Diseases and Medical Conditions of the Infant that Interfere with Successful Feeding

October 27, 2011

Carlos Botas MD

Objectives

1. Identify infants at high risk for feeding difficulties
2. Identify strategies for supporting successful feedings
3. Identify infants appropriate for referral to a feeding specialist

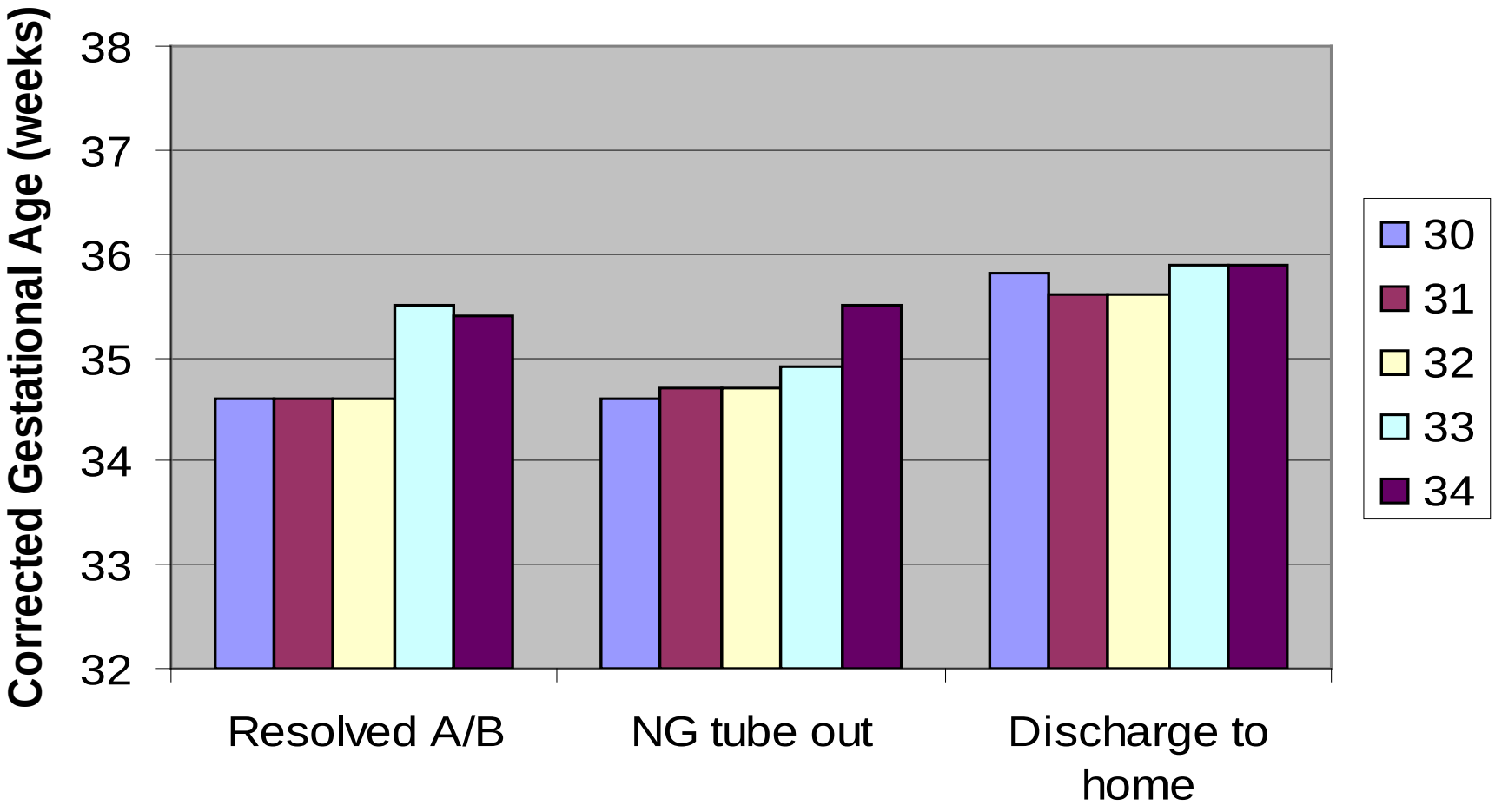
Diseases and Medical Conditions of the Infant that Interfere with Successful Feeding

- Prematurity
  - Chronic Lung Disease/ BPD
  - Necrotizing Enterocolitis
  - PDA
  - Intraventricular Hemorrhage
  - Porencephalic Cyst
- Cleft Palate / Cleft Lip
  - Pierre Robin Sequence
  - DiGeorge Syndrome
- Hypotonia
  - Down Syndrome
  - Prader Willi Syndrome
  - Zellweger Syndrome
  - Spinal Muscular Atrophy
- Ankyloglossia (tongue-tie)
- Hypoxic Ischemic Encephalopathy
  - Neonatal seizures
- Bowel Obstruction
  - TE fistula
  - Duodenal Atresia
- Pulmonary anomalies
  - Congenital Diaphragmatic Hernia
  - Congenital Cystic Adenomatoid Malformation
- Congenital Heart Disease
  - Transposition of Great Arteries
  - Hypoplastic Left Heart Syndrome
  - Tetralogy of Fallot
- Neonatal Sepsis / Meningitis
  - Meconium Aspiration Syndrome
- AND MANY OTHERS

Why do we care about successful feedings?

- Most common patients in a NICU
  - Premature infants
  - Hyperbilirubinemia
  - Rule out sepsis
- Barriers to discharge home (premature infants)
  - **Feeding adequately (breast and/or bottle)**
  - **Resolved Apnea / Bradycardia episodes**
  - Adequate weight gain / size
  - Thermoregulation
  - Absence of infection
  - Oxygen need / respiratory support

Barriers to Discharge from the NICU



Eichenwald et al. Pediatrics 2001 (435 infants – all 30 to 34 wks)

Case One

The neonatal team is rounding in the ICN and reviewing the care of Baby Washington.

She is a 35 day old, ex- 26 week premature infant with a corrected gestational age of 31 weeks.

Current weight 1300 grams

Feedings of MBM (24 calorie) at 25 ml every 3 hrs.

All feedings by nasogastric tube

Room air, no respiratory support

Normal head sonogram at 7 and 14 days of age

NICU Hospital Course:

- Intubated at birth, given surfactant and extubated at 48 hours of age. Nasal CPAP for 3 days, then nasal cannula.
- No PDA noted by exam or echocardiogram.
- Initially started on TPN and lipids. NG feeds introduced at 3 days of age and gradually advanced without difficulty.
- Positive blood culture for E.coli at 14 days of age. Treated with full course of IV antibiotics. Repeat cultures (including CSF) were negative.
- No evidence of NEC.
- Normal head sonograms

The mother at the bedside has lots of questions about feedings.

When can we start breast feeding?

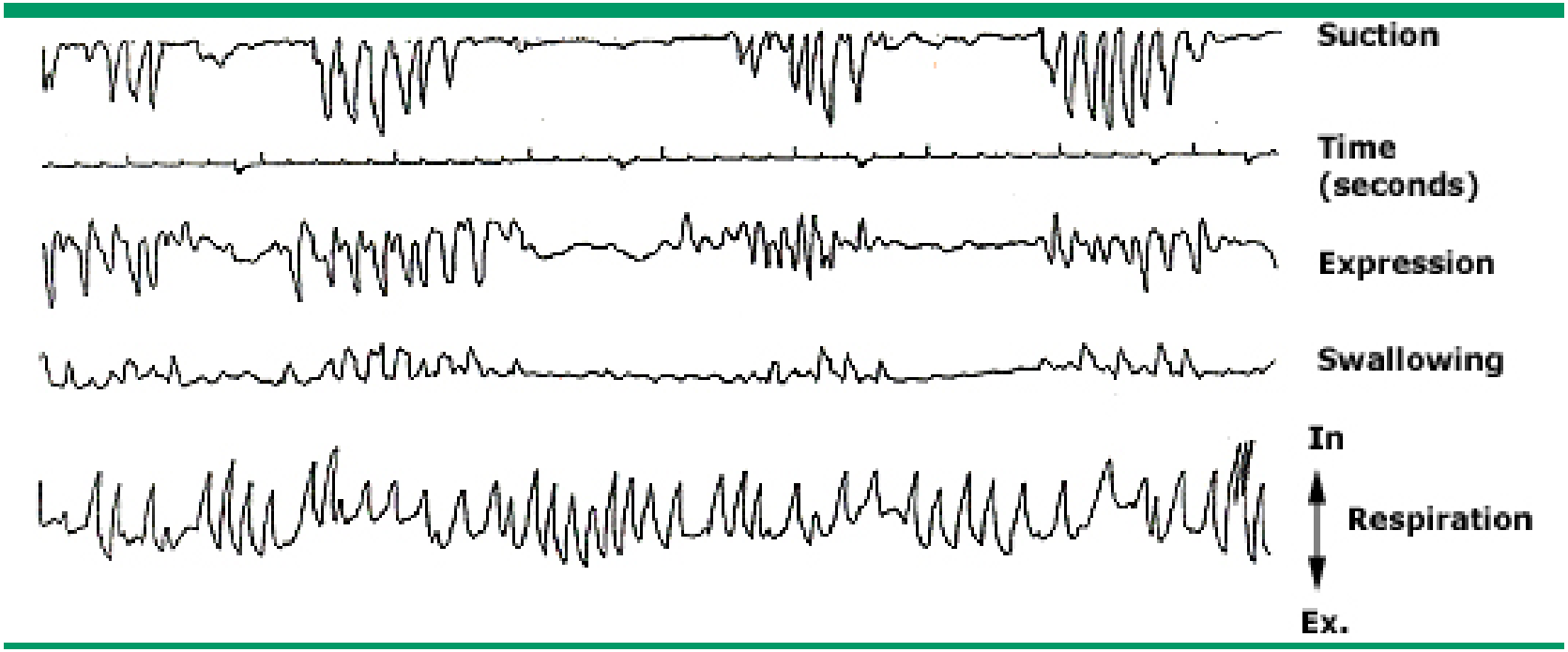
When can we start bottle feeding?

Does she have any risk factors for not feeding well?

A Quick Review… the Mechanics of Successful Feeding

- Sucking
- Swallowing
- Suck – Swallow – Breath Coordination
- Infant's Behavioral State
- Infant's Organization

Simultaneous recordings of suction, expression, swallowing, and respiration from an 8-day-old term infant



Time markers are in seconds.

Patterns of Feedings for Premature / Immature Infants

Stage		Sample tracings	Suction/expression amplitude range of tracings, mm Hg	Description
1A and/or 1B	Suction		Absent	No Suction
	Expression		+0.5 to +1.0	Arrhythmic expression
	Time, sec			**and**
	Suction		-2.5 to -12.5	Arryhthmic alternation Suction/expression
	Expression		+0.5 to 1.0	
2A and/or 2B	Suction		Absent	No Suction
	Expression		+0.2 to +0.4	Rhythmic expression
	Time, sec			**and**
	Suction		-7.5 to -15.0	Arrhythmic alternation of: - Suction/expression - Presence of sucking bursts
	Expression		~ +0.2	

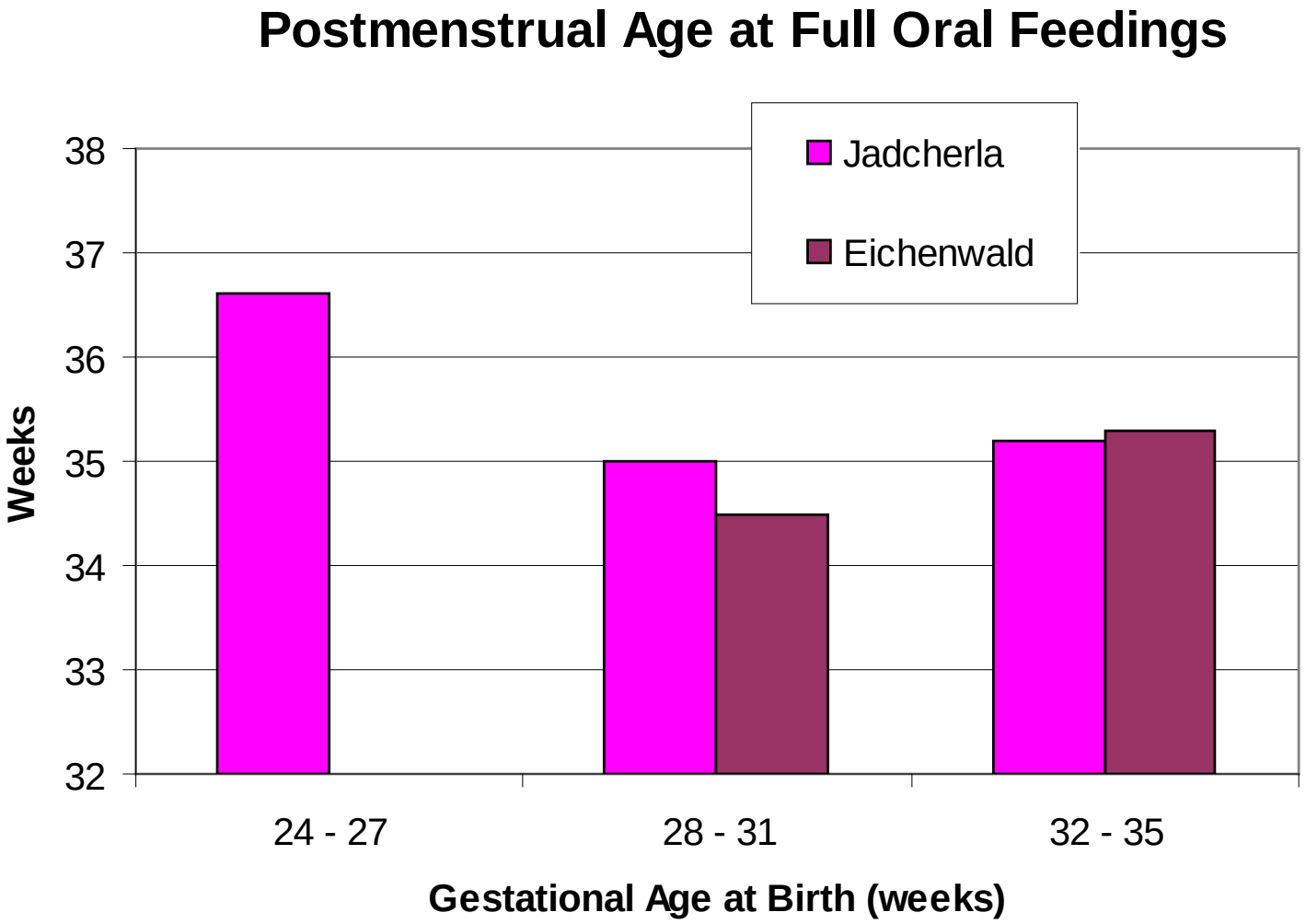
Sucking

- Use of lips, cheeks, tongue and palate to draw milk into the mouth
- Milk is propelled into back of the pharynx
- Mature sucking – rhythmic alternation between suction and expression of milk
- Two types of suction
  - Nutritive – during feedings
    - Usually introduced at 33 – 34 weeks
  - Nonnutritive – no milk is transferred

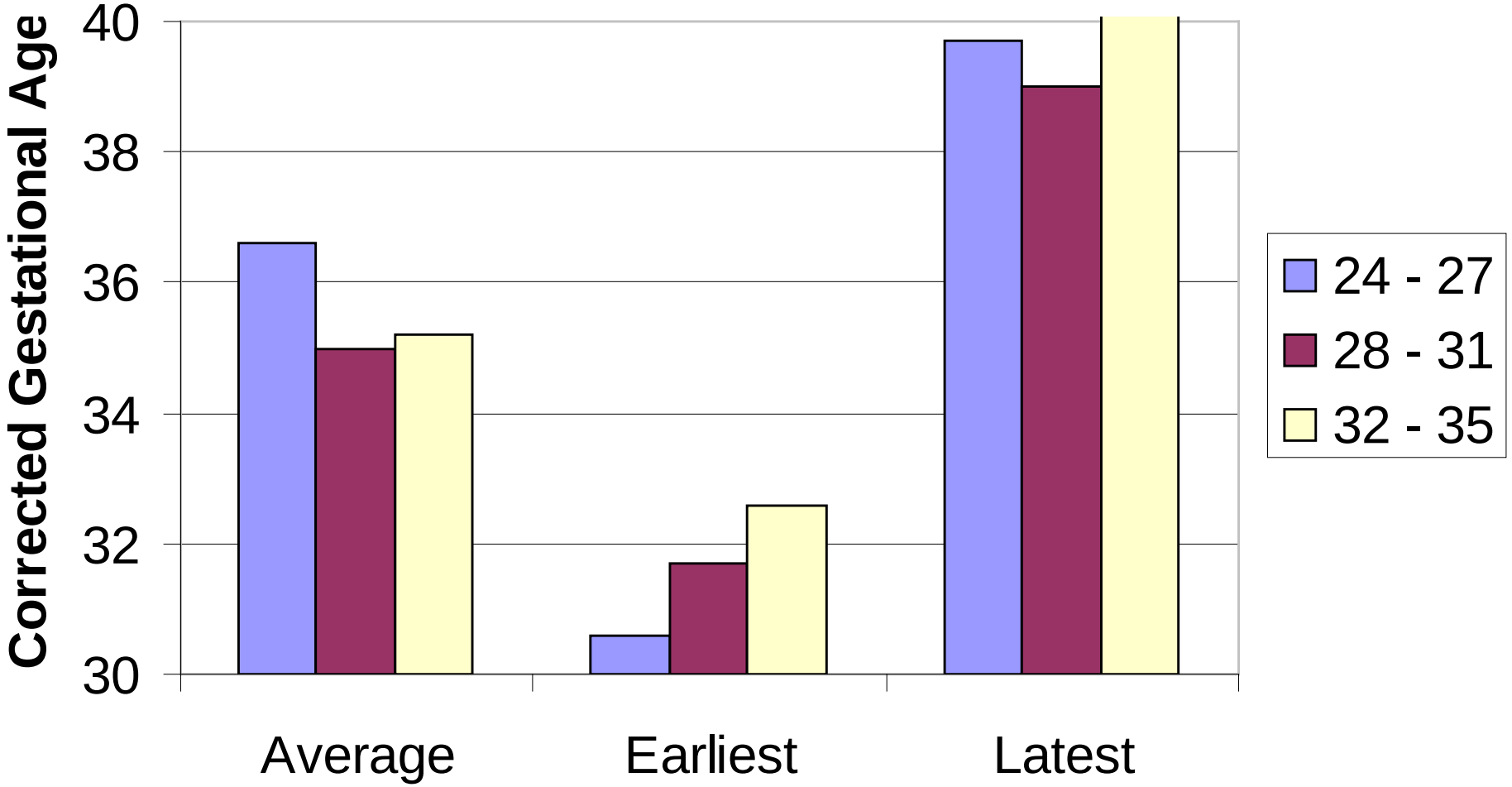
What is the Average Gestational Age when premature infants feed successfully?

- 34 weeks
- 35 weeks
- 36 weeks
- 37 weeks

What is the Average Gestational Age when premature infants feed successfully?



What Is The Range When Premature Infants Feed Successfully?



Jadcherla et al. 2010

What factors are associated with more or less success with feedings?

Gestational Age?

Severe Respiratory Distress Syndrome and Ventilation?

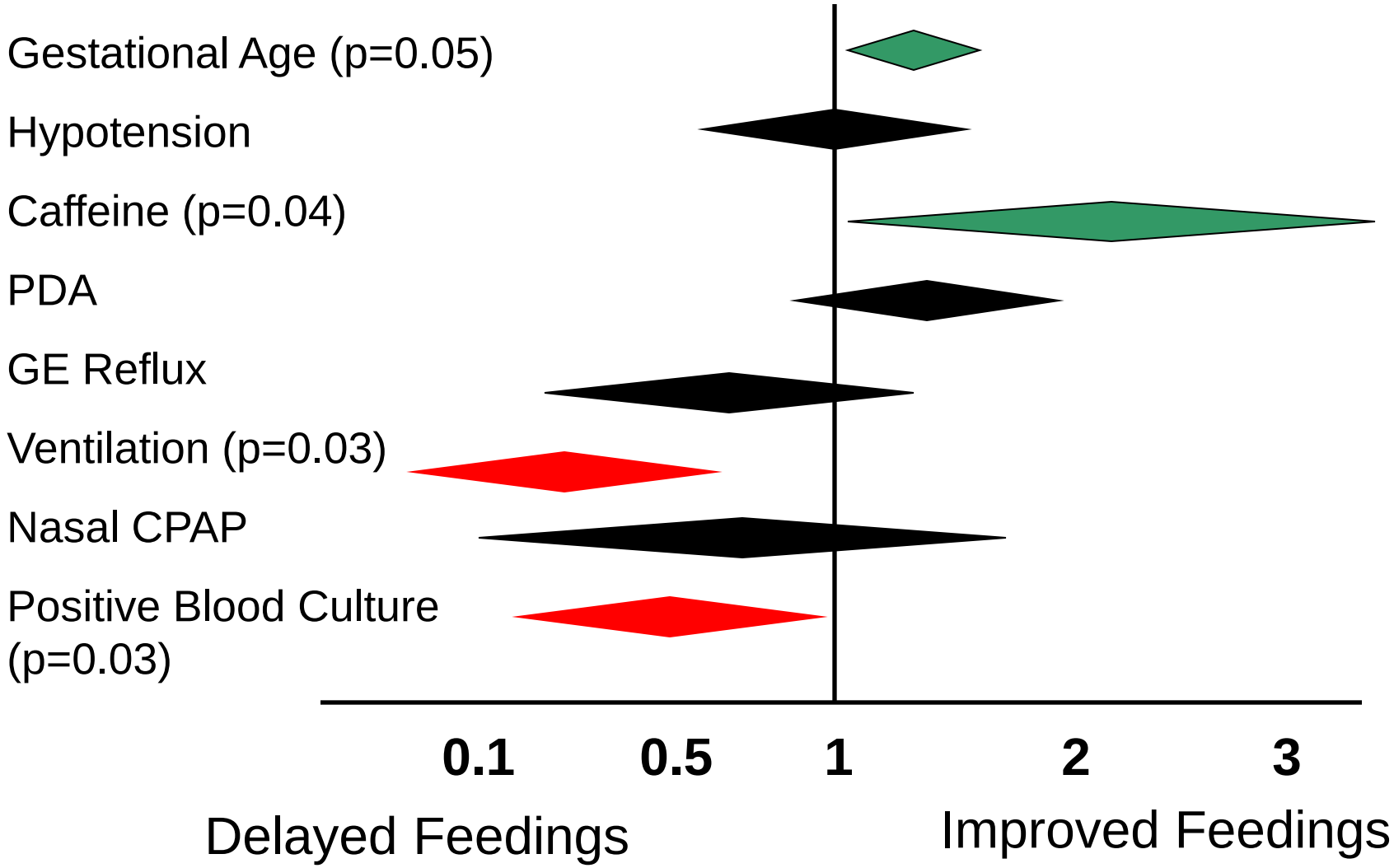
Apnea of Prematurity? Use of Caffeine?

Cardiac Disease (i.e. Hypotension, PDA)?

Infections / Neonatal Sepsis?

GI Diseases (NEC, GE Reflux)?

Co-existing Parameters and Time to obtain maximal Oral feedings



Back to the mother's questions…

When can we start breast feeding?

31 – 34 weeks when infant show interest

When can we start bottle feeding?

NICU dependent – usually 32 – 34 weeks

Does she have any risk factors for not feeding well?

Prematurity

Neonatal Sepsis (E. Coli)

RDS and ventilation

Case Two

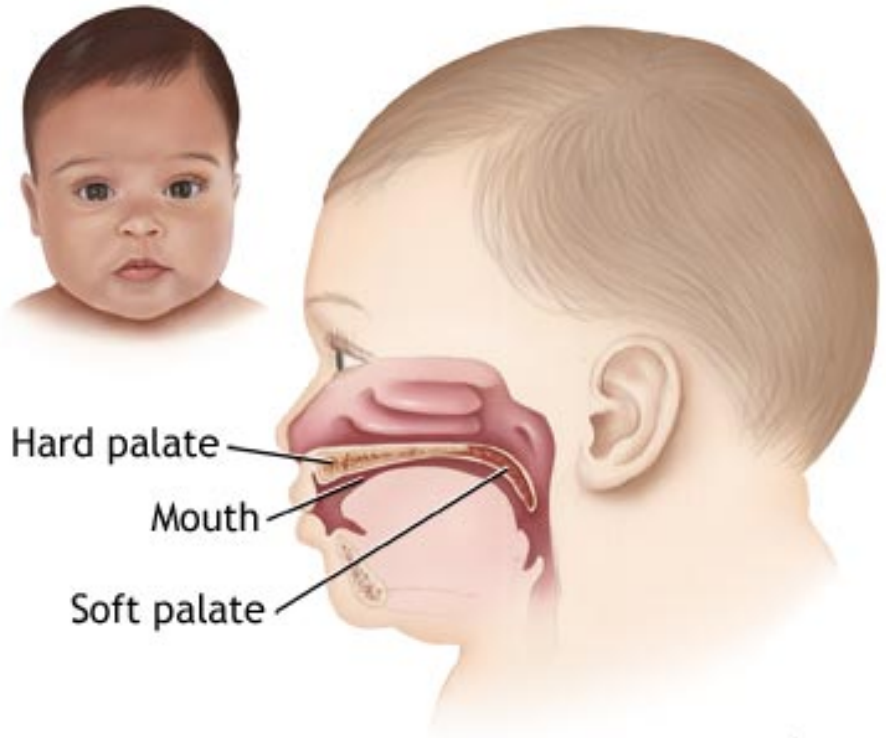
Baby Adams is a newborn infant prenatally diagnosed with bilateral cleft lip and palate. No other anomalies were discovered and the amniocentesis was normal.

The infant is admitted to the ICN at 2 days of age for hyperbilirubinemia and phototherapy.

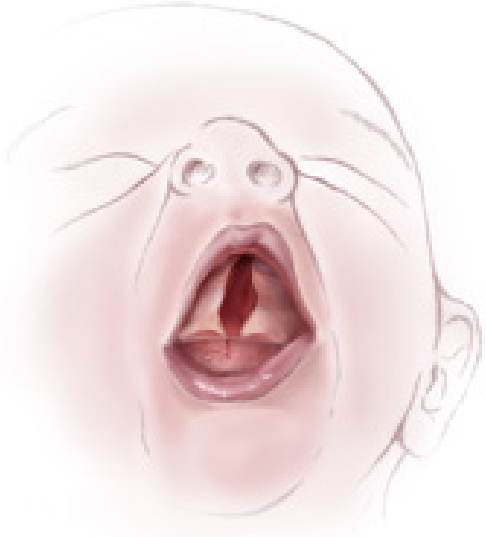
The mother reports that he is feeding poorly from the breast and bottle.

Cleft Lip / Palate

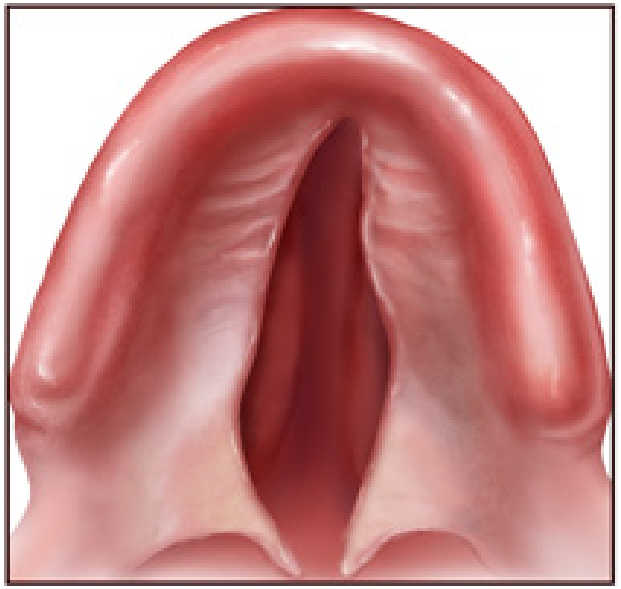
- Approximately 1 / 700 infant
- Cleft palate results in opening between oral and nasal cavity = velo-pharyngeal inadequacy
- Infant unable to produce adequate SUCKING to draw milk into oropharynx
- SWALLOWING mechanism is usually intact
- 25 to 30% of infants with non-syndromic cleft palate have difficulty with feedings



A.D.A.M.



Baby with cleft palate



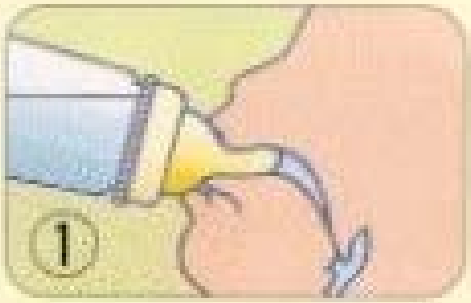
Cleft palate

Haberman Nipple

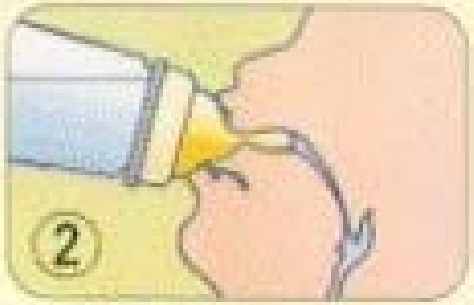
Mead Johnson
Cleft Palate Nurser

Pigeon Nipple

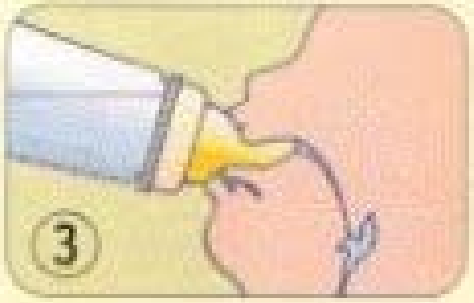
Peristaltic Movement



The front edge of a tongue moves a little beyond the gum, and the center of the tongue becomes hollow.



The edge of the tongue rises, and the top moves backwards.



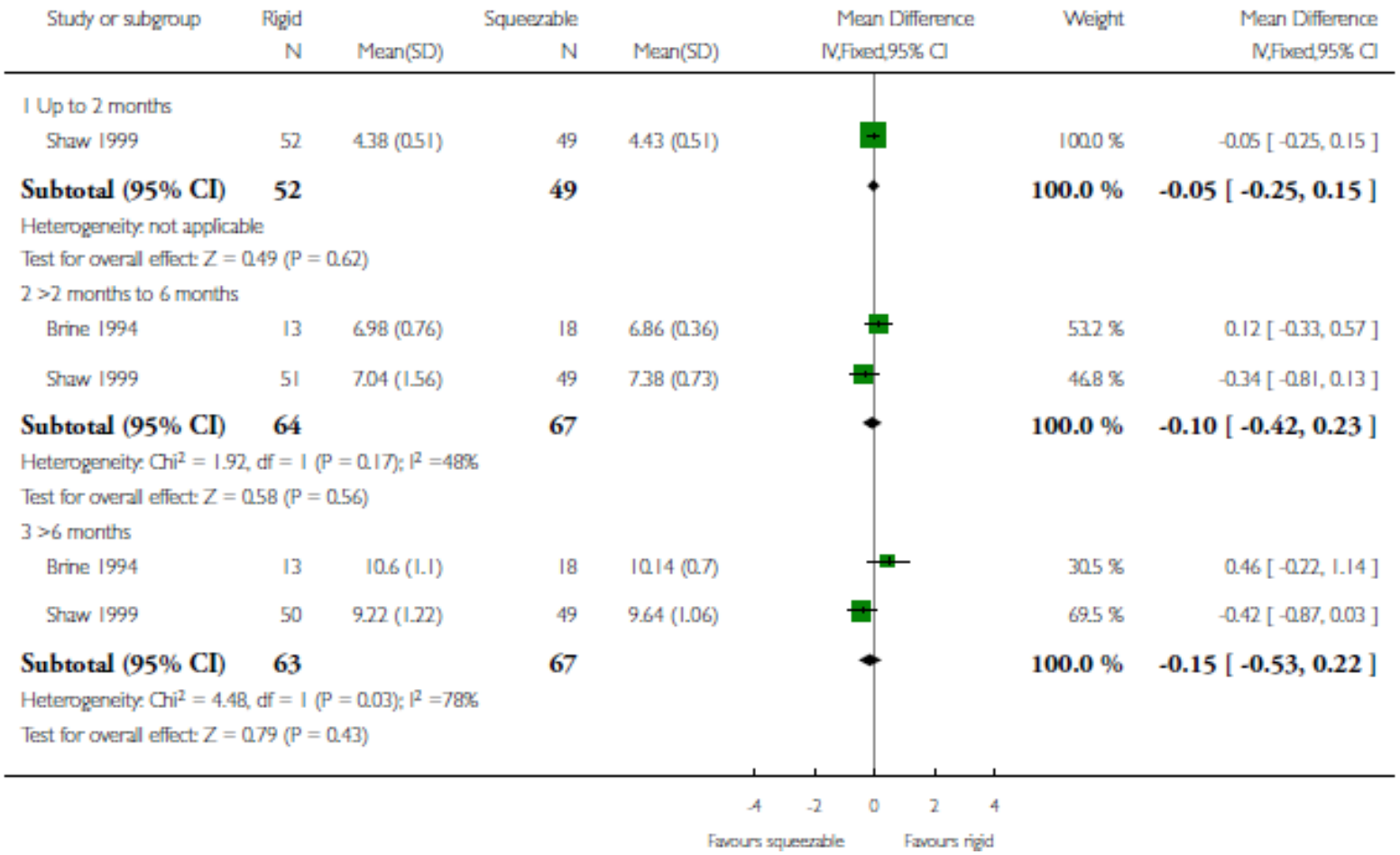
The top moves further backwards, and the peristaltic movement of ①, ② and ③ are repeated.

Analysis 1.1. Comparison 1 Rigid versus squeezable bottle, Outcome 1 Weight (kg).

Review: Feeding interventions for growth and development in infants with cleft lip, cleft palate or cleft lip and palate

Comparison: 1 Rigid versus squeezable bottle

Outcome: 1 Weight (kg)



Feeding interventions for growth and development in infants with cleft lip, cleft palate or cleft lip and palate. Cochrane Database, February 2011

Analysis 1.3. Comparison 1 Rigid versus squeezable bottle, Outcome 3 Head circumference (cm).

Review: Feeding interventions for growth and development in infants with cleft lip, cleft palate or cleft lip and palate

Comparison: 1 Rigid versus squeezable bottle

Outcome: 3 Head circumference (cm)

Study or subgroup	Rigid N	Mean(SD)	Squeezable N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Up to 2 months							
Shaw 1999	52	38.1 (1.5)	49	38.5 (1.5)		100.0 %	-0.40 [-0.99, 0.19]
Subtotal (95% CI)	**52**		**49**			**100.0 %**	**-0.40 [-0.99, 0.19]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.34 (P = 0.18)							
2 >2 months to 6 months							
Brine 1994	13	43.6 (1)	18	43.4 (1.1)		31.5 %	0.20 [-0.54, 0.94]
Shaw 1999	51	43.5 (1.23)	49	44 (1.34)		68.5 %	-0.50 [-1.00, 0.00]
Subtotal (95% CI)	**64**		**67**			**100.0 %**	**-0.28 [-0.70, 0.14]**
Heterogeneity: Chi^2 = 2.33, df = 1 (P = 0.13); I^2 =57%							
Test for overall effect: Z = 1.31 (P = 0.19)							
3 >6 months							
Brine 1994	13	48.5 (1.7)	18	48.2 (0.64)		25.9 %	0.30 [-0.67, 1.27]
Shaw 1999	50	46.1 (1.49)	49	47.1 (1.42)		74.1 %	-1.00 [-1.57, -0.43]
Subtotal (95% CI)	**63**		**67**			**100.0 %**	**-0.66 [-1.16, -0.17]**
Heterogeneity: Chi^2 = 5.11, df = 1 (P = 0.02); I^2 =80%							
Test for overall effect: Z = 2.64 (P = 0.0084)							

Pierre Robin Sequence

- Micrognathia (small mandible)
- Cleft Palate (U shaped)
- Glossoptosis - Posterior displacement of the tongue
- Airway Obstruction

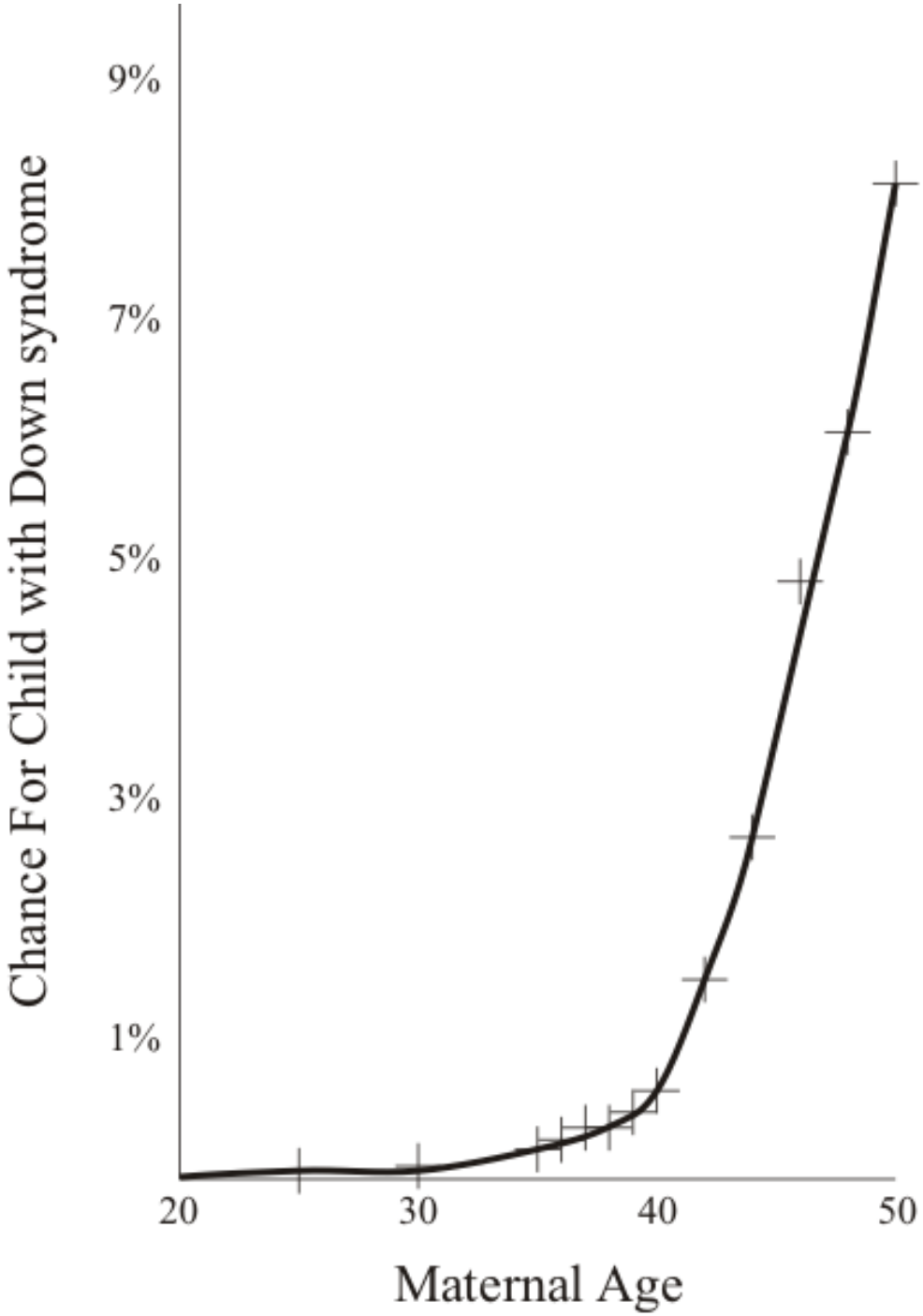
Case Three

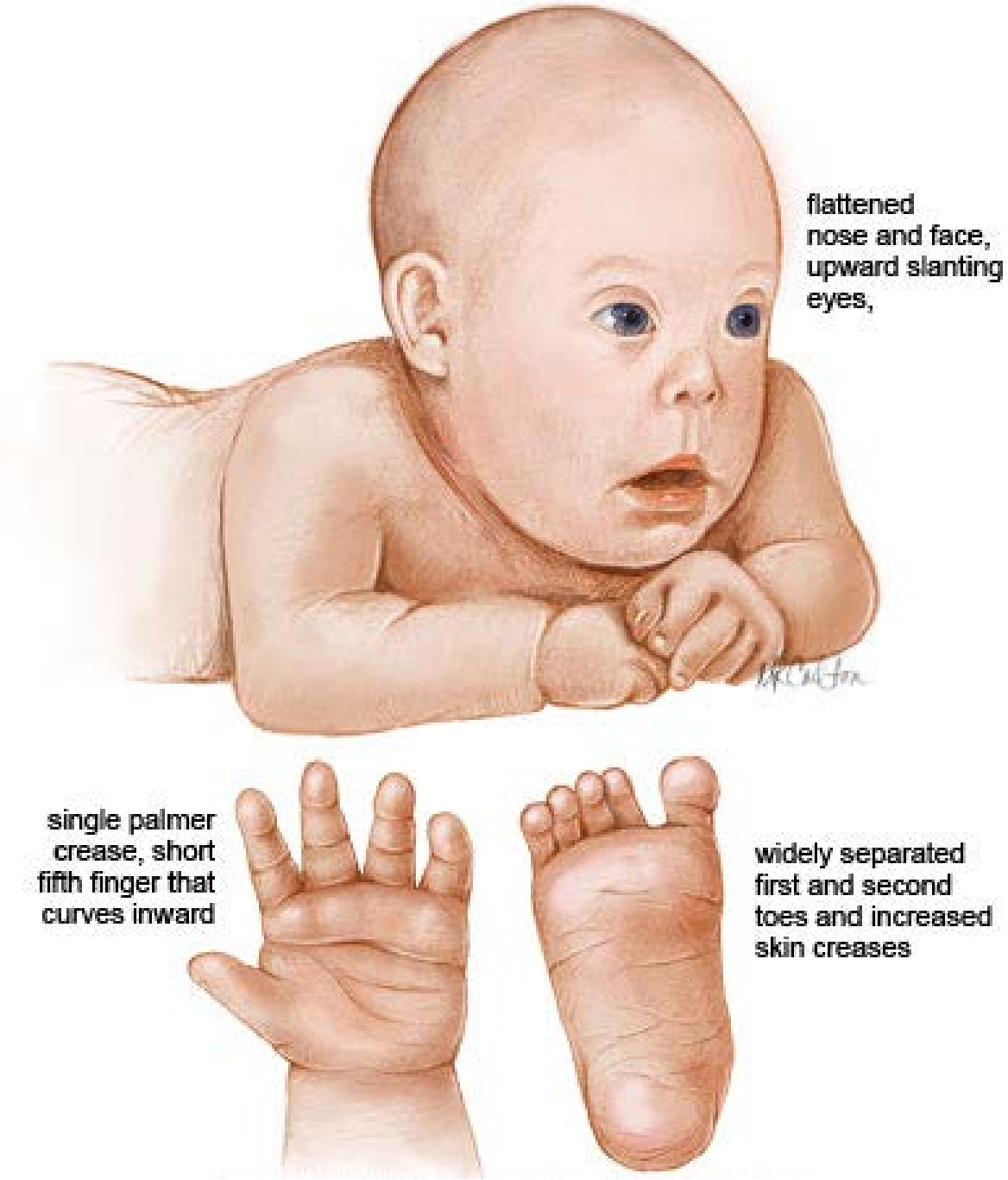
Baby Jefferson is a newborn male born to a 43 year old mother this morning. The mother was late to prenatal care and did not have prenatal screening including an ultrasound or amniocentesis.

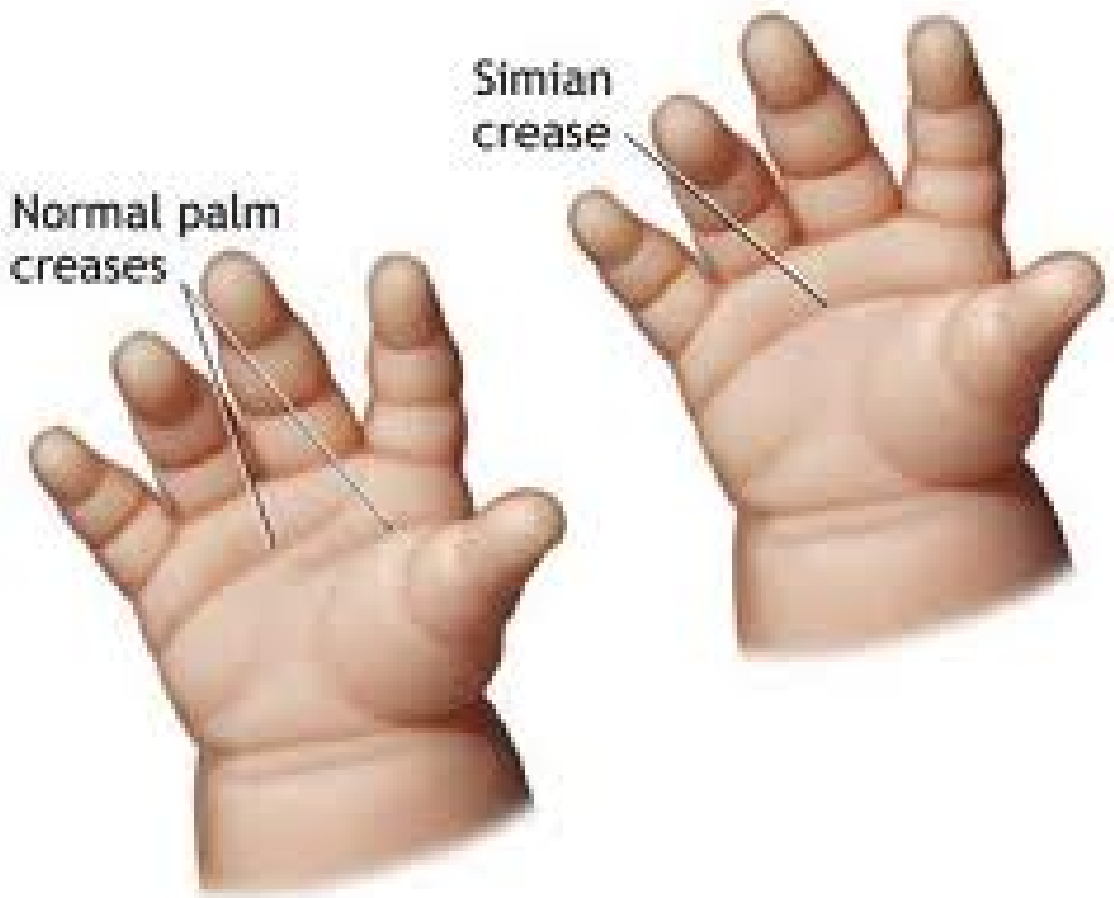
The infant is noted after birth to be hypotonic (floppy) and the parents are concerned about his appearance.

Down Syndrome

- Trisomy 21 (extra copy of Chromosome 21)
- Most common chromosomal malformation
  - Estimated 6000 infants born annually in USA
- Increased frequency with advanced maternal age
- Hypotonia often leads to feeding difficulties
- Successful breastfeeding is less likely in infants with Down Syndrome.
    - 48% vs. 78% ($p < 0.05$)
    - Wiejerman et al. J Peds 2009


Chance For Child with Down syndrome
9%
7%
5%
3%
1%
20
30
40
50
Maternal Age


flattened
nose and face,
upward slanting
eyes,
single palmer
crease, short
fifth finger that
curves inward
widely separated
first and second
toes and increased
skin creases


Simian
crease
Normal palm
creases

What are the most common signs of Down Syndrome in a newborn?

- Hypotonia (floppiness)
- Poor feeding
- Congenital Heart Disease
- Bowel Obstruction
  - Duodenal Atresia
  - Hirschsprung's Disease
- Protruding Tongue

Prader – Willi Syndrome

- Deletion of part of Chromosome 15
- Occurs 1 / 15,000 births
- Newborn presentation
  - Hypotonia
  - Poor sucking and feeding / Failure to Thrive
  - Underdeveloped genitalia (undescended testes in boys)
  - Typical facies

- Facial features of Prader Willi Syndrome
  - “Almond” shaped eyes
  - Narrowing of head at temples
  - Small down-turned mouth
  - Thin upper lip
- Obesity and Over-eating in older children and adults with Prader Willi Syndrome

Case Four

Baby Madison is a 3 week old infant born at 40 weeks. He was diagnosed with Transposition of the Great Arteries shortly after birth and underwent cardiac surgery at 5 days of age. He has recovered from surgery but is not feeding well.

The parents are concerned about his delay in establishing breastfeeding.

Congenital Heart Disease

- 8 / 1000 live births
- Most commonly acyanotic heart disease
  - VSD
  - PDA
- Significant delay in successful feedings in infants with congenital heart disease.
- Cyanotic heart disease infants were most delayed

Feeding abilities in neonates with congenital heart disease: a retrospective study

Jadcherla et al, Journal Perinatology 2009

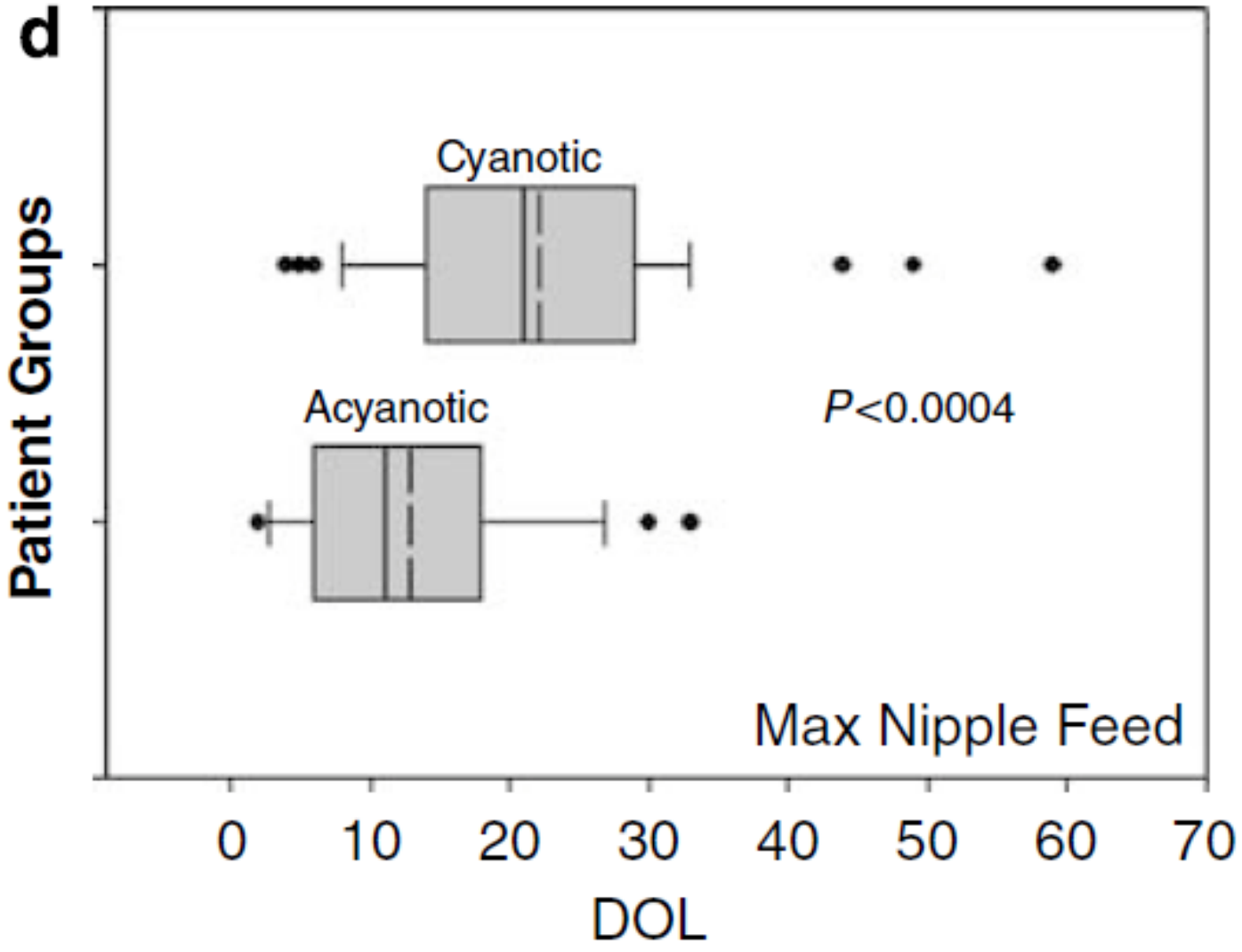
76 infants with Congenital Heart Disease

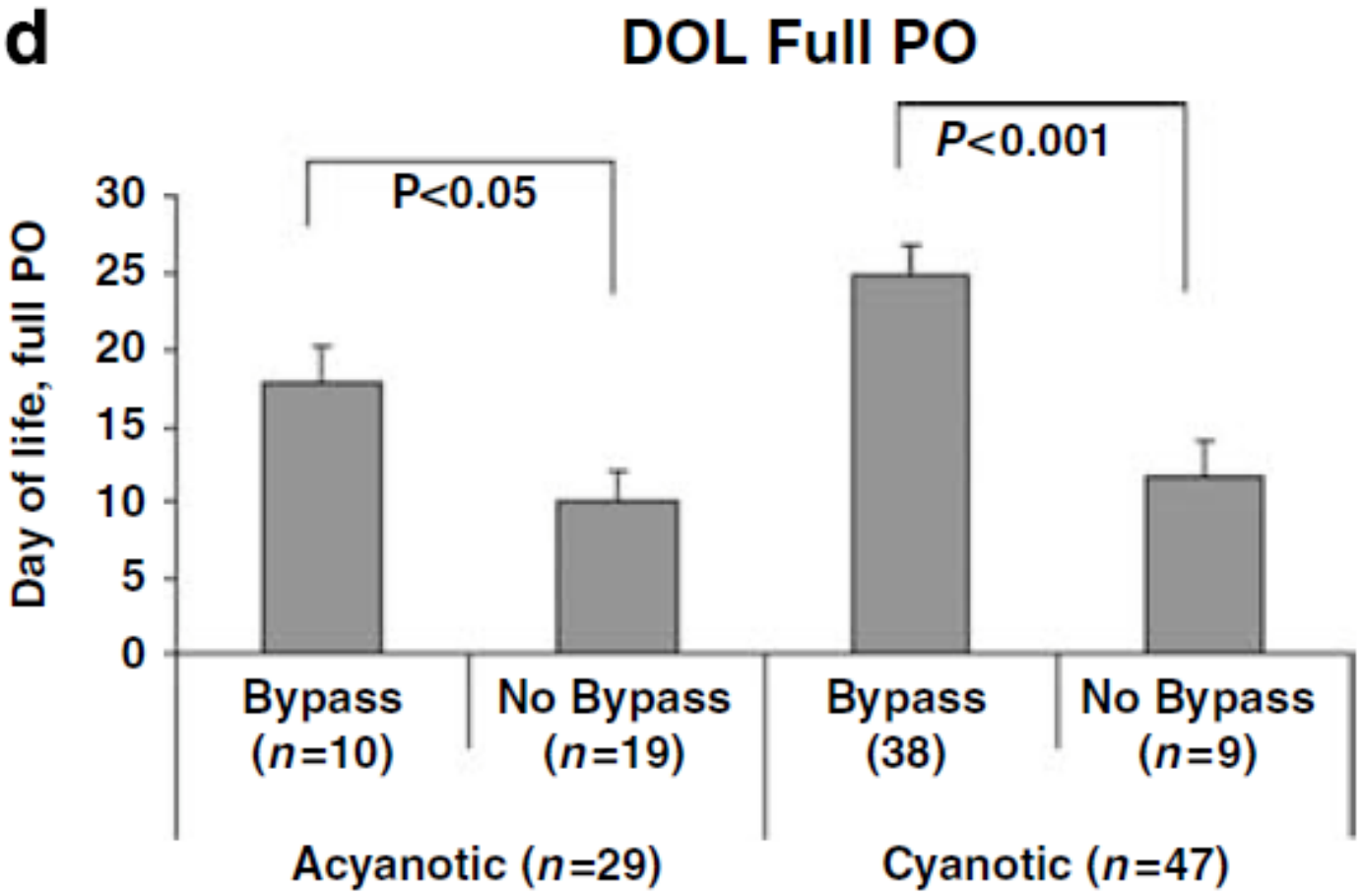
- 29 acyanotic heart disease
- 47 cyanotic heart disease

93% achieved full nipple feedings at discharge
7% discharged home on gavage feeds

Corrected Gestational Age at Discharge

Acyanotic CHD = 41.4 weeks
Cyanotic CHD = 42.3 weeks


d
Patient Groups
Cyanotic
Acyanotic
P<0.0004
Max Nipple Feed
0
10
20
30
40
50
60
70
DOL


d
DOL Full PO
P<0.05
P<0.001
Day of life, full PO
30
25
20
15
10
5
0
Bypass
(n=10)
No Bypass
(n=19)
Bypass
(38)
No Bypass
(n=9)
Acyanotic (n=29)
Cyanotic (n=47)

Case Five

Baby Monroe is a 2 week old baby boy born by emergent C-section for placental abruption. He was profoundly depressed at birth and underwent a vigorous and prolonged resuscitation.

The infant was treated with body cooling after birth. He developed neonatal seizures at 24 hours of age. An MRI of the brain showed typical findings of Hypoxic Ischemic Encephalopathy.

He has weaned off all respiratory support and is receiving full feeds by NG tube.

What is Hypoxic Ischemic Encephalopathy?

Hypoxic Ischemic Encephalopathy (HIE)

- Hypoxia – deficiency of O2 reaching the tissues
- Ischemia – decreased blood flow to tissue
- Encephalopathy – Injury to the brain

- ***HIE – Injury / Damage to the brain due to lack of oxygen / blood flow***

- ***Incidence approximately 1-2 / 1000 live births***
- ***Approximately 4000 – 8000 cases in US / yr***

HIE Clinical features

- 0 to 24 hours of age
  - Stupor or Coma
  - Periodic breathing or respiratory failure
  - Hypotonia (floppy) or Hypertonia (stiffness)
  - Seizures
  - Apneic episodes
- 24 to 72 hours of age
  - Stupor or Coma
  - Respiratory Arrest
  - Persistent Seizures
  - IVH or catastrophic bleed in preterm infants

HIE Clinical features (continued)

- After 72 hours of age
  - Decreased but persistent stupor
  - **Abnormal sucking, gag and tongue movements**
  - Development of Hypertonia
  - Increased DTR (increased reflexes)
  - Weakness, proximal, arms > legs

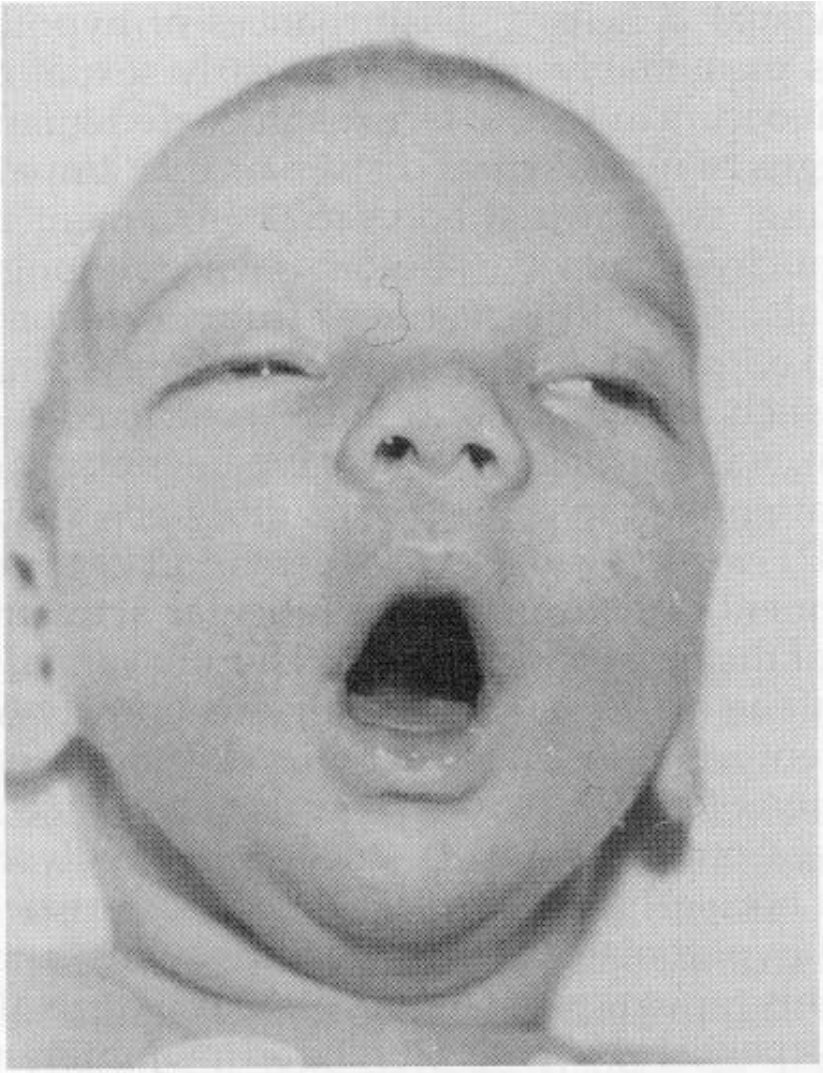


Figure 9-37 Facial appearance at age 1 month in an infant who experienced perinatal asphyxia. Note dysconjugate gaze, ptosis, marked facial weakness, and wide-open mouth. Infant also exhibited fasciculations of the tongue on physical examination. (From Roland EH, Hill A, Norman MG, et al: *Ann Neurol* 23:39, 1988.)

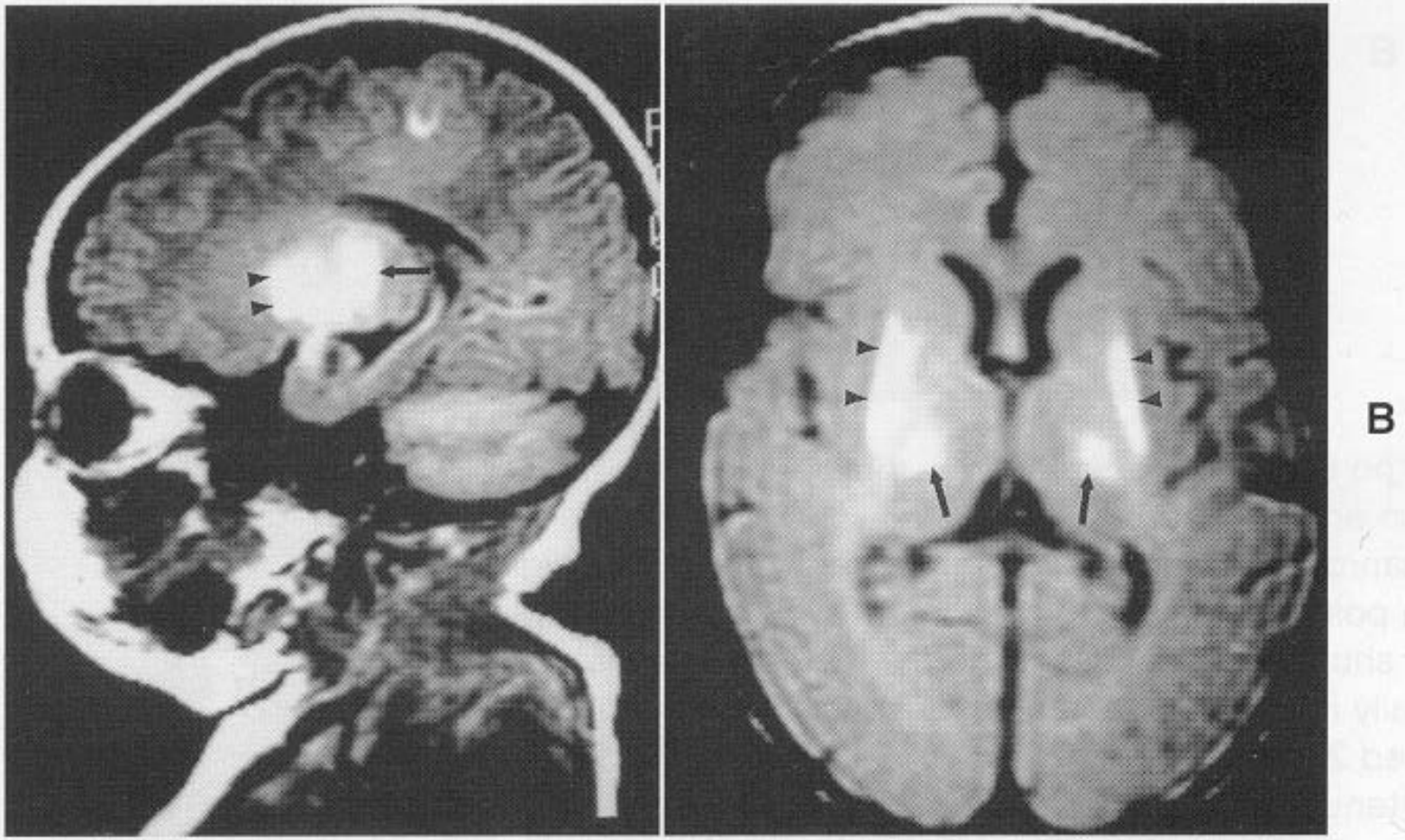


Figure 9-22 MRI scans of hypoxic-ischemic injury to basal ganglia and thalamus. Scans obtained from a 5-day-old infant who experienced severe perinatal asphyxia. **A,** Note in the parasagittal T1-weighted image markedly increased signal in basal ganglia, especially putamen *(arrowheads),* and in thalamus *(arrow).* **B,** The axial proton density image also demonstrates the injury well in the same distribution. (Courtesy of Dr. Patrick Barnes.)

The NEW ENGLAND JOURNAL of MEDICINE

2005

ORIGINAL ARTICLE

Whole-Body Hypothermia for Neonates with Hypoxic–Ischemic Encephalopathy

Seetha Shankaran, M.D., Abbot R. Laptook, M.D., Richard A. Ehrenkranz, M.D.,

Feeds at Discharge from Hospital	Hypothermia (105 infants)	Control (106 infants)
Gavage Feeds	**11%**	**7%**
Gastrostomy Feeds	**7%**	**17%**
Nipple Feeds (all)	**82%**	**76%**
Death	*24%*	*37%*

Diseases and Medical Conditions of the Infant that Interfere with Successful Feeding

- Prematurity
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  - Congenital Cystic Adenomatoid Malformation
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