

**Herczegfalvi Ágnes**

# **Neurological Examination of Infants**

**SE II. sz. Gyermekklinika**



**Budapest, 2016-09-14.**

# The elements of a complete neurological assessment

- Focused clinical history
- Physical examination
- Detailed neurological examination

Presumptive diagnosis,  
Differential diagnosis  
and  
plan for laboratory  
evaluation

We test the child's:

**mental status**

**motor skills**

**sensory skills**

**balance and coordination**

- In some cases, developmental screening tests are also helpful

**reflexes, functioning of the nerves**

# In infants and children

- **the history should include** information about
  - prenatal exposures and
  - symptoms and assessment of developmental milestones
- **Observations of infants and toddlers during play** (eg, while stacking blocks or playing with an age-appropriate toy)- **can** provide valuable information about
  - the patient's attention span
  - gross and fine motor coordination and
  - problem solving abilities
- **the higher cortical functions** are also assessed with a series of questions appropriate to the child's age

# General Physical examination

- 1. Height, weight, blood pressure, and head circumference. **Developmental scales!!**
- -Rule of thumb for head circumference is the 3 & 9 rule.
- AGE head circumference
  - newborn 35 cm
  - 3 month 40 cm
  - 9 month 45 cm
  - 3 yo 50 cm
  - 9 yo 55 cm
- 2. General appearance, including dysmorphology.
- 3. Skin exam: neurocutaneous lesions (ash leaf spots (TS), cafe au lait spots (NF), angiomas (SW), axillary freckling (?), adenoma sebaceum (?), or shagreen patches (?).
- 4. Location of the hair whorl (can signify presence of cerebral malformations) and appearance of palmar creases (*which genetic syndrome?*)
- 5. Quality of scalp hair, eyebrows, and nails. Friable, kinky hair may signify Menkes kinky hair disease that is associated with mental retardation and optic atrophy.
- 6. Exam of the midline of the back and neck for sacral dimples, tufts of hair, or other signs of spinal dysraphism.
- 7. Comparison of thumbnail sizes and their convexity. Abnormalities may signify a growth disturbance, which may be a sign of hemiparesis.
- 8. Presence of unusual body odor, which is present in some inborn errors of metabolism.
- 9. Hepatosplenomegaly .
- *Rule of thumb guides\*:* At 1 year:  $3 \times \text{birth weight}$  1-9 years:  $\text{Age (years)} \times 5 + 17$  ... At birth, *head circumference* exceeds chest circumference by 2-3 cm

# Cranial nerve

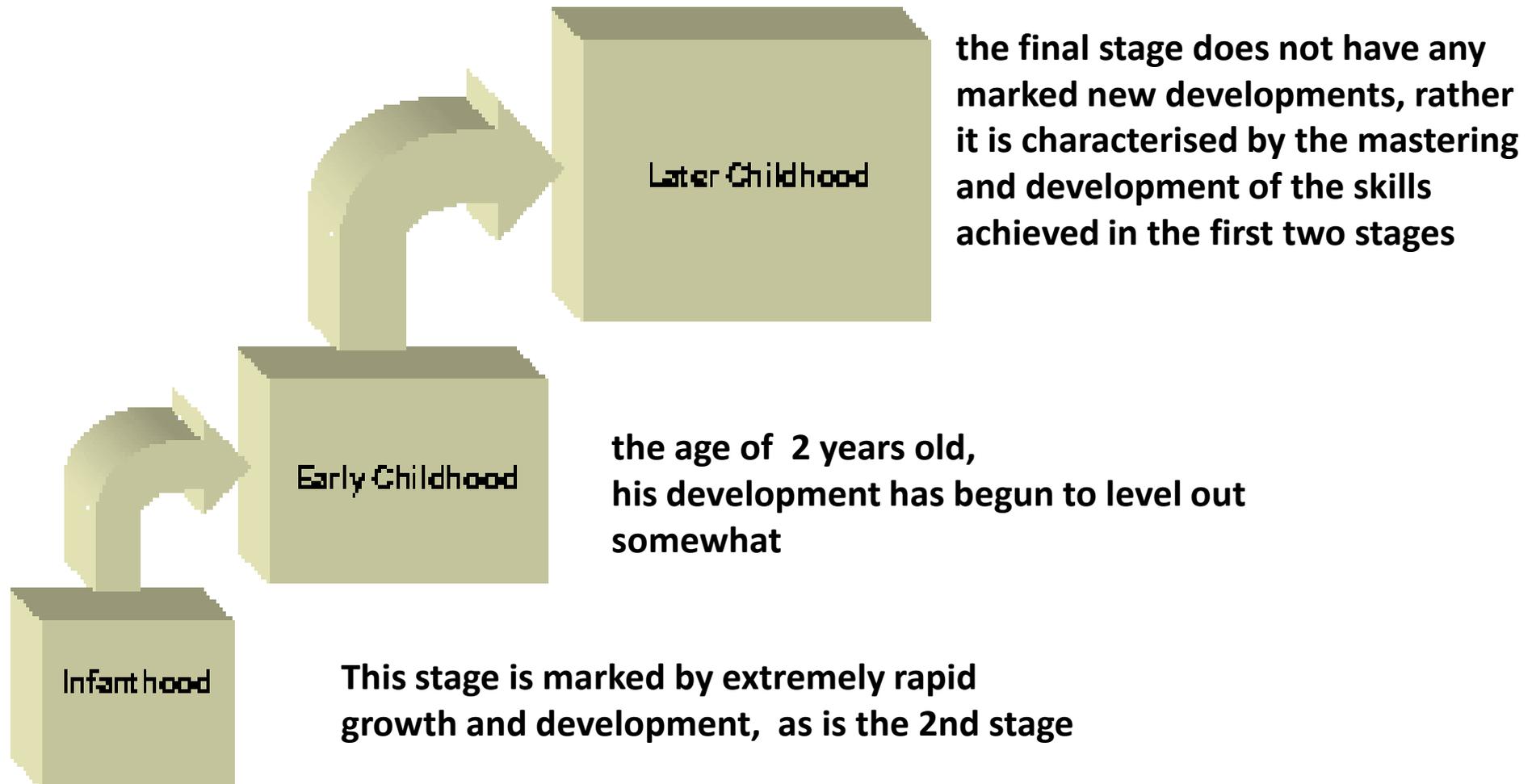
<https://www.youtube.com/watch?v=VZ-2CFCK2Dk>

<https://www.youtube.com/watch?v=VZ-2CFCK2Dk>

Testing in infants is often by observation for specific movements and responses and is less reliable

- The patient should be observed for *abnormalities of posture and movements*, including asymmetry at rest, fisting of the hand, frog-legged position suggesting hypotonia, tremor, myoclonus or tics
- **Muscle tone** is the resistance felt upon passive movement of a joint through its range of motion.
- **Hypotonia** is characterized by decreased resistance to passive movement and hyperextension at the joints.
- **Hypertonia** can be either spastic in nature or characterized by muscle rigidity.
- **Sensory examination** in young children is often imprecise, and **only gross deficits can be detected**. In children > 5 -6 years sensory function is evaluated in the same manner as in an adult.

# 3 stages of motor development in children.



# The Importance of Integrating Primitive reflexes

- **Primitive (infant) reflexes** are repetitive, automatic movements that are essential for development of **head control, muscle tone sensory integration and development.**
- **They form the basis of our postural, lifelong reflexes**
- These primitive reflexes surface in utero and infancy and **become inhibited in sequential order during the first year (movements become more practiced and controlled),** and replacement reflexes, called **postural reflexes emerge. PR,** are more mature patterns of response that **control balance, coordination and sensory motor development**

When a baby has been given the opportunity to develop freely and naturally the primitive reflexes will integrate and no longer be active. **When the primitive reflexes remain active** then many difficulties can emerge

# Types of Primitive Reflexes

- **Moro Reflex:** The Moro reflex acts as a baby's primitive fight/flight reaction and is typically replaced by the adult startle reflex by 4 months old.
- If a child experiences a retained Moro reflex beyond 4 months, he may become over sensitive and over reactive to sensory stimulus resulting in poor impulse control, sensory overload, anxiety and emotions and social immaturity.
- <https://www.youtube.com/watch?v=7oD6set72lo>



- **Rooting Reflex:** The rooting reflex assists in the act of breastfeeding and is activated by stroking a baby's cheek, causing her to turn and open her mouth
- Retention of the rooting reflex beyond four months may result in difficulty with solid foods, poor articulation and thumb sucking.
- **Sucking reflex**

▶ [0:49](#)

<https://www.youtube.com/watch?v=1am5Qlf5A00>



# Types of Primitive Reflexes

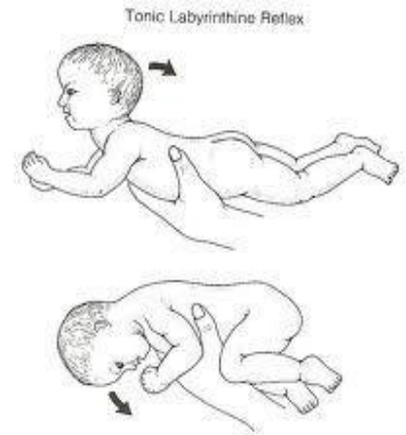


- **Palmar Grasp Reflex:** The palmer reflex is the automatic flexing of fingers to grab an object and should integrate by six months. If the palmer reflex is retained, a child may have difficulty with fine motor skills, stick out tongue while writing and exhibit messy handwriting
- **Spinal Galant Reflex:** The spinal galant reflex happens when the skin along the side of an infant's back is stroked, the infant will swing towards the side that was stroked.

<https://www.youtube.com/watch?v=jRa1kmHSpeo>

This reflex helps with the birthing process and should inhibit between 3-9 months. If it persists, it may affect a child's posture, coordination attention and ability to sit still.

# Types of Primitive Reflexes



- **TLR:** The tonic labyrinthine reflex (TLR) is the basis for head management and helps prepare an infant for rolling over, creeping, crawling, standing and walking.

This reflex initiates when you tilt an infant's head backwards while placed on the back causing legs to stiffen, straighten and toes to point. Hands also become fisted and elbows bend. It should integrate gradually as other systems mature and disappear by 3 1/2 years old.

placed on the  
Hands also become  
other systems mature

If retained, the TLR can lead to poor muscle tone, tendency to walk on toes, motion sickness and poor balance.

- **Landau Reflex:** assists with posture development and technically **isn't a primitive reflex as it isn't present at birth**. It is when a baby lifts his head up causing the entire trunk to flex and typically emerges at around 3 months of age. It is fully integrated by one year.

If the landau reflex persists beyond this point, children may experience short term memory problems, poor motor development and low muscle tone.

- <https://www.youtube.com/watch?v=hMKV5MnIp4k>

# Types of Primitive Reflexes

- **STNR:** Also known as the crawling reflex, symmetrical tonic neck reflex (STNR) is present briefly after birth and then reappears around six to nine months. This reflex helps the body divide in half at the midline to assist in crawling – as the head is brought towards chest, the arms bend and legs extend. It should disappear by 11 months. Developmental delays related to poor muscle tone, tendency to slump while sitting, and inability to sit still and concentrate can result if the STNR is retained.

[https://www.youtube.com/watch?v=X8HGnhT\\_3DgHasonló](https://www.youtube.com/watch?v=X8HGnhT_3DgHasonló)

- **ATNR:** Asymmetrical tonic neck reflex (ATNR) is initiated when laying babies on their back and turning their head to one side. The arm and leg of the side they're looking should extend while the opposite side bends. This reflex serves as a precursor to hand-eye coordination and should stop by six months.
- <https://www.youtube.com/watch?v=dPyBzID-854>
- <https://www.youtube.com/watch?v=uXsb7bxTc5q>

# FEW SELECTED NEWBORN REFLEXES:

Description:	Image:	Description:	Image:
<p><b>1. Moro Reflex:</b> Loud noises or sudden movements may cause newborn baby to arch back, throw out his/her arms and legs, and cry. This is called the startle, or Moro reflex, and it will last about four months.</p>	<p>The moro reflex</p> 	<p><b>4. Tonic neck Reflex:</b> It is also known as the "Fencing reflex" because of the characteristic position of the infant's arms and head. When the face is turned to one side, the arm and leg on the side to which the face is turned extend and the arm and leg on the opposite side flex.</p>	<p>Tonic neck reflex</p> 
<p><b>2. Grasp Reflex:</b> At birth, a newborn baby has such a strong grip that it is possible to lift the baby up entirely by his/her grasp. By five to six months, this reflex disappears entirely.</p>	<p>Grasp reflex</p> 	<p><b>5. Crawling Reflex:</b> If the baby is placed on stomach, he/she will pull his/her legs under the body and kick them out in a crawling motion. In fact, when newborn babies are placed on their mother's stomachs, they are able to crawl up to their mother's breast and start suckling. The crawling reflex disappears after just a few weeks.</p>	<p>Crawl reflex</p> 
<p><b>3. Rooting Reflex:</b> Stroke your baby's mouth or cheek, and you will notice the baby turning in that direction and opening his/her mouth in search of a nipple. This reflex lasts into the fourth month.</p>	 <p style="text-align: center;"><b>Rooting Reflex</b></p>	<p><b>6. Stepping Reflex:</b> Hold the newborn baby in a standing position on a flat surface, and watch as he/she tries to take little steps. The stepping reflex usually subsides by about two months.</p>	<p>Step reflex</p> 

## Common developmental reflexes

Reflex	Description	Age at appearance	Age at resolution
Moro (startle)	The examiner holds the infant supine in his or her arms, then drops the infant's head slightly but suddenly. This leads to the infant extending and abducting the arms, with the palms open, and sometimes crying. Alternatively, the examiner may lift the infant's head off the bed by 1 to 2 inches and allow it to gently drop back; this maneuver elicits a similar response.	34 to 36 weeks PCA	5 to 6 months
Asymmetric tonic neck reflex	With the infant relaxed and lying supine, the examiner rotates the head to one side. The infant extends the leg or arm on the side towards which the head has been turned, while flexing the arm on the contralateral side (fencing posture).	38 to 40 weeks PCA	2 to 3 months
Trunk incurvation (Galant)	With the infant in a prone position, the examiner strokes or taps along the side of the spine. The infant twitches his or her hips toward the side of the stimulus.	38 to 40 weeks PCA	1 to 2 months
Palmar grasp	The examiner places a finger in the infant's open palm. The infant closes his or her hand around the finger, tightens the grip if the examiner attempts to withdraw the finger.	38 to 40 weeks PCA	5 to 6 months
Plantar grasp	The examiner places a finger under the infant's toes. The infant flexes the toes downwards to "grasp" the finger.	38 to 40 weeks PCA	9 to 10 months
Rooting	The examiner strokes the infant's cheek. The infant turns the head toward the side that is stroked, and makes sucking motions.	38 to 40 weeks PCA	2 to 3 months
Parachute	The infant is held upright, back to the examiner. The body is rotated quickly forward (as if falling). The infant reflexively extends the upper extremities towards the ground as if to break a fall.	8 to 9 months of age	Persists throughout life

PCA: post-conceptual age.

Courtesy of Suresh Kotagal, MD.

# Primitive Reflexes

Primitive Reflex	Purpose of Reflex	Appears	Should Integrate By:	Signs of Retention
<b>Moro Reflex</b>	Primitive Fight or Flight Reaction	Birth	2 to 4 Months	Hyper Sensitivity, Hyper Reactivity, Poor Impulse Control, Sensory Overload, Social & Emotional Immaturity
<b>Rooting Reflex</b>	Automatic Response to Turn Towards Food	Birth	3 to 4 Months	Fussing Eating, Thumb Sucking, Dribbling, Speech and Articulation Problems
<b>Palmer Reflex</b>	Automatic Flexing of Fingers to Grab	Birth	5 to 6 Months	Difficulty with Fine Motor Skills, Poor Manual Dexterity, Messy Handwriting
<b>ATNR</b>	To Assist Baby Through Birth Canal and Develop Cross Pattern Movements	Birth	6 Months	Poor Eye-Hand Coordination, Difficulty with Handwriting, Trouble Crossing Vertical Mid-line, Poor Visual Tracking for Reading and Writing
<b>Spinal Gallant Reflex</b>	Assist Baby with Birth Process	Birth	3 to 9 Months	Unilateral or Bilateral Postural Issues, Fidgeting, Bedwetting, Poor Concentration, Poor Short Term Memory
<b>TLR</b>	Basis for Head Management and Postural Stability Using Major Muscle Groups	In Utero	3 1/2 Years	Poor Muscle Tone, Tendency to Walk on Toes, Poor Balance, Motion Sickness, Spatial Orientation Issues
<b>Landau Reflex</b>	Assist with Posture Development	4 to 5 Months	1 Year	Poor Motor Development
<b>STNR</b>	Preparation for Crawling	6 to 9 Months	9 to 11 Months	Tendency to Slump While Sitting, Poor Muscle Tone, Poor Eye-Hand Coordination, Inability to Sit Still and Concentrate

## Common developmental milestones

Milestone	Age at acquisition
Fixes gaze briefly, habituates to stereotyped auditory, visual, and tactile stimuli	At birth (40 weeks post conceptional age)
Smiles responsively, gurgles	2-3 months
Visual tracking of a bright object to 180 degrees	3 months
Rolls over, holds head upright when pulled from supine to sitting	3 months
Reaches out for objects	4-5 months
Maintains sitting position independently	6 months
Grasps objects using thumb and index finger pulp	8-9 months
Crawls, babbles, uses non-specific "Mama", "Dada" sounds	9-10 months
Pulls up to stand and walks with support	10-11 months
Walks independently, uses 2-3 clear words, including specific "Mama" and "Dada"	13-14 months
Can point to body parts, use simple phrases	18-19 months
Names body parts, states age, uses phrases	24 months
Pedals tricycle, speaks in sentences, asks questions, likely toilet trained, can name primary colors	36 months
Masters concepts of alphabets and numbers	4-5 years
Able to read simple words, add, subtract	5-6 years
Concepts of division, multiplication, geography, general information like cities, states, large rivers, oceans, etc.	7-8 years

*Courtesy of Suresh Kotagal.*

- Cranial nerves
- <https://www.youtube.com/watch?v=VZ-2CFCK2Dk>
- *Facial nerve exam.*
- <https://www.youtube.com/watch?v=VZ-2CFCK2Dk>
- **PEDIATRIC NEUROLOGICAL EXAMINATION**
- <https://www.youtube.com/watch?v=CkT65JgvTsE>
  
- Cranial nerves
- <https://www.youtube.com/watch?v=eEqmuF6Xbwo>
- Normal tone
- <https://www.youtube.com/watch?v=OXrGGJBt8KI>
- Stepping reflex
- <https://www.youtube.com/watch?v=PfhbxYXqsY4>



Thank you