooperate with exact fixation and centration.

Another factor will be assessed in our study is the corneal power. The measurement of corneal power is based upon the steepness of the cornea. A keratometer measures the curvature of the anterior corneal surface based on the power of a reflecting surface as the cornea is assumed to be a spherical optical mirror with a curvature (8).

This study aims to evaluate the axial length and other biometric data changes after penetrating corneal wound in pediatric eyes.

Patients and methods

This is a prospective comparative control study carried on thirty of children with unilateral penetrating ocular trauma associated with cataract attending ophthalmology pediatric unit of ophthalmology department of Tanta university hospital between 2020 and 2021. Patients with the following criteria were included: Children up to 18 years with unilateral traumatic cataract after penetrating injury (corneal wound), and the contralateral eye is normal to serve as a control for the study eye (axial length and k readings).

Children with history of previous ocular insult or surgery, single eyed children, children with ocular congenital anomaly as microphthalmia or microcornea, children with posterior segment insult following the trauma or extended corneoscleral wound (5 mm beyond limbus) were excluded.

Patients were classified into 3 groups: Group A: 15 eyes who underwent cataract extraction and IOL implantation within 6 weeks after the history of trauma. Group B: 15 eyes who underwent cataract extraction then IOL implantation later on within 12 weeks after trauma. Group C: 30 contralateral normal eyes of previous two groups.

All children were subjected to Nylon 10/0 stitches removal of the corneal wound under microscopic visualization after 6 weeks from date of surgery to ensure stable coapted wound. Topical anasthesia (Benox) eye drops was used for the age group older than 12-14 years (cooperative group). While younger children needed general anaesthesia to complete the procedure. Inhalation anesthesia was administrated to the patient using either isoflurane or sevoflurane delivered to effect in concentrations of 1-3 % in oxygen (up to 5 % for intial induction) using a precision vaporizer.

Each child visited the hospital 6 weeks after the repair of wound and 12 weeks after trauma. On the first visit, full history was taken including past medical and surgical history in addition to mode and time of trauma. Full ophthalmological examination was carried out and other investigations including the following; ultrasound for the cataractous eye B scan for assessment of posterior segment using Sonomed Escalon 300 AP, Globe axial length (AL) of both eyes A scan for measurement of axial length for calculation of IOL power using Pac Scan 300 AP using the contact method and K readings of affected eye which were measured using the hand Held autorefractor Keratometer Nidek AR-20 / ARK 30 and it was used mainly in younger children who were under general anaesthesia or sedation and manual keratometry which was used to measure the anterior corneal curvature for older cooperative children (usually older than 5 years).

Full ophthalmological examination was done in the second visit in addition to globe axial length (AL) of both eyes and K readings of the affected eye.

Postoperative treatment included: Topical antibiotic eye drops 5 times daily for a week, prednisolone acetate eye drops 5 times daily for 1 week then tapered gradually over a month, topical combined antibiotic and steroid ointment at bedtime and topical non-steroidal anti-inflammatory eye dops 4 times daily for one week.

Postoperative follow up was done by examination of the child one day, 3 days, one week, 2 weeks, one and half months and three months postoperatively, sutures removal was at 5-6 weeks post-operative, refraction, k readings and axial length was recorded after 1week and 6 weeks after sutures removal by portable Auto- refractometer , manual keratometer and A scan and the last post-operative examination was done three months post operatively.

We collected the following data for each patient: age, affected eye, K readings, axial length, implanted IOL, IOL power, amount of reduction and actual refractive outcome.

Statistical analysis

Statistical analysis was done using statistical package for the social sciences version 20. Chi square, paired t test and t-independent tests were used in statistical analysis to compare between data. There was a statistically significant difference if p-value was ≤ 0.05.

Results

There were no significant differences between the groups regarding age (p=0.273) nor gender (p=0.456) as shown in table 1

Table.1 Age and distribution in each group

		Group A			Group B			t	P-value
Age	Mean ± SD	6.933	±	3.793	8.5	±	3.887	-1.117	0.273
		N	%		N		%	X2	P-value
Sex	Male	10	66.67		8		53.33	0.556	0.456
	Female	5	33.33		7		46.67		

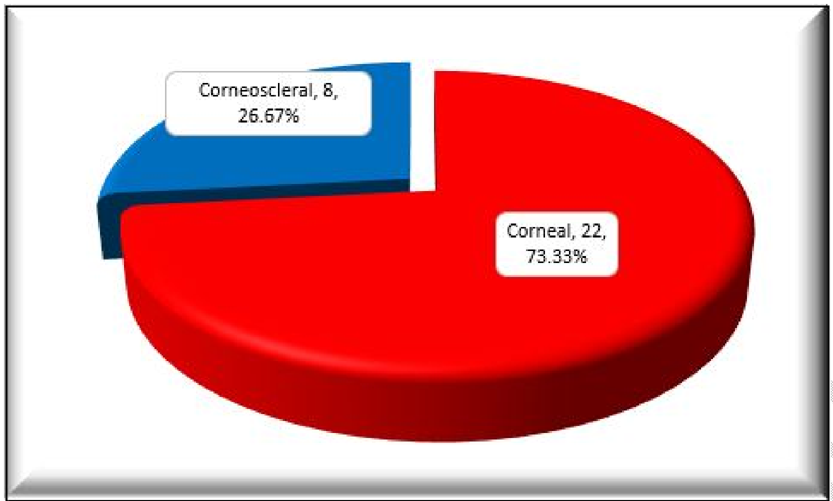

Figure.1 Types of wounds

Regarding axial length, measures were reported to be was (22.882 ± 0.712) mm in group (A) after 6 weeks from the incidence of trauma, while in group (B) it was (22.568 ± 0.881) mm. P-value was insignificant (0.292). After 12 weeks, mean AL in group A was reported to be 23.199 ± 0.724) mm while in group B it was (22.903 ± 1.008) mm with insignificant p value as well (0.362). Table.2

After 6 weeks, the mean K-readings for group A were found to be 41.184 ± 2.109 while group B were (42.928 ± 2.433). After 12 weeks, the mean K-readings for group A were 41.491 ± 1.729 while group B were (42.797 ± 2.518). Table.2

Table 2 Axial length and k-readings changes in each group

		Group A			Group B			t	P-value
Axial length									
After 6 Weeks	Mean ±SD	22.882	±	0.712	22.568	±	0.881	1.074	0.292
After 12 Weeks	Mean ±SD	23.199	±	0.724	22.903	±	1.008	0.926	0.362
Differences	Mean ±SD	-0.317	±	0.170	-0.335	±	0.324		
Paired Test	P-value	<0.001*			0.001*				

Mean K									
After 6 Weeks	Mean ±SD	41.184	±	2.109	42.928	±	2.433	-2.098	0.045*
After 12 Weeks	Mean ±SD	41.491	±	1.729	42.797	±	2.518	-1.656	0.109
Differences	Mean ±SD	-0.307	±	1.093	0.131	±	2.284		
Paired Test	P-value	0.296			0.827				

No significant difference was found in K readings of group A regarding time of measurement (6 and 12 weeks) using paired t test. The mean of K readings in the total number of cases is (41.184± 2.109) after 6 weeks, while the mean after 12 weeks is 41.491± 1.729, p= 0.296. The mean of K readings in the total number of cases in group is 42.928 ± 2.433 after 6 weeks, while the mean after 12 weeks is 42.797 ± 2.518, p= 0.827 (insignificant)

On comparing the AL changes that occurred in traumatized eye (group A and B together) with the fellow normal eye (group C), the results showed that the mean AL for the traumatized eye for group (A & B) was (23.051 ± 0.875) mm while the mean other eye (group C) was (22.843 ± 0.833) mm. The difference was significant, group (A & B) had longer AL than group (C) as the P-value was <0.001 as shown in table 3

Table.3 comparison of axial length readings between traumatized and normal eye

Time	Axial length						Differences		Paired Test	
	Range			Mean	±	SD	Mean	SD	t	P-value
Group A+B	21.32	-	25.89	23.051	±	0.875	0.208	0.248	4.604	<0.001*
Group C	21.07	-	25.34	22.843	±	0.833				

On comparing 2 types of wounds regarding axial length and k readings the following was reported. The mean AL in the cases with corneal wound is (23.204 ± 0.936) while it's (22.631 ± 0.522) in Corneoscleral wound, p=0.115 (insignificant)

Regarding K readings, mean K-readings for the patients who had pure corneal wound (22 patients) was (42.629 ± 2.205) while patients who had corneoscleral wound (8 patients) the mean was (40.809 ± 1.767). Significant difference was found as P-value was 0.045. See table.4

Table 4 Axial length and k-readings changes between two types of wounds

Type of wound		AL After 12 Weeks			T-Test	
	N	Mean	±	SD	t	P-value
Corneal	22	23.204	±	0.936	1.629	0.115
Corneoscleral	8	22.631	±	0.522		
Type of wound	Mean K After 12 Weeks				T-Test	
	N	Mean	±	SD	t	P-value
Corneal	22	42.629	±	2.205	2.096	0.045*
Corneoscleral	8	40.809	±	1.767		

The mean best corrected visual acuity (BCVA) in group (A) was 0.544 ± 0.255 LogMAR , while in group (B) was 0.329 ± 0.149. LogMAR. BCVA was significantly better in group (B) patients than group (A), p= 0.018) as shown in table.5

Table.5comparison of BCVA between group (A) & (B).

	Group A	Group B	t	P-value
Final BCVA	0.456 ± 0.194	0.329 ± 0.149	1.772	0.091

Discussion

The current study supports occurrence of axial elongation in the eyes exposed to trauma and IOL implantation when compared to the contralateral normal eye (the control group) after 6 and 12 weeks following trauma. Similar to our study, in Sorkin JA, et al.1997, they evaluated the axial length changes that occur in children 3 to 9 years of age who had cataract extraction with primary intraocular lens (IOL) implantation. The overall change in mean axial length in 17 eyes was 0.64 mm. Eyes with traumatic cataracts experienced more axial elongation than eyes with developmental/congenital cataracts (9). The same was found in Enyedi LB, et al. 1998 (10).

While unlike our results, in Urban B, et al.2007, the results showed that there were no significant differences between operated and non- operated eyes. This study included only 7 cases of traumatic cataract out of total small included eyes (20 eyes) and the included age group was from 7 to 20 years so these may be causes for difference in our results (11). Leiba H, et al. 2006 showed similar results to our study. It demonstrated a tendency toward greater axial lengthening in pseudophakic eyes of children, when compared with their non-operated eyes. It showed also that no significant difference was found in the tendency for increased axial lengthening between eyes operated on for traumatic cataracts and those operated on for congenital cataracts (12).

Regarding K readings, The K-readings of the two groups did not alter much over time. Concerning corneal curvature, Flitcroft DI, et al. (1999) found that congenital cataract patients experienced increasing corneal flattening in the postoperative period, but developing cataract patients exhibited no change in corneal curvature. In cases of congenital cataract, significant decreases in keratometry values were detected only during the first year of life, as indicated by the study results (13). Also in the Refractive development of the human eye research, Gordon RA, et al. (1985) shown that corneal curvature changes quite fast during the first few months of birth, but stays remarkably stable throughout the majority of childhood and adolescence (14). Due to the stability of corneal curvature at 12 weeks of age, keratometry should offer very little to error after that point. (15). According to Capozzi et al, the rate of biometric changes in Caucasian eyes was 0.46 mm/month for the first six months, 0.15 mm/month for the second semester, and 0.10 mm/month for the second year (16). In the 0–6, 6–18, and 18–60 month age groups, the median decrease in keratometry was –0.083, –0.035, and 0 D/month, respectively. According to Trivedi and Wilson, axial length elongation persists beyond the first year of life, while keratometry stabilises by age 6 months (17).

Regarding timing of intervention, BCVA was significantly better in group (B) patients than group (A) . This result is affected by difference of wound size and location in each case. As cases with significantly large corneal and centrally located wounds had significant decrease in the visual acuity either they are in group A o B.

Early operation provides the benefits of doing traumatic cataract surgery at the same admission and minimising expense and time, but late procedure has the benefits of performing surgery in a calm eye, improved IOL calculation after suture removal, and understanding the possibility for visual improvement (18). As demonstrated by a randomised clinical research conducted at Farabi Eye Hospital, Tehran University of Medical Sciences, there is no consensus in the literature about the timing of traumatic cataract surgery and its effect on visual prognosis. Shah et al. stated in their study that it is preferable to undertake traumatic cataract surgery as an early treatment due to a reduced complication rate and faster, more effective visual recovery (19). Memon et al advocate secondary procedure in the absence of fragmentized or intumescent traumatic cataract to manage traumatic cataract due to the following: better evaluation of visual improvement postoperative, more accurate IOL estimation, and less post-op inflammation; timeframe between injury and cataract surgery did not influence the final visual outcome of traumatic cataract patients (20). Also, Agarwal et al. (2017) advised that in the event of extensive corneal injury and edoema, lensectomy should be delayed to improve surgical visibility (18).

Limitations of the study include the following: short time follow up for biometric changes, small sample size and big differences between type, shape and size of the rupture globe wound between the cases. Recommendations include the following: The refractive error being corrected with spectacles, the spectacle correction is then gradually decreased over the next 2 years as the myopic shift occurs, the fear of amblyopia shouldn‘t be a cause for early I/A and IOL (before stitches removal) as the K readings error will lead to an inaccurate biometry and blindness from ocular trauma can be prevented by employing protective measures and children should be supervised while playing and using firecrackers. Education in schools should be carried out to prevent sports-related and other ocular injuries.

Conclusion

Axial length significantly increases in traumatized eye than the normal eye (ambylogenic effect). K-readings shared no significant difference between groups at final measurement or within each group.BCVA was significantly different between groups being better in the second group.

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