Ocular Growth in Premature Infants Conceived by In Vitro Fertilization versus Natural Conception

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Purpose. To evaluate the possible effect of in vitro fertilization (IVF) on early development of the eye in premature infants.

Methods. Biometric and keratometric values, intraocular pressure, and retinal vascular status were assessed in a cohort of 133 premature infants. These values were compared between premature infants conceived by IVF or naturally, and the relationship between these parameters and postconceptional age and weight at examination were evaluated.

Results. The sample consisted of 133 premature infants, 62 (46.6%) born by IVF and 71 (53.4%) by natural conception. Postconceptional age at examination was 28 to 46 weeks. In both groups, axial length, anterior chamber depth, and corneal radius correlated with the postconceptional age and weight at examination and followed a linear growth pattern. Lens thickness changed very slightly. The rate of retinal vascularization correlated with the postconceptional age as well. No correlation was found between intraocular pressure and corrected age or weight at examination. There was no difference between the study and control groups in any of the biometric or keratometric parameters or in intraocular pressure, according to two-way analysis of variance.

Conclusions. IVF apparently does not affect early ocular growth, intraocular pressure, changes in corneal curvature, or retinal vascularization in premature infants. These findings may aid ophthalmologists in assessing ocular dimensions in this patient population. (*Invest Ophthalmol Vis Sci.* 2005;46:1163–1169) DOI:10.1167/iovs.04-1232

The growing number of infants conceived by assisted-reproduction techniques has increased concerns regarding the effects of these procedures on neonatal and postnatal development. In vitro fertilization (IVF) is known to be associated with a high rate of twin pregnancy, prematurity, and treatments for special needs.[1–8] However, the prevalence of developmental abnormalities in children of IVF pregnancies remains largely unknown. Some studies have reported a similar rate of malformations in the IVF and the non-IVF newborn population,[1–5,9] whereas others have noted an elevated rate of chromosomal aberrations in the IVF group.[6–8]

There is little information in particular on the ocular outcome of IVF-conceived infants. Anteby et al.,[10] in a study of 47 children conceived by IVF, noted reduced visual acuity in 9% and anisometropia of >1.0 D in 17%. Major ocular malformations were documented in 26%, including Coats' disease, congenital cataract, coloboma of the uvea, hypoplastic optic nerve heads, idiopathic optic atrophy, congenital glaucoma, and retinoblastoma.

The purpose of the present comparative study was to evaluate the effects of IVF on the early development of the eye in premature infants.

Methods

We examined 133 consecutive infants admitted to the Neonatal Intensive Care Unit of Schneider Children's Medical Center of Israel from June 2003 to June 2004. The study was approved by the institutional review board at Rabin Medical Center and adhered to the tenets of the Declaration of Helsinki. Parents provided informed consent after receiving a detailed explanation of the nature of the study and its possible consequences. Exclusion criteria were current assisted ventilation, cardiac malformations, intraventricular hemorrhage, necrotizing enterocolitis, birth weight < 700 g, neurologic disease, any syndrome, general condition too poor for an ocular examination, previous laser treatment of the retina, and lack of parental consent. During the study period, there were 33 infants who met these exclusion criteria. A single examination was performed in each of the 133 infants who were included in the study. For each infant, we recorded gestational age, birth weight, APGAR score, head circumference at birth, postconceptional age (PCA), and weight on the day of the ocular examination. History of assisted ventilation, type of conception (IVF or natural) and type of pregnancy (twin or singleton) were recorded as well.

All ophthalmic examinations were performed by the same examiner (DB) and included measurement of intraocular pressure (IOP), keratometry and ultrasound biometry, and funduscopy.

IOP was measured with the Tonopen (Solan, Jacksonville, FL) after instillation of two drops of topical anesthetic (oxybuprocaine HCl 0.4%; Fischer Pharmaceuticals, Tel Aviv, Israel). The eyelids were retracted gently, without using a speculum and without applying pressure on the globe. The measurement was performed only when the infants were quiet, to prevent IOP fluctuations.[11] Three measurements with no more than a 2-mm Hg difference were obtained for each eye, and the average IOP was recorded.

Corneal curvature was measured with a hand-held autokeratometer (model KM 500; Nidek, Gamagori, Japan) after manual retraction of the eyelids, as just described. The keratometer was placed perpendicular to the eye and focused until three readings were obtained. The cornea was kept moist by instillation of saline solution. The average horizontal and vertical radii were recorded for each eye.

Biometry was performed with an ultrasound biometer (model 820; Carl Zeiss Meditec, Dublin, CA), using the technique described by Butcher and O'Brian.[12] This involved applanation of the cornea with the A-scan probe after instillation of topical anesthetic (oxybuprocaine HCl 0.4%). The eyelids were retracted manually without exerting direct pressure on the globe, and the probe was placed lightly on the center of the cornea, perpendicular to its axis. Special care was taken to avoid corneal indentation. The probe was maintained in this position until three clear traces were obtained on the screen. The average value of the three best images was recorded for each eye. Data included axial length, anterior chamber depth, and lens thickness.

For the funduscopic examination, an additional drop of oxybuprocaine HCl 0.4% was instilled, and a lid speculum was placed gently

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Table 1. Demographic Data of the Study Group

	Whole Group (n = 133)		Natural Conception (n = 71)		IVF (n = 62)		P (ANOVA)
	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	
Gestational age (wk)	24–42	32.5 (4.0)	25–42	32.8 (3.8)	24–42	32.2 (4.3)	0.4
Birth weight (g)	640–3750	1808 (740)	788–3595	1818 (730)	640–3750	1797 (757)	0.9
Head circumference (cm)	24–34	29.4 (2.6)	24.5–34.5	29.4 (2.6)	24–34	29.4 (2.7)	0.9
APGAR score							
1 Minute	2–9	8.0 (1.8)	3–9	8.3 (1.5)	2–9	7.8 (2.0)	0.2
5 Minutes	4–10	9.2 (1.3)	4–10	9.3 (1.3)	4–10	9.2 (1.4)	0.7
Examination day	1–99	15.2 (16.6)	1–99	14.4 (15.5)	1–88	16.0 (17.9)	0.6
Postconceptional age (wk)	28–46	34.8 (3.5)	29–46	35.0 (3.7)	28–43	34.6 (3.4)	0.5
Weight at examination (g)	718–3600	1835 (645)	718–3580	1855 (661)	876–3600	1813 (632)	0.7

between the eyelids. Scleral indentation was performed for examination of the peripheral retina. Vascular development was measured according to the zone reached by the normal vasculature.[13] The presence and stage of retinopathy of prematurity (ROP) were noted as well.

Statistical Methods

Statistical analysis was performed on computer (BMDP Statistical Software, Los Angeles, CA).[14] We performed one- and two-way analysis of variance (ANOVA), analysis of covariance (ANCOVA), Fisher exact test, and Pearson correlation, when appropriate.

Results

One hundred and thirty-three infants (266 eyes) were examined during the study period: 62 (46.6%) were conceived by IVF and 71 (53.4%), naturally. The IVF group included 33 female and 29 male infants, and the control group, 33 female and 38 male infants. The demographic data are presented in Table 1. ANOVA yielded no statistically significant differences between the IVF and natural-conception groups in gestational age ($P = 0.4$), birth weight ($P = 0.9$), head circumference ($P = 0.9$), APGAR score at 1 and 5 minutes, age at examination ($P = 0.6$), PCA ($P = 0.5$), or weight at examination ($P = 0.7$).

Table 2 shows the number and percent of singleton and twin infants and of neonates treated with assisted ventilation. There were no statistically significant differences between the groups for either of these parameters ($P = 0.7$ for both, Fisher exact test).

The biometric, keratometric, and IOP data are presented in Table 3. There were no statistically significant differences between the IVF and natural-conception groups in any of these parameters (ANOVA). The entire group was then split into four subgroups according to PCA at examination (≤32 weeks, 33–36 weeks, 37–41 weeks, and >41 weeks), and the average biometric, keratometric, and IOPs were calculated for each age group separately and compared by ANOVA. The findings are shown in Table 4. A significant difference was noted between the groups for axial length and horizontal corneal radius. Further division of the four age groups by type of conception yielded no difference between the IVF and natural-conception subgroups in any of the parameters by two-way ANOVA.

The retinal vascular status is presented in Table 5. The proportion of infants with complete retinal vascularization was similar in the IVF and natural-conception groups (53% and 45%, respectively), but ROP stage 2 was more prevalent in the IVF group (6.5% vs. 0%). However, the difference was not statistically significant. The zone of retinal vascularization correlated with the axial length and the PCA (ANCOVA).

Correlation Analyses

Whole Group. The axial lengths of the right and left eyes correlated significantly with PCA at examination ($r = 0.686$, $P < 0.001$ and $r = 0.675$, $P < 0.001$, respectively, Pearson correlation). Axial growth followed a linear pattern, with an increase of 0.13 mm per week (Fig. 1). A significant correlation was noted with weight at examination as well ($r = 0.723$, $P < 0.001$ and $r = 0.708$, $P < 0.001$ for the right and left eyes, respectively).

The anterior chamber depth correlated weakly with PCA at examination ($r = 0.297$, $P < 0.001$ and $r = 0.206$, $P = 0.017$, respectively, for the right and left eyes). Like axial length, anterior chamber depth increased in a linear fashion, with an average weekly increase of 0.016 mm in the right eyes and 0.010 mm in the left eyes (Fig. 2). A more significant correlation was found for the right and left anterior chamber depth with weight at examination ($r = 0.382$, $P < 0.001$ and $r = 0.226$, $P = 0.009$, respectively).

The lens thickness changed very little with PCA ($r = 0.004$, $P = 0.967$ in the right eyes and $r = 0.183$, $P = 0.035$ in the left eyes; Fig. 3). From weeks 30 to 42, there was no change in the right eyes and only a mild increase of 0.15 mm in the left eyes. Lens thickness also did not correlate with weight at examination ($r = -0.110$, $P = 0.207$ and $r = 0.150$, $P = 0.85$, respectively).

A significant correlation was found between the horizontal and vertical corneal radii of curvature with PCA (horizontal: $r = 0.489$, $P < 0.001$ in the right eyes and $r = 0.346$, $P < 0.001$ in the left eyes; vertical: $r = 0.327$, $P < 0.001$ in the right eyes and $r = 0.356$, $P < 0.001$ in the left eyes, Figs. 4, 5, respectively). The horizontal radius increased weekly at a linear rate of 0.08 mm per week in the right eyes and 0.07 mm per week in the left eyes, and the vertical radius increased by 0.06 mm

Table 2. Multiple Pregnancy and Assisted Ventilation Data

	Whole Group (n = 133)	Natural Conception (n = 71)	IVF (n = 62)	P (Fisher)
Singletons	108 (81.2%)	59 (83%)	49 (79%)	
Twins	25 (19%)	12 (16%)	13 (21%)	0.7
Assisted ventilation	42 (31.6%)	21 (29.6%)	21 (33.9%)	0.7

TABLE 3. Biometric, Keratometric, and IOP Data

	Eye	Whole Group (*n* = 266)	Natural Conception (*n* = 124)	IVF (*n* = 142)	*P* (ANOVA)
AXL	Right	16.1 (0.66)	16.15 (0.70)	16.11 (0.61)	0.95
	Left	16.1 (0.67)	16.09 (0.70)	16.09 (0.62)	0.99
ACD	Right	2.17 (0.19)	2.16 (0.17)	2.19 (0.20)	0.45
	Left	2.25 (0.36)	2.27 (0.39)	2.24 (0.33)	0.73
LT	Right	3.93 (0.25)	3.90 (0.30)	3.98 (0.16)	0.56
	Left	3.84 (0.37)	3.82 (0.36)	3.86 (0.38)	0.45
IOP	Right	13.7 (3.28)	13.4 (2.85)	14.0 (3.70)	0.29
	Left	13.8 (3.67)	13.6 (3.62)	14.2 (3.73)	0.34
HCC radius (mm)	Right	6.32 (0.60)	6.31 (0.62)	6.34 (0.57)	0.74
	Left	6.34 (0.66)	6.32 (0.71)	6.36 (0.61)	0.73
VCC radius (mm)	Right	6.10 (0.61)	6.06 (0.64)	6.15 (0.60)	0.41
	Left	6.19 (0.59)	6.20 (0.62)	6.20 (0.56)	0.75
KCA (deg)	Right	97.2 (46.3)	102.8 (48.1)	90.9 (43.7)	0.15
	Left	75.9 (40.7)	71.2 (44.0)	81.3 (36.3)	0.16

Data are the mean (SD). AXL, axial length; ACD, anterior chamber depth; LT, lens thickness; HCC, horizontal corneal curvature; VCC, vertical corneal curvature; KCA, keratometric corneal axis.

per week for both eyes. The correlation with weight at examination in the right and left eyes was similar for the horizontal radius ($r = 0.486$, $P < 0.001$ and $r = 0.356$, $P < 0.001$, respectively) and slightly higher in the vertical radius ($r = 0.418$, $P < 0.001$ and $r = 0.409$, $P < 0.001$, respectively).

No correlation was found between intraocular pressure and PCA or weight at examination for the right and left eyes ($r = -0.139$, $P = 0.111$ and $r = -0.004$, $P = 0.965$ respectively, and $r = -0.145$, $P = 0.95$ and $r = -0.029$, $P = 0.745$ respectively).

Conception Groups. Pearson correlations performed separately for the IVF and natural-conception groups for the same parameters in relation to PCA and weight at examination yielded similar results to those for the whole group, as shown in Table 6.

DISCUSSION

Children conceived through assisted reproductive technology account for up to 1% to 2% of the total births in some countries.[15] These technologies are known to be associated with high rates of multiple births, with attendant complications of prematurity and low birth weight.[5,6] Concerns are now emerging about increased risks of congenital anomalies owing to new methods of fertilization that use intracellular and biological manipulations.[15] Several studies of IVF births have demonstrated increased risk of congenital anomalies, including cardiac,[15–17] urogenital,[18] and upper gastrointestinal.[19] Ocular findings were reported as well, including reduced visual acuity, anisometropia, and ocular malformations.[10] A meta-analysis of assisted reproductive technique data sets documented an increased risk of chromosomal abnormalities.[20] The elevated birth defect risks are attributed to the treatments, the multiple pregnancies, parental selection bias, medications, and procedural factors involving manipulations of oocyte, sperm, and embryos.[15] Recently, an increased risk of retinoblastoma with assisted reproductive technology (ART) was reported.[21] In contrast, in a controlled national cohort study of 3,393 twins and 5,130 singletons conceived by assisted-reproduction technologies and 10,239 twins conceived naturally, children born after IVF had a similar risk of neurologic sequelae as their naturally conceived peers.[8] In our study, we excluded infants who had neurologic syndromes or were too sick to be examined, and thus we did not address the problem of congenital anomalies. We concentrated on the ocular growth in premature infants conceived by IVF compared with premature infants born after natural conception, avoiding differences that might arise from systemic and ocular anomalies. Thus, it is probably not surprising that we did not find differences in

TABLE 4. Biometric, Keratometric, and IOP Data by Postconceptional Age

	Eye	Up to 32 Weeks (*n* = 35)	33–36 Weeks (*n* = 58)	37–41 Weeks (*n* = 31)	Over 41 Weeks (*n* = 7)	*P* (ANOVA)
AXL	Right	15.66 (0.32)	16.02 (0.55)	16.58 (0.65)	17.00 (0.68)	<0.001
	Left	15.67 (0.35)	15.96 (0.58)	16.59 (0.66)	17.04 (0.52)	<0.001
ACD	Right	2.13 (0.15)	2.16 (0.16)	2.23 (0.24)	2.26 (0.24)	0.081
	Left	2.17 (0.16)	2.17 (0.15)	2.20 (0.15)	2.30 (0.23)	0.179
LT	Right	3.93 (0.20)	3.97 (0.16)	3.98 (0.21)	4.02 (0.20)	0.198
	Left	3.87 (0.19)	3.90 (0.17)	3.87 (0.23)	4.07 (0.19)	0.095
IOP	Right	14.4 (3.2)	13.7 (2.9)	13.2 (3.6)	12.3 (4.9)	0.300
	Left	13.9 (4.4)	14.2 (3.5)	13.2 (3.2)	13.7 (2.9)	0.697
HCC radius (mm)	Right	6.09 (0.55)	6.23 (0.45)	6.61 (0.70)	7.03 (0.66)	<0.001
	Left	6.10 (0.54)	6.31 (0.57)	6.55 (0.82)	6.82 (0.73)	<0.001
VCC radius (mm)	Right	5.94 (0.52)	6.05 (0.47)	6.29 (0.78)	6.54 (0.89)	0.110
	Left	5.96 (0.50)	6.15 (0.46)	6.43 (0.74)	6.54 (0.81)	0.030
KCA (deg)	Right	99.3 (49.0)	101.9 (41.2)	90.3 (50.9)	78.9 (53.7)	0.483
	Left	67.6 (41.4)	79.9 (39.0)	73.5 (41.7)	94.7 (45.7)	0.307

All data are the mean (SD). Abbreviations are as in Table 3.

TABLE 5. Status of Retinal Vascularization

Vascularization	Whole Group (n = 133)	Natural Conception (n = 71)	IVF (n = 62)
Complete	130 (49%)	64 (45%)	66 (53.2%)
Incomplete zone 3	96 (36%)	60 (42.3%)	36 (39%)
Incomplete zone 2	26 (9.7%)	14 (9.9%)	12 (9.6%)
ROP stage 1	6 (2.2%)	4 (2.8%)	2 (1.6%)
ROP stage 2	8 (3.0%)	0	8 (6.4%)

ROP, retinopathy of prematurity.

ocular growth that are attributable solely to the methods of conception.

Although earlier studies have reported on ocular biometry, keratometry, refraction and IOP in preterm infants, to the best of our knowledge, there are no published data on biometric values and IOP specifically in premature infants conceived by IVF. Our findings both in the whole sample of infants and in the IVF and natural-conception groups separately, correspond with the previous data.

In our series, axial length and anterior chamber depth showed a linear growth pattern in both the IVF and natural-conception groups, and correlated with the PCA and weight at examination. Fledelius[22] noted similar findings, in addition to a direct relationship between the two parameters. The rate of increase in axial length in our series was 0.13 mm per week. Studies of the general population of preterm infants revealed that axial length increased from 12.6 to 16.2 mm from 25 to 27 weeks of age,[11] and from 15.38 to 16.88 mm from 33 to 41 weeks' postmenstrual age,[23] for a linear rate of 0.18 mm per week. Cook et al.[24] reported a fitted value of 16.02 mm at 36 weeks, similar to our values of 16.02 for the right eye and 15.96 for the left in infants up to 32 weeks. Isenberg et al.[25] had similar findings.

Regarding anterior chamber depth, the weekly rate of increase in the series of Cook et al.[24] was 0.04 mm—higher than our depth of 0.016 and 0.010 mm in the right and left eyes, respectively—although the average depth at term (2.25 mm) was similar (Table 4). O'Brian and Clark[23] reported an increase from 1.92 mm at 33 weeks to 2.43 mm at 41 weeks for a rate of 0.064 mm per week, and Isenberg et al.[25] reported a depth of 2 mm at term, with a correlation with PCA. All these studies, like ours, show a constant, linear growth pattern related to PCA. The small variations may be attributable to differences in the study populations or the measuring instruments used.

Correlations with PCA and weight at examination were also documented for the corneal radius of curvature. Cook et al.,[24] noted that the curvature increased at 0.0947 mm per week, compared to 0.08 and 0.07 mm for the horizontal radius of the right and left eyes respectively, and 0.06 for the vertical radius, in the present study. They found a radius of 6.94 mm at 40 weeks' postmenstrual age, which is slightly higher than the radii discovered in the present study in the right and left eyes at 37 to 41 weeks (horizontal: 6.61 and 6.55, respectively; vertical: 6.29 and 6.43, respectively, Figs. 4, 5). However, extension of their observations to 60 weeks' postmenstrual age showed that growth slowed after 40 weeks, yielding a quadratic pattern overall. As our measurements were performed from 27 to 46 weeks, with most infants examined up to 41 weeks, the data are not directly comparable. Findings Similar to ours were noted in other studies. Friling et al.,[26] in a study including full-term infants, reported a mean horizontal radius of curvature of 5.76 mm and vertical radius of 6.25 mm; both meridians declined with an increase in birth weight and PCA. In the series of Snir et al.,[27] the mean keratometric reading at 40 weeks was 6.82 mm in the premature infants versus 7.03 mm in the term infants (compared with horizontal radii of 7.03 and 6.82 mm in the right and left eyes, respectively, and vertical corneal radius of 6.54 in both eyes in infants over 41 weeks' PCA in the present study). Others noted an average radius in premature infants of 5.63 mm at 28 weeks and 6.62 mm at term,[28] 6.35 at term,[29] 6.65 mm at term,[30] and 7.0 mm at 2 to 4 weeks after birth.[31] Yuji[32] found a rapid change in corneal curvature (6.89–7.34 mm) in the first 2 to 4 weeks of life, followed by a deceleration after 8 weeks (7.57 mm). In the present study, we observed a correlation of the corneal radii not only to age at examination, but to weight at examination as well.

Lens thickness, however, showed little change in correlation with PCA (weeks 30–42) or weight at examination. Mean thickness at term was 3.98 mm in the right eye and 3.87 mm in the left. Similar data were reported by Cook et al.[24] (3.84–3.98 mm from 32 weeks to term), O'Brian and Clark[23] (3.83–3.90 mm from 33 to 41 weeks), and Isenberg et al.[25] (3.8 mm at term).

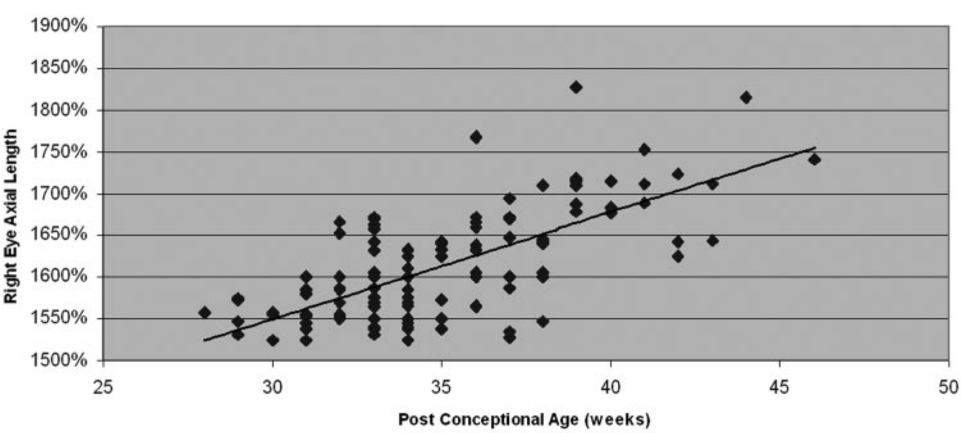

FIGURE 1. Correlation between axial length of the right eye and PCA.

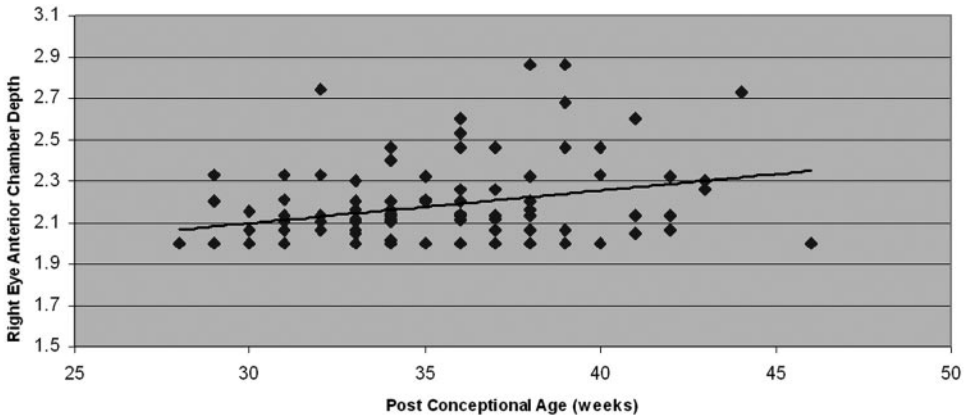

FIGURE 2. Correlation between anterior chamber depth of the right eye and PCA.

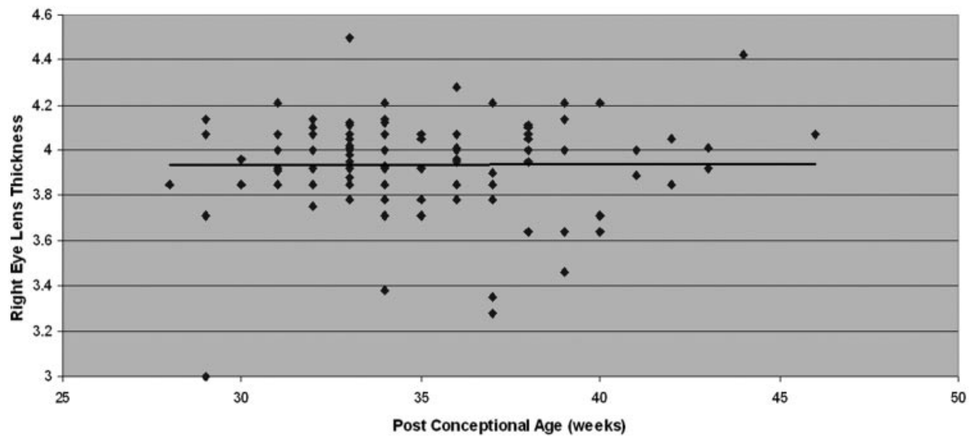

FIGURE 3. Lens thickness of the right eye and PCA.

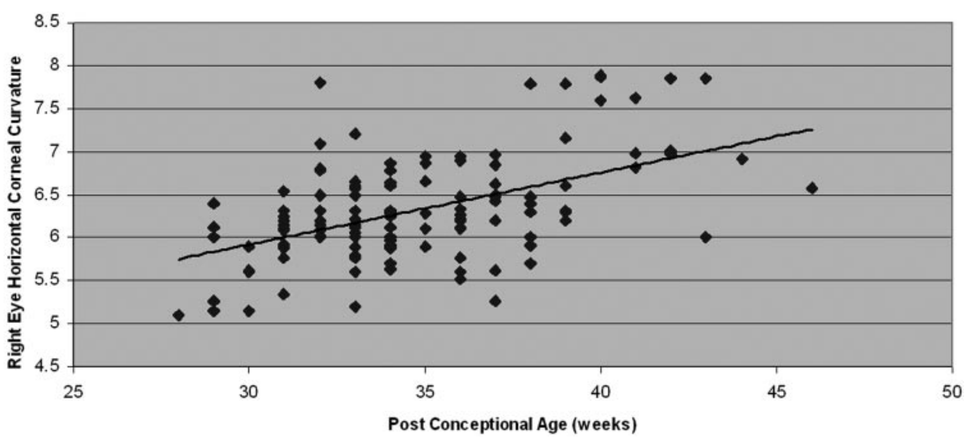

FIGURE 4. Correlation between horizontal corneal curvature of the right eye and PCA.

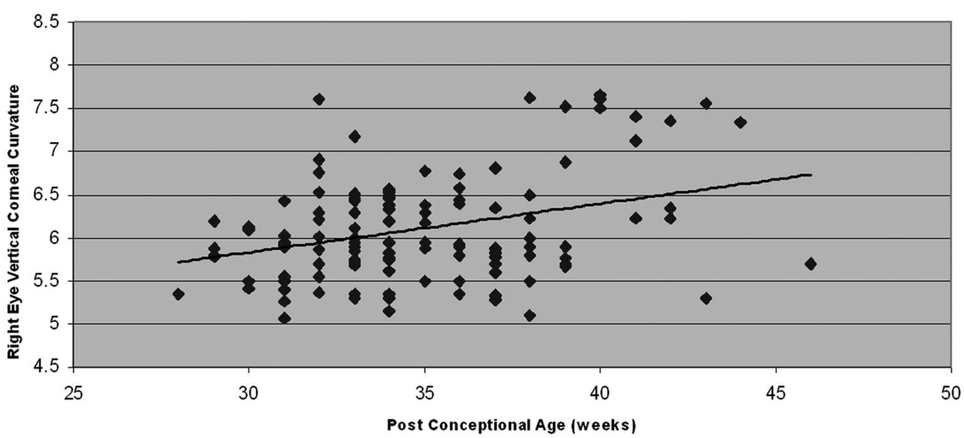

FIGURE 5. Correlation between vertical corneal curvature of the right eye and PCA.

TABLE 6. Summary of Pearson Correlation Analysis

		Postconceptional Age at Examination			Weight at Examination		
	Eye	Whole Group (n = 133)	Natural Conception (n = 71)	IVF (n = 62)	Whole Group (n = 133)	Natural Conception (n = 71)	IVF (n = 62)
AXL	Right	r = 0.686***	r = 0.748***	r = 0.598***	r = 0.723***	r = 0.763***	r = 0.670***
	Left	r = 0.675***	r = 0.715***	r = 0.620***	r = 0.708***	r = 0.744***	r = 0.660***
LT	Right	r = 0.004	r = 0.070	r = 0.125	r = −0.110	r = −0.043	r = −0.268*
	Left	r = 0.183*	r = 0.302**	r = 0.052	r = 0.150	r = 0.242*	r = 0.051
ACD	Right	r = 0.297***	r = 0.294*	r = 0.315*	r = 0.382***	r = 0.292*	r = 0.484***
	Left	r = 0.206*	r = 0.195	r = 0.217	r = 0.226**	r = 0.240*	r = 0.208
HCC	Right	r = 0.489***	r = 0.519***	r = 0.454***	r = 0.486***	r = 0.523***	r = 0.442***
	Left	r = 0.346***	r = 0.351**	r = 0.343**	r = 0.356***	r = 0.375***	r = 0.334**
VCC	Right	r = 0.327***	r = 0.264*	r = 0.425***	r = 0.418***	r = 0.394***	r = 0.458***
	Left	r = 0.356***	r = 0.284*	r = 0.454***	r = 0.409***	r = 0.391***	r = 0.433***
IOP	Right	r = −0.139	r = −0.198	r = −0.077	r = −0.145	r = −0.309*	r = 0.007
	Left	r = −0.004	r = 0.029	r = −0.034	r = −0.029	r = −0.067	r = 0.022

Abbreviations are as in Table 3.
* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

In preterm infants, with maturation, the axial length enlarges, the anterior chamber depth deepens, and the corneal curvature flattens, whereas the lens thickness remains stable. This is true for both infants born after IVF and natural conception.

IOP did not correlate with PCA or weight at examination, being slightly, but not significantly, higher in the IVF group (14 mm Hg in the right eye, 14.2 mm Hg in the left) than in the control group (13.4 and 13.6 mm Hg, respectively). These data agree with those in an earlier study by our team in a different group of premature infants,[33] although a lower value of 10.3 mm Hg was reported by Tucker et al.[11] This difference may be explained by the techniques used: Tucker et al.[11] inserted an eye speculum, and then performed keratometry and biometry, followed by IOP measurement. Performing tonometry several minutes after introducing an eye speculum may have lowered the reading. Conversely, we measured the IOP at the beginning of the ocular examination, before performing any ocular manipulations.

The positive correlation noted between the zone of retinal vascularization and the axial length and PCA in both the IVF and natural-conception groups is in line with the well-established knowledge that retinal vascularization matures with elongation of the eye. Although complete vascularization was observed in a similar proportion of infants in the two groups, the IVF infants had a slightly higher rate of ROP stage 2; this difference was not significant.

Watts and Adams[5] reported an increased percentage (41.6%) of IVF-conceived premature infants reaching threshold ROP, which was unaccounted for by multiple pregnancies alone. The difference in outcomes for assisted conception has been suggested to result from exposing the gametes to physical and pharmacological manipulations, as well as to potential hazardous nurturing conditions and inappropriate uterine environment.[5] In our series we excluded infants with birth weight <700 g, with intraventricular hemorrhage and necrotizing enterocolitis, as well as infants with previous laser treatment, thus lowering the likelihood of including infants with threshold ROP. Moreover, because the average PCA and weight at examination were similar in both groups, it is not surprising that there were no differences in the rates of ROP between the IVF and naturally conceived infants.

In summary, all biometric and IOP calculations performed in the present series of premature infants born after IVF concur with previous studies performed in preterm infants with slight variations that are probably attributable to the different study populations and study designs. The biometric and IOP values in our IVF-conceived neonates did not differ from those in the infants conceived naturally. These findings may reflect either a true similarity in ocular growth between the groups, or they may mask differences due to prematurity per se. Our findings may help ophthalmologists in assessing ocular dimensions in premature infants conceived by IVF.

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