

Vision Development and the Link to Overall Development in Prematurity

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Chair, InfantSEE[®] - A Program of Optometry
Cares[™] -the AOA Foundation



Two Parts to Prematurity

- Growth – some background to be covered
- Development
 - Passive
 - Active

Ocular Growth in Prematurity

- Blood vessels in retina begin to develop around three months post conception
- Progresses from center of the eye toward the periphery
- Mostly complete at the time of birth
- If born prematurely, physical growth within eye is affected

Prenatal development

- Much of the eyes' development takes place in the last 12 weeks of a 40-week gestation.
- In cases of preterm babies, the retina hasn't had time to develop
- The earlier a baby is born, the greater the potential for development of eye-related issues
- Even with more normal development of the eye, significant vision issues can appear as the baby ages and later in life

Retinopathy of Prematurity

- When there is abnormal development of blood vessels in the retina, which is the very thin tissue that lines the back of the eye, the condition is called retinopathy of prematurity
- Retinopathy of prematurity occurs when a preterm birth disrupts the normal growth of blood vessels toward the periphery of the eye

Retinopathy of Prematurity

- It occurs mainly in babies born before 32 weeks of pregnancy.
- ROP is diagnosed during a dilated eye examination a few weeks after birth.
- Complications range from mild issues to complete blindness

Retinopathy of Prematurity

- Based on three factors
 - Length of pregnancy
 - Weight
 - Amount of oxygen used
- Oxygen should be monitored in order to minimize abnormal vessel growth
 - In the early day, many babies received too much oxygen – better controlled today

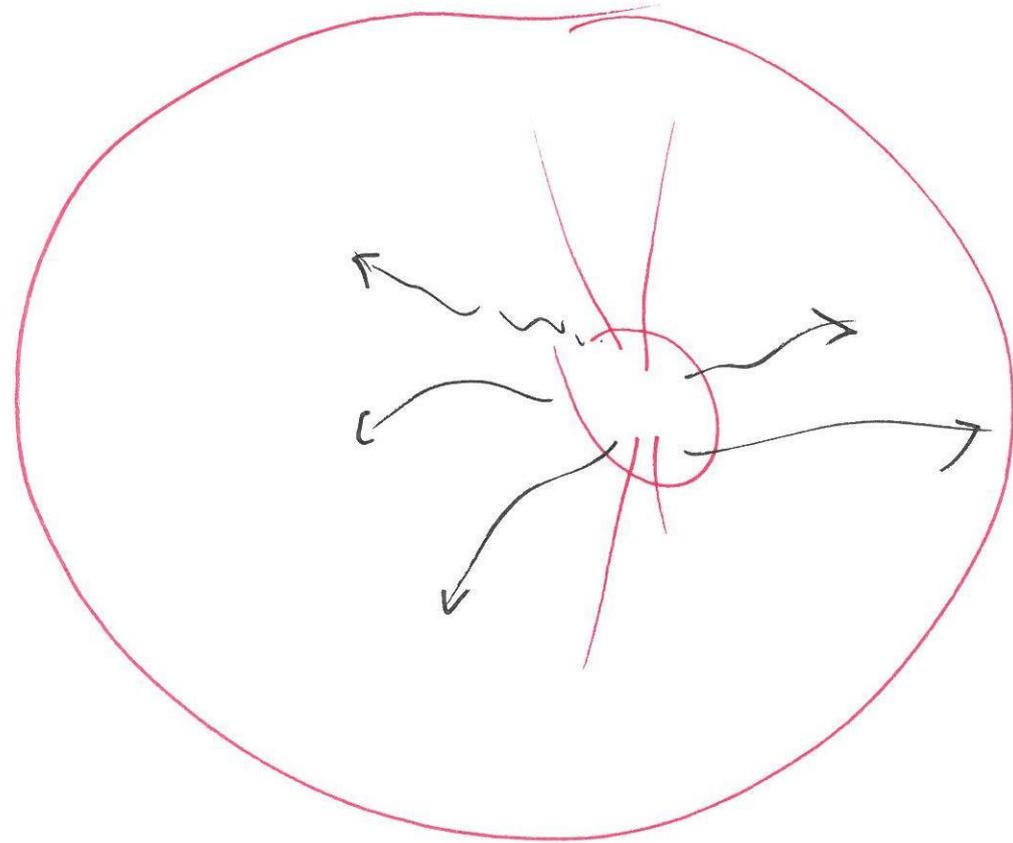
Retinopathy of Prematurity

- Fortunately, most cases are mild and heal by themselves with little or no vision loss
- In severe cases, doctors may treat the abnormal vessels with a laser or with cryotherapy (freezing) to protect the retina and preserve as much vision as possible.
- However, as more and more babies are surviving, the incidence of vision related issues throughout life is increasing

Evaluation for ROP

- **What is it?**
 - Dilation of eyes to determine the stage of vessel growth
- **How it is available**
 - Should be done on all babies born prematurely
- **Often not available**
- **Other issues take priority - survival**

ROP





Development

Overall Development

- Overall development happens in a predictable order
- Happens at the baby's own rate
- Many factor influence overall development of which vision development is a part
 - Heredity – physical – family values
 - In the case of the subject today - prematurity

Visual Development

- Visual development is not something that is separate from overall development
- It is an integrated part of the entire process of development
- The critical issue is that it is often given little to no attention especially in prematurity

Visual Development

- Beyond saving sight, risks for visual issues are significant
- Due to care needed for survival, the everyday activities related to visual development are often missed
- Premature babies are then placed in a world where expectations may be greater than their ability at the time
- This especially includes vision since it usually was not addressed during the critical stages of survival

Children's Eye Care Historically

- Through EPSDT, most babies receive eye screening as a basic part of each well-baby health exam - visual acuity usually does not begin until age 3
- Bright Futures - done through Risk Assessment - a short questionnaire regarding the parent's view of the child's vision
- Premature babies have the retina checked but not other aspects including "looking"

Children's Eye Care Historically

- Prior to InfantSEE[®] it was assumed that an average of one in 30 babies may have a risk factor – amblyopia or “lazy eye” was primarily the only thing considered
- With specific protocols, an infant eye and vision examination project was completed in 2009 in eight states
- Another is in final stages through HRSA as we speak

What is InfantSEE®

- A public health initiative designed to provide the best care for children during the first year of life
- Volunteer optometrists provide first examination for babies without charge to parent or third party - best care for babies
- An ongoing project - year round

What is InfantSEE®

- Specific emphasis times to educate parents and caregivers about the need for early identification and intervention
- Most importantly, -
 - **It's About Changing Lives**

InfantSEE[®] - What We Found (CDC)

- 1051 total: 536 (F) 515 (M)
- 145 Premature Babies (13.8 %)
- 280 non-Caucasian background (26%)
- 180 showed Risk Factors (17%) or

One in SIX at Risk

- Premature and minority (25%)

One in FOUR at Risk

InfantSEE[®] - What We Found (CDC)

- **Income: \$41,648 Average Reported Income**
 - 1 of 8 Exams above Avg. Income had Risk Factors
 - 1 of 4 Exams below Avg. Income had Risk Factors
- **Areas most frequently noted were:**
 - Ocular motility
 - Visual acuity
 - Binocular function

InfantSEE[®] - What We Found (CDC)

- Results suggest that visual impairment in infancy is more significant than originally reported
- Children from families with lower income show a significantly higher incidence of visual risk factors
- 315 of 1051 Exams have Public Insurance or NO Insurance (33%)

CDC Grant Number – 1H75DD000472-01

InfantSEE[®] - What We Found (CDC)

- Tabulated results over seven years and over 80,000 babies are consistent with the outcome of this project

Early Intervention

- When diagnosis and intervention takes place earlier in a baby's life, the chance of later success increases dramatically
- What can optometry bring to the team?
- Early infant eye examinations is one specific way
- What is it?
- How do we do it?
- How do we change lives?

How do we know it is a problem?

- Each patient in the following slides had a life altering experience during and following their InfantSEE examination
- Without discovery of their condition, they would not have a life as full as theirs is today

Grace

- 2005 - The InfantSEE[®] Launch –
 - TODAY Show June 8, 2005
- 2006 - The Call that changed everything–
 - “Thank you for saving my daughter’s life”
 - Retinoblastoma
 - Lost eye but alive and well almost seven years later



Alaina

- At seven months, Alaina was already on a Developmental Delay track
- Marked Hyperopia – farsightedness (+12.00)

Maya

- Dislocated lenses discovered during the InfantSEE[®] examination
- Parent told by consulting doctor that “InfantSEE was worthless”
- Parent created a blog from Maya’s perspective entitled: **How Being Told, “InfantSEE is worthless,” Changed My Life**
- Second consultant became very involved with the family and recommended a completely different approach to management

Ben

- Red, watery eyes
- Being treated for “pink eye”
- Diagnosed with infantile glaucoma

Anderson

- Unilateral congenital cataract
- Surgically removed with lens implant
- Significant effort will be required to develop the ability to see and use both eyes together

Emory

- Bilateral congenital cataracts
- When removed and prescribed contact lenses, he studied the teeth in the zipper on his mother's jacket and the stubble on his father's face
- We must realize how important vision is in exploring our surroundings and how that relates to development

Impact on Family

- Beyond the illness itself, the stress on the rest of the family is significant
- Other children are “neglected” but this is not intentional – parents can only do what they can do
- These babies had issues that were not particularly obvious until diagnosis

Impact on Family

- Premature babies are recognized from the start but more stressful due to many factors
- These include but are not limited to:
 - Separation
 - Even when with the baby, limited holding and nurturing – trying to make the best of the situation

How is Vision Involved?

- Vision is a core aspect of development and everyday life
- Overall developmental milestones
 - Social and Emotional
 - Cognitive
 - Significant relation to vision
 - Autism Spectrum Disorders

Arnold Gesell, M.D.

- The infant
 - Is born with visual hunger
 - Uses his waking time for the accumulation of visual experience and the exercise of ocular functions.
 - Indeed, so fundamental is the sense of vision that it is the traditional criterion of wakefulness as opposed to sleep. An infant does not really wake up until he begins to look; and when he ceases to look he goes to sleep
 - Gesell and Amatruda; Developmental Diagnosis 1947

Culture and the Development of Vision

- As a person develops his visual model from all the available information, he comes to emphasize particular aspects of objects and events.
 - What he pays attention to (**consistently**)
 - what he sees
 - how he sees it, and
 - how he orders what he sees
- Carr, WR and Francke, AW. Culture and the Development of Vision JAOA vol 47 no.1 Jan 76

Culture and the Development of Vision

- At birth, everything visual is relatively equal
- Throughout the first few weeks and months, babies visual attention helps discriminate and differentiate objects they see
 - Recommendation of high contrast playthings
- Environmental factors may limit this development

Social and Emotional Milestones 12 mos

- Shy or anxious with strangers
- Cries when mother or father leaves
- Enjoys imitating people in his play
- Shows specific preferences for certain people and toys
- Tests parental responses to her actions during feedings
- Tests parental responses to his behavior
- May be fearful in some situations
- Prefers mother and/or regular caregiver over all others
- Repeats sounds or gestures for attention
- Finger-feeds herself
- Extends arm or leg to help when being dressed

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Cognitive Milestones

- Explores objects in many different ways (shaking, banging, throwing, dropping)
- Finds hidden objects easily
- Looks at correct picture when the image is named
- Imitates gestures
- Begins to use objects correctly (drinking from cup, brushing hair, dialing phone, listening to receiver)

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- Shelov; Caring for your baby and young child 1991

Autism Warning Signs - BabyTalk

- ▶ By 2 to 3 months, your baby isn't making frequent eye contact.
- ▶ By 3 months, he isn't smiling at you and the sound of your voice.
- ▶ By 6 months, he doesn't laugh or make other joyful expressions.
- ▶ Around 8 months, he isn't following your gaze when you look away from him towards something else.
- ▶ By 9 months, he hasn't begun to babble.
- ▶ By 1 year, he isn't consistently turning to you when you call his name

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Gaze Following

- Active gaze following by 12 months
 - 335 words – known by 18 months
- Babies without Active gaze following or other patterns
 - 195 words known by 18 months

Brooks and Meltzoff; The development of gaze following and its relation to language
Developmental Science 8:6 (2005), pp 535–543

It Starts Much Earlier Than We Think

- In 1979, University of Washington psychologist Andy Meltzoff stuck out his tongue at a baby that was just 42 minutes old, then sat back to see what happened. After some effort, the baby returned the favor, slowly rolling out his own tongue. Meltzoff stuck his tongue out again. The infant responded in like manner.

- Meltzoff and Moore; Newborn Infants Imitate Adult Facial Gestures; Child Development, 1983 54, 702-709

It Starts Much Earlier Than We Think

- Meltzoff discovered that babies could imitate right from the start of their little lives (or, at least, 42 minutes from the start of their little lives).
 - Meltzoff and Moore; Newborn Infants Imitate Adult Facial Gestures; Child Development, 1983 54, 702-709

It Starts Much Earlier Than We Think

- From birth to six months – babies look into parent's eyes
- At six months, they begin to look at mouths to help them form words
- At twelve months, they shift back to eyes
- Infants deploy selective attention to the mouth of a talking face when learning speech
Social Sciences - Psychological and Cognitive Sciences: David J. Lewkowicz and Amy M. Hansen-Tift *PNAS* 2012 109 (5) 1431-1436; published ahead of print January 17, 2012, doi:10.1073/pnas.1114783109
- Important to look at and talk with your baby

It Starts Much Earlier Than We Think

- “Amidst those cries, feedings, and photo-worthy coos, your baby’s brain is making vital, critical connections and developments that will determine how ready they are for their first day in kindergarten.”
- <http://www.urbanchildinstitute.org/articles/features/kindergarten-ready>

Active versus Passive

- **Active**
 - Looking, following, reaching
 - Tummy time – as babies raise their head, they become more aware of objects outside their reach
 - These objects stimulate babies to begin movement to get it

Active versus Passive

- **Passive**
 - Looking, following
 - The “Container”
 - Toys that get their visual attention but do not require movement to get to them



Do Milestones Need to Be Adjusted?

- Base milestones on gestational age rather than chronological age
 - Growth and development follows a uniform pattern
 - Baby will do things when ready
 - Baby will do things at their own rate
- Observe what the baby can do
- Many will not be able to engage in activities due to health issues – feeding tubes, etc.
- Adjust manner in which activities are encouraged

Do Milestones Need to Be Adjusted?

- Depending on conditions, encourage looking from first day
- Since so many milestones have a vision component, make sure vision is stimulated

How Does This Relate to Vision?

- The genesis for movement is strongly linked to vision
 - If you don't see it you can't move toward it
 - If you don't practice moving toward it, to cannot become proficient
- It is the process of seeing and moving that leads to visual development and thereby overall development

We Even Learn About Vision From the Blind

- To the sighted infant, people and objects remain visible even when direct physical contact has ceased. The sounds and noises they make become connected to their visible impressions. The continuity and connection of sensory experiences provides a major contribution for the "permanence" of objects to emerge. Later, the child comes to understand that things continue to exist even when not perceived, and will search or move to find them.

- *Fraiberg, Selma "Insights From The Blind," London: Souvenir Press (Educational and Academic) Ltd., 1977.*

How do We Examine a Baby?

- When considering the best care for children, these are the areas of evaluation necessary for every baby
 - History
 - Ocular motility
 - Binocular function
 - Refraction
 - Visual acuity
 - Eye health evaluation including dilation

How do We Examine a Baby?

- **History**
- **Basics are important but what else is needed**
 - Parent/Caregivers view of how the baby “looks” – how they search for information
 - A lot of variability in the first few months – especially with prematurity
- **Ocular motility**
 - Don't expect sustained fixation in the first few days/months but they will find things in the room
 - Lights are more attractive than other targets
 - Looking for limitations of movement

How do We Examine a Baby?

- Binocular function
 - Variable alignment during first four months but increasing consistency in alignment
 - Stereopsis measurable as soon as they can begin to reach
- Refraction (amount of nearsightedness, farsightedness, astigmatism, etc.)
 - Objective measurement with a light (retinoscope)
 - Considerable variation during first few days that gradually shows more consistent fixation as they become more adept at “looking”

How do We Examine a Baby?

- Visual acuity (the 20/XX answer)
 - Several ways to measure but most common is Forced Choice Preferential Viewing



How do We Examine a Baby?

- Eye Health
 - External
 - Hand instruments that magnify
 - Internal
 - Dilating drops
 - Instruments to view the inside of the eye

Outcomes

- Address potential issues
 - Eye movement issues – baby's ability to look
 - Binocular issues – using both eyes together
 - Amblyogenic (lazy eye) factors
- Encourage visually interacting with the baby

What Should Parents Do?

- Watch as your baby looks and moves eyes – observation is your greatest ally
- Look at your baby and talk with your baby – never underestimate the importance of this
- Encourage caregivers to look baby in the eyes as they hold them or even talk with them – even in the NICU
 - Everyone is appropriately focused on survival yet the baby is going about the business of developing awareness through all senses

What Should Parents Do?

- Get them out of the “containers” and on to the floor as soon as possible and reasonable
- “Tummy time” is important in vision development as well as overall development
- When "playing," really play – don't just be in their presence and talking from across the room – be active
- Promote overall development of which vision is a part

What Should Parents Do?

- It is ok to be silly or crazy but remember to make eye contact and encourage them to do the same.
- Get down on the floor on their level
- When changing, dressing, and when you get to feed them, look at them and talk with them
- Bottom line – engage them visually from the earliest moments possible – especially in the presence of prematurity

What Can Others Do?

- InfantSEE[®] is a public health initiative about caring for the eye and vision care needs for humans beginning at birth and continuing throughout their lifetime – **It's about changing lives**

What Can Others Do?

- Promote early identification and care through the program in your city, your state, and especially with the parents of the babies with whom you have contact – year round all the time

Links to Vision are Everywhere

- InfantSEE[®] is a program for every baby – not just those with problems
- BUT - When you do have a baby who is not at the expected levels always consider vision as one of the contributing factors
- Don't assume that vision has already been checked simply from screening results – a full examination is needed

My Challenge to Caregivers

- Remember these ten very important words
- I Will Walk With You Every Step of the Way
- By doing so, babies will get an earlier start toward success and the parents will have someone to help them better understand the diagnosis, it's implications and possibilities of treatment.

How to find an InfantSEE Optometrist

- Link with an InfantSEE[®] provider in your area – www.infantsee.org or 1-888-396-EYES (3937)
- Enter your zip code and be sure to select InfantSEE provider