Pediatric Neurologic Examination

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History

* review of **pregnancy**, **labor**, **delivery**.
* history of Apgar score, birthweight, length, head circumference.
* ***jaundice***, ***feeding difficulties***, ***sleep & cry patterns***.

for further details → see [p. Exam11 >>](http://www.neurosurgeryresident.net/USMLE%202\00.%20Ligonio%20tyrimas\Exam11.%20PEDIATRIC%20examination.pdf)

Objective Examination

see also [p. Exam11 >>](http://www.neurosurgeryresident.net/USMLE%202\00.%20Ligonio%20tyrimas\Exam11.%20PEDIATRIC%20examination.pdf) for general examination tips!

* the more examination seems like a game, the greater will be degree of cooperation.

CNS *at birth* is underdeveloped – ***functions at subcortical level*** – **cortical function** cannot be tested in its entirety until early childhood!

* in *newborn ÷ early infancy period*, normal brainstem and spinal functioning do not ensure intact cortical system; vice versa - abnormalities of brainstem and spinal cord may exist without concomitant cortical difficulties!

Determine **hand preference** (right or left *dominance* should not be present until age 2 - before this it suggests problem with neglected hand)!

Motor examination

* most infants have excess of body fat - muscle *fasciculations & atrophy* are best demonstrated in *tongue*.
* tremors at rest after 4 days signal CNS disease!

1. Put each major joint through its range of motion – determine **muscle tone**.

N.B. ***kūdikiams iki 3 mėn. raumenų tonusas fiziologiškai yra padidėjęs, bet prematūrai esti hipotoniški*** (*scarf sign, popliteal angle > 80°*):

* ***premature*** infant of 28 wk tends to ***extend all extremities*** at rest, but by 32 wk there is evidence of lower extremities flexion;
* normal ***full-term*** infant's posture is ***flexion of all extremities***.

Hypotonic infant:

* assumes *frog-leg* posture in supine position.
* when suspended in prone position, limbs and head all hang limply "like rag doll" (“floppy infant”).

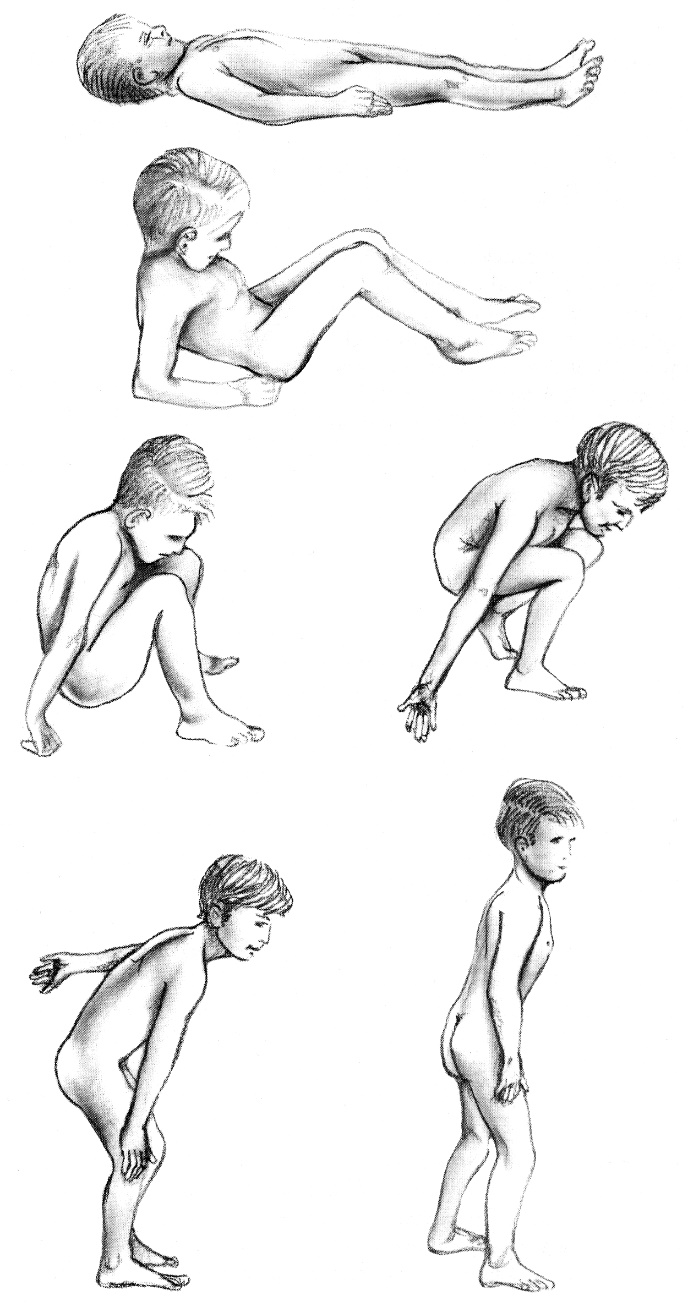
*normally, arms and legs move out, and head is held in line with body*

*Head lag* (when infant is pulled to sitting position from supine) is sign of weakness, not of low tone! Must not be present in 6 month-old-infant!

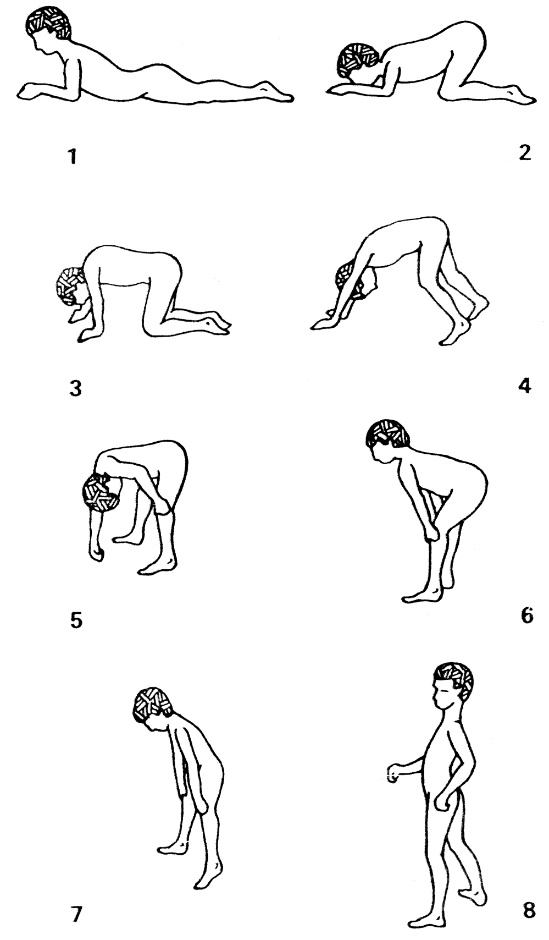
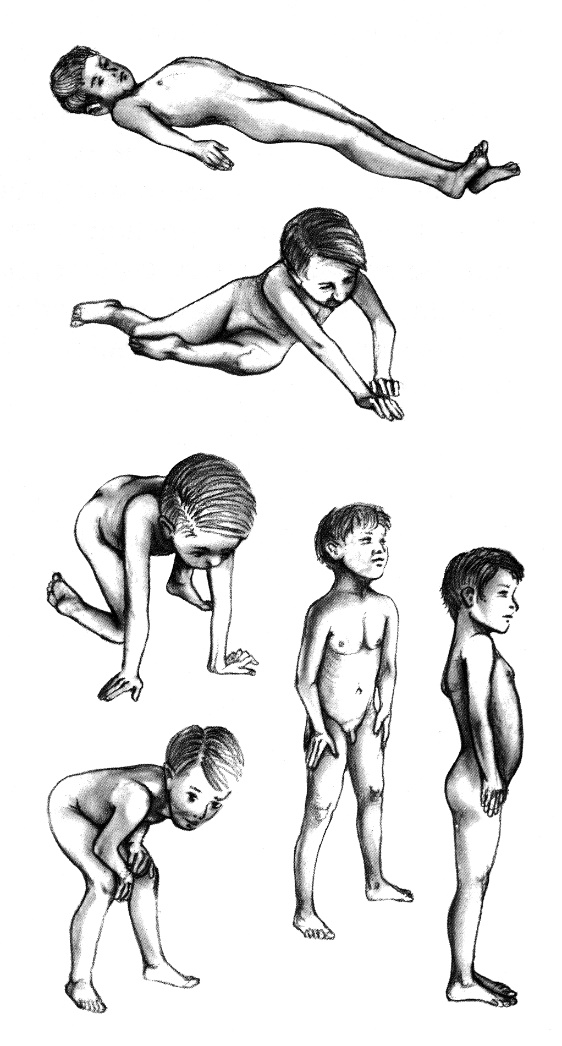
Observe newborns for asymmetry of spontaneous movements!

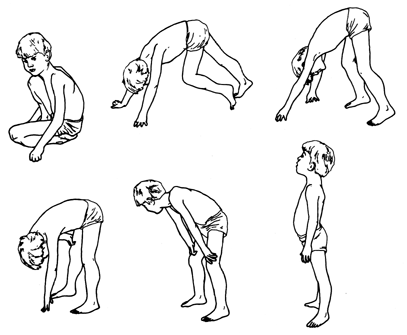
1. **Muscle strength**
   1. **shoulder girdle strength** - support baby by axillae - patient with weakness will be unable to support body weight and will "slip through" examiner's hands.
   2. **distal power** - palmar grasp.
   3. are sucking and swallowing impaired?
   4. observe gait (walking & running); ***unequal wear of soles and heels*** on child’s shoes may indicate hemiparesis.
   5. **pelvic girdle strength** - observe rising from floor from supine position:

**normal** – patient assumes squatting position:



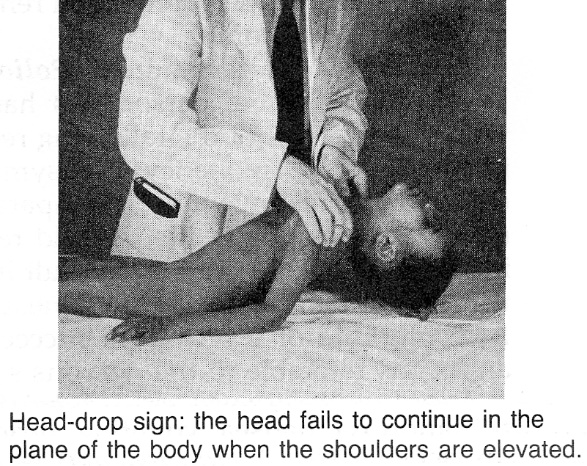
**Gow****ers sign** (“climbing up himself”) – ***pelvic girdle weakness*** (e.g. Duchenne muscular dystrophy) - patient ***turns prone***, ***kneels*** (forming arch with buttocks at apex), pushes against knee with nonfloor hand, and then slowly pushes erect by using his ***hands to climb up his thighs***.





**Erb's palsy** - right arm is medially rotated and wrist is flexed:





Sensory examination

Infants:

* + *thresholds* higher, *reactions* relatively slow;
  + screening – gently touch arms and legs with **pin** – observe movement of stimulated extremity and concomitant facial expression change;

UMN paralysis - facial change without extremity movement

spinal cord lesion - extremity movement without facial change

* child quickly loses patience and soon begins to disregard stimuli.

Cranial nerves

- tested as in adults; see [p. D1 >>](http://www.neurosurgeryresident.net/D.%20Diagnostics\D1-5.%20Neurologic%20Examination\D1.%20Neurologic%20Examination.pdf), [p. D1eye >>](http://www.neurosurgeryresident.net/D.%20Diagnostics\D1-5.%20Neurologic%20Examination\D1eye.%20Ophthalmologic%20Examination.pdf), [p. D1ear >>](http://www.neurosurgeryresident.net/D.%20Diagnostics\D1-5.%20Neurologic%20Examination\D1ear.%20Otologic%20Examination.pdf)

Reflexes

## are variable in infancy (*underdeveloped corticospinal pathways*!) - reflex↑ or ↓ has very little diagnostic significance unless asymmetric.

* + in infants use ***semiflexed index (or middle) finger*** instead of reflex hammer.
* **Babinski sign** (ir kiti pažeistų piramidinių laidų refleksai) - norma vaikams iki 2 metų amžiaus, o iki 6 mėn. jie pasireiškia spontaniškai!
* **unsustained ankle clonus** (8-10 rapid, rhythmic plantar flexions in response to *eliciting ankle reflex* or *abrupt foot dorsiflexion*) is common in newborns; **sustained ankle clonus** indicates severe CNS disease.
* **triceps reflex, abdominal reflexes** are absent until after 6 months (**anal reflex** is present in newborns!).
* ***crossed adductor response*** (tapping patellar tendon in one leg causes contraction in opposite extremity) is not abnormal until 6-7 months of age.
* **oralinio automatizmo & griebimo refleksai** yra norma ankstyvoje kūdikystėje (infantile automatisms – žr. žemiau)!

Head

newborn

* size & shape.
* **head circumference** - occipitofrontal circumference (OFC). [*see below* >>](#OCCIPITOFRONTAL_CIRCUMFERENCE)
* **molding**, **caput succedaneum**, **subgaleal hematoma**, **cephalohematoma**

→ see [p. Ped9 >>](http://www.neurosurgeryresident.net/Ped.%20Pediatrics\Ped9.%20Perinatal%20Period.pdf)

infants

* ***dilated scalp veins*** – long standing ICP↑, thrombosis of superior sagittal sinus.
* **craniotabes** (syphilitic or rachitic) – localized ***areas of osteoporotic thinning*** in outer table of cranial flat bone; by pressing firmly on such area you may feel momentarily give (as ping-pong ball would respond to similar pressure).
* direct finger percussion over parietal bones will produce “cracked-pot” sound prior to closure of sutures.

Assess fontanelles (soft concavities) - baby is quietly sitting or being held upright:

**posterior fontanelle** (1-2 cm at birth – admits finger tip) closes at birth or by 2 months; persistence suggests hydrocephalus or congenital hypothyroidism.

**anterior fontanelle** (4-6 cm in largest diameter at birth) closes at 9 ÷ 26 months (average – 18); best evaluated when infant is held upright and is asleep or feeding - normally slightly depressed and pulsatile.

* anterior fontanelle *pulsations* reflect peripheral pulse.
* anterior fontanelle *tenseness & fullness* reflects ICP:
  1. bulging - ICP↑, but also in normal crying, coughing, vomiting.
  2. depression - ICP↓, dehydration.

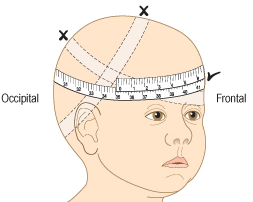
N.B. **palpate anterior fontanelle before proceeding with any other part of physical examination on acutely ill baby**!

Assess sutures (slightly depressed ridges) – palpable ridging resolves by ≈ 6 months.

Occipitofrontal circumference (OFC) (greatest head circumference) – obtain at every examination during first 2 years (± biennially thereafter) - should be recorded on suitable chart.

e.g. from Centers for Disease Control and Prevention - [www.cdc.gov/growthcharts/](http://www.cdc.gov/growthcharts/)

* place non-extendible tape over occipital, parietal and frontal prominences:



* measure three times and note largest measurement.
* normal head circumference of term infant:

at birth - 34-35 cm

at 6 months - 44 cm

at 12 months - 47 cm

if ↓ - suspect premature closure of sutures, microcephaly;

if ↑ - suspect hydrocephalus, subdural hematoma, brain tumor.

* children who are ***above 90-98th percentile*** or ***below 5th percentile*** (as well as those who ***cross percentiles*** rather than growing along curve) require evaluation for cerebral pathology.
* value for head circumference should be *related to age, sex, body length*.

e.g. head circumference of +3SD, is not abnormal unless body length is < +1SD.

* for objective confirmation of **hypertelorism / hypotelorism** – measure **interpupillary distance** (vs. intercanthal distance)!

Assess cranial vault and face for asymmetry.

* in utero positioning may result in transient ***facial asymmetries*** (e.g. micrognathia due to head flexion on sternum).
* head of ***premature infant*** at birth is relatively long in occipitofrontal diameter and narrow bitemporally; this continues for first year.
* ***plagiocephaly*** (cranial vault asymmetry) occurs when infant sleeps constantly on one side; disappears as baby becomes more active and spends less time in one position.

Skull transillumination (not routinely used since advent of CT) – in completely darkened room, with standard 3-battery flashlight (with soft rubber collar).

|  |  |
| --- | --- |
| * in normal infant ***2 cm halo*** of light is present around flashlight when placed over frontoparietal area, and ***1 cm halo*** – over occipital area; * ***uniform transillumination*** of entire head – thinned / absent cortex, advanced hydrocephaly (+ “setting sun” sign): * ***decreased area of transillumination*** - acute subdural hematoma. | D:\Viktoro\Neuroscience\D. Diagnostics\D1-5. Neurologic Examination\00. Pictures\Hydrocephaly.jpg |

Auscultation (with stethoscope diaphragm) over anterior fontanelle and temporal areas:

systolic / continuous bruit is normal in < 5 years;

***bruit after 5 years*** – significant anemia, ICP↑, AV malformation.

Spine

- turn baby over and feel along length of vertebral column starting at neck

* note that sacrum and coccyx are present (sacral agenesis is associated with maternal diabetes).
* ***hairy / pigmented patch*** over lower spine may indicate spina bifida occulta.
* if you find ***sacrococcygeal pit*** → visualize bottom of it by separating surrounding skin in good light (if pit is lined with dry skin, it excludes pathological communication with spinal cord).

Infantile automatisms (Primitive Reflexes)

- **normal developmental reflex phenomena** present at birth and disappearing in early infancy.

N.B. *absence in neonate*, *asymmetry*, or *persistence beyond expected disappearance time* (delayed neuromaturation) – nonspecific indicator of severe CNS dysfunction!

Not fully developed in premature infants!

In preferred order:

1. **Blinking (dazzle) reflex** – eyelids close in response to bright light.
   * *disappears* after 1st year.
   * absence may indicate blindness.
2. **Acoustic blink (cochleopalpebral, audiopalpebral) reflex** for details → see [p. D1ear >>](http://www.neurosurgeryresident.net/D.%20Diagnostics\D1-5.%20Neurologic%20Examination\D1ear.%20Otologic%20Examination.pdf)
   * difficult to elicit during first 2-3 days.
   * may disappear temporarily after it is elicited (habituation).
   * *disappearance time* variable.
   * absence may indicate decreased hearing but it is crude test and does not indicate deafness!
3. **Darwinian (grasping) reflex**
4. **palmar grasp**: with baby’s head positioned in midline and arms semiflexed, place your index fingers from ulnar side into baby’s hands and press against palmar surfaces → flexion of all baby’s fingers to grasp your fingers and hang suspended; you can enhance reflex by offering bottle (sucking facilitates grasping).
   * *starts* at 28 wk gestation and is well established by 32 wk.
   * *disappears* at 3-4 months; persistence beyond 4 months suggests cerebral dysfunction.

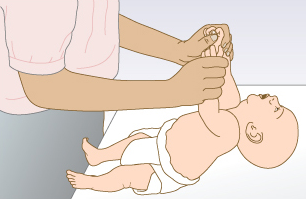
N.B. ***newborns normally hold hands clenched***, but persistence of fisted hand beyond 2 months suggests spastic diplegia.

* + light stroking of hand ulnar surface and 5th finger → finger extension (**digital response reflex**).

1. **plantar** **grasp** - stroke sole → toes will flex and curl round your examining finger.

N.B. make sure response is not inhibited by inadvertently stimulating dorsal aspects of feet and hands!

1. **Pull to sit** - hold baby's hands and gently pull to sit - watch sternocleidomastoid muscles which should bilaterally anticipate pull to sit; head flexes for moment before head lag occurs:



|  |  |  |
| --- | --- | --- |
| 1. **Galant (trunk incurvation) reflex** - gulint krūtine ant tiriančiojo delno pusiau vertikalioje padėtyje, braukiant pirštu lygiagrečiai stuburui (≈ 1 cm nuo midline) per visą liemens ilgį → mažylio kūnas išsilenkia į dirginamąją pusę.    * *disappears* at 2 months.    * used to detect transverse spinal cord lesions. | | D:\Viktoro\Neuroscience\D. Diagnostics\D1-5. Neurologic Examination\00. Pictures\BATES 506 (1).jpg |
| 1. **Rotation test** – hold baby under axillae, at arm length facing you, and rotate him in one direction and then the other → baby’s head turns in direction in which you turn baby; if you restrain head with your thumbs, his eyes will open and turn in direction in which he is turned.    * *disappearance time* variable.    * early detection of strabismus; absence indicates vestibular dysfunction. | D:\Viktoro\Neuroscience\D. Diagnostics\D1-5. Neurologic Examination\00. Pictures\BATES 472.jpg | |

|  |  |
| --- | --- |
| 1. **Vertical suspension positioning** - už pažastų paėmus naujagimį (rodomaisiais pirštais ir nykščiais prilaikant galvą) ir pakeliant jį vertikaliai, mažylis sulenkia kojas per kelio ir klubo sąnarius, o nuleidžiant ant atramos, jis atsiremia visa pėda ir "stovi" ant pusiau sulenktų kojų ištiesęs liemenį.    * *disappears* after 4 months.    * fixed leg extension and adduction (“scissoring”) indicates spastic paraplegia: | D:\Viktoro\Neuroscience\D. Diagnostics\D1-5. Neurologic Examination\00. Pictures\BATES 506 (2).jpg |

1. **Placing response** - laikant naujagimį iš nugaros už pažastų (rodomaisiais pirštais ir nykščiais prilaikant galvą):

|  |  |
| --- | --- |
| 1. allow dorsal surface of one foot to touch undersurface of table top (do not plantarflex foot!) → baby flexes hip & knee and places stimulated foot on table top. | 1. pastačius ant stalo ir šiek tiek palenkus jo kūną į priekį, kojos atlieka žengimo judesius. |
| D:\Viktoro\Neuroscience\D. Diagnostics\D1-5. Neurologic Examination\00. Pictures\BATES 507 (1+2).jpg | D:\Viktoro\Neuroscience\D. Diagnostics\D1-5. Neurologic Examination\00. Pictures\BATES 507 (3+4).jpg |

* *best* after the first 4 days; *disappearance* time variable (replaced by voluntary action).
* absence indicates paresis or **breech delivery**.

Here is also convenient to test **Moro reflex**. [*see below* >>](#Moro_reflex)

|  |  |
| --- | --- |
| 1. **Rooting reflex** – with baby’s head positioned in midline and his hands held against his anterior chest, stroke with your index finger perioral skin:   ***at mouth corners*** → mouth will open and turn to stimulated side;  ***at midline of upper lip*** → head will retroflex;  ***at midline of lower lip*** → jaw will drop.   * *disappears* at 3-4 months; may be present longer during sleep. * absence may indicate cerebral dysfunction. | D:\Viktoro\Neuroscience\D. Diagnostics\D1-5. Neurologic Examination\00. Pictures\BATES 505.jpg |

1. **Straubliuko** - stuktelėjus pirštu per lūpas.
2. **Sucking** – įdėjus į burną pirštą ar čiulptuką, pradeda čiulpimo judesius.
3. **Tonic neck reflex** – baby in supine position; turn head to one side (holding jaw over his shoulder) → arm & leg on this side extend, while opposite arm & leg flex.

|  |  |
| --- | --- |
| * + present at birth (from 37th week gestation); most intensive at 1 month; *disappears* at 6 months.   N.B. reflex normally must not occur each time it is elicited!!!   * + if ***persists beyond 6 months*** or ***occurs each time is elicited*** (at any age) or is ***asymmetric*** or is ***obligatory*** (posture maintained beyond 30 sec.) – major cerebral damage. | D:\Viktoro\Neuroscience\D. Diagnostics\D1-5. Neurologic Examination\00. Pictures\BATES 508.jpg |

1. **Babkino (delnų-burnos)** - paspaudus delną, naujagimis išsižioja.
2. **Galvos posūkio** - paguldžius ant pilvo, jis pasuka galvą į vieną arba kitą pusę, išlaisvindamas kvėpavimo takus.
3. **Bauerio (šliaužimo)** - gulint ant pilvo ir pridėjus prie kojų atramą, naujagimis ima šliaužti.

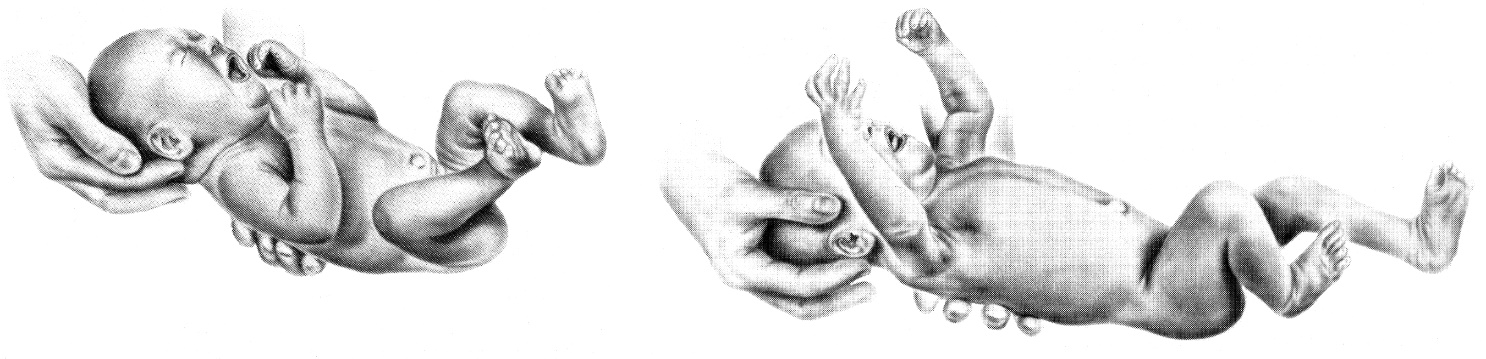
Mass reflexes:

* + *disappear* by 3rd month.
  + absence indicates cerebral ÷ muscular lesion.

absent Moro reflex + “setting sun” sign + opisthotonus = *kernicterus*

* + persistence beyond 6 months – clearly abnormal (*neurologic disease*).

1. **Perez reflex** - padėtis kaip Galanto, spaudžiant nykščiu perbraukti per stuburą nuo uodegikaulio iki kaklo → head & spine extension, truputį sulenkia galūnes, pravirksta ir pasišlapina (tinka naujagimiams paimti šlapimo mėginiui!).
2. **Startle reflex (s.** **Moro reflex)** - baby’s arms briskly abduct and extend with hands open and fingers extended + legs flex slightly and abduct (but less so than arms); arms then return forward over body in clasping maneuver (sukryžiuoja, lyg apglėbdamas krūtinės ląstą);
   * it is phylogenetic remnant of movements used by subhuman ***primate infants to cling to their mothers***.
   * reflex begins by 28-32 wk gestation and is well established by 37 wk; may occasionally occur in term newborns during handling.
   * reflex is elicited by any stimulus that suddenly moves head in relation to spine:
     1. lift supine baby by supporting his head at angle ≈ 30° → suddenly release your grip by allowing head to fall ≈ 1 cm backward (into your hand):



* + 1. hold baby in supine position (supporting head, back and legs); suddenly lower entire body ≈ 2 feet and stop abruptly;
    2. support baby in vertical position; suddenly tip upper body downward (as if child were to fall) - child spontaneously extends upper extremities (as protective mechanism) - **parachute reflex**.
    3. produce sudden loud noise (e.g. strike examining table with palms of your hands on either side of baby’s head).

“Soft” Neurologic Signs

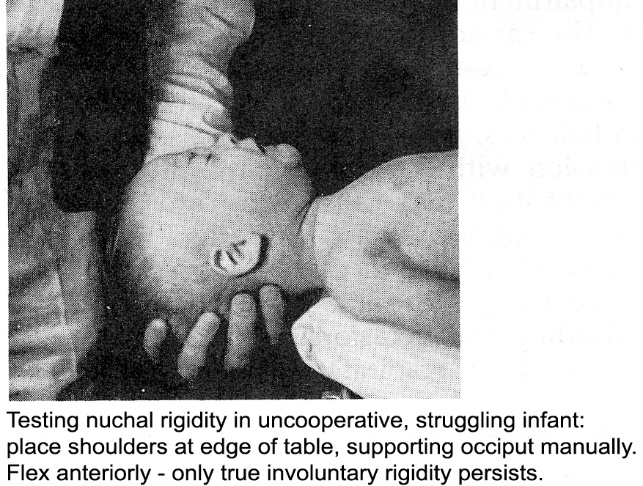
- considered **normal in younger children**, but when still present in school-aged child suggest **neuromaturational delay**.

N.B. specific soft signs *lack association with particular disability* and can occur in normal child - it is unwise to label child who manifests several soft neurologic signs!

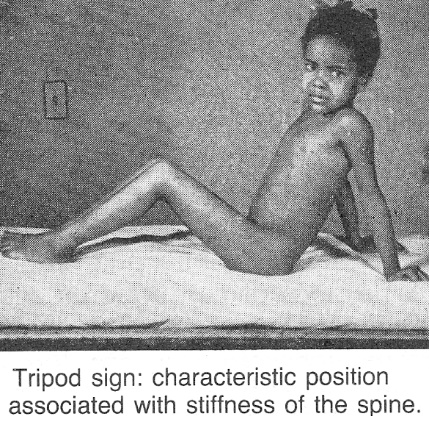
* 1. **Dystonic posturing of arms & hands** when walking on heels.
  2. **Mirror movements** of opposite hand while performing rapid alternating movements with thumb & fingers.
  3. **Substantial movements of tongue or mouth** while writing.

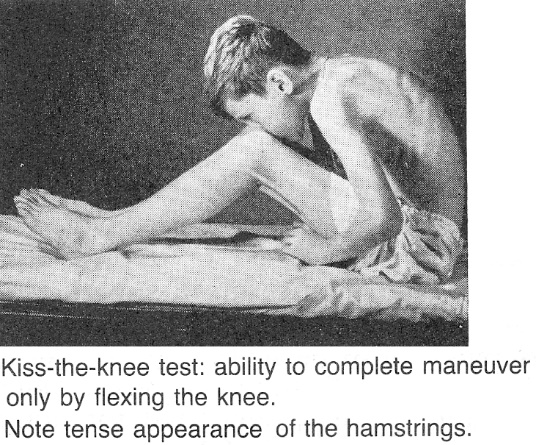
Meningeal signs

* **nuchal rigidity** is most reliable sign of meningeal irritation; infants may lie in opisthotonus position:

* ask child to sit with legs extended; normally he is able to sit upright and touch chin to chest (padėk žaisliuką ant sternum – vaikas pats į jį pasižiūrės); in meningeal irritation child assumes tripod position:



* kūdikių didžiojo **momenėlio** išsipūtimas ir pulsacija!
* **Lesažo** - pakeltas už pažastų vaikas pritraukia ir laiko kojas prie pilvo.

Neonates - 25-75% will not have **nuchal rigidity**\*; tense bulging fontanel is more reliable sign (but may be absent in dehydration).

\*Kernig's and Brudzinski's signs appear at or shortly after 1st year of life

Spasmophilia signs

* + - 1. **Chvostek sign** – plaktuku / pirštu sudavus tarp skruosto lanko ir lūpos kampo, just aterior to auditory meatus (*n. facialis*), toje pusėje trukteli burnos, nosies, voko raumenys.

Normal in newborns and some infants!

* + - 1. **Trousseau sign** - 3 min užspaudus *a. brachialis* plaštaka įgauna "akušerio rankos" formą (***carpopedal spasm*** - flexion of wrists and metacarpophalangeal joints and extension of phalangeal joints; feet are dorsiflexed at ankles and toes plantar flexed).
      2. **Liusto** - stuksenant *n. peroneus* sritį, pėda įgauna "arklio pėdos" formą.

Psychomotor Development

Išvados daromos tik apžiūrėjus pakartotinai! (wide variations in normal development are rule!)

Screening of **infant** - ability to:

1. Reach toy
2. Transfer cube from one hand to other
3. Use thumb and forefinger pincer grasp in picking up small object

Screening in **early childhood** - ability to:

1. Build tower with blocks
2. Play ball with examiner
3. Perform hop, skip, jump

Screening for **early schoolchildren**:

1. Orientation to time and place
2. Language and numbering skills
3. Tie shoelaces
4. Button shirt fronts
5. Writing skills
6. Using scissors
7. Right-to-left discrimination: for self (attained at 6-7 yrs), for examiner (attained at 8-9 yrs).

**Kūdikis** vertinamas gulintis ant pilvo, po to ant nugaros:

1. stebimas spontaninis aktyvumas.
2. kaip reaguoja į žmogaus ar daiktų, patekusių į regėjimo lauką, judėjimą bei į jo artimiausią pasiekimo zoną pakliuvusius stambius daiktus.

**≥ 7 mėn vaikams** paduodami kubeliai, sviedinukai arba pieštukas ir popieriaus lapas - ar sugeba pakartoti gydytojo veiksmus.

**> 2.5 metų vaikų** galima paprašyti nupiešti žmogų, kitą figūrą.

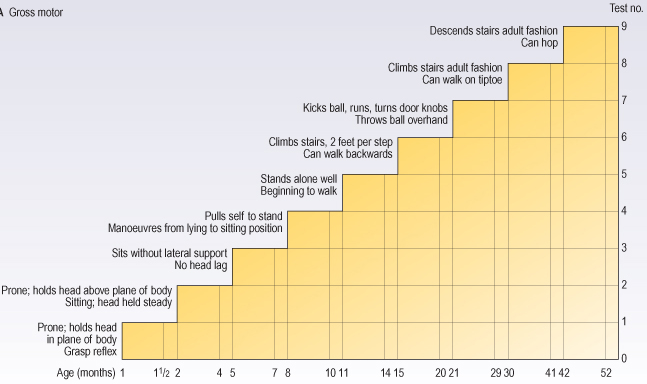
Screening Scheme for Developmental Delay (Upper Range of Normal Skills):

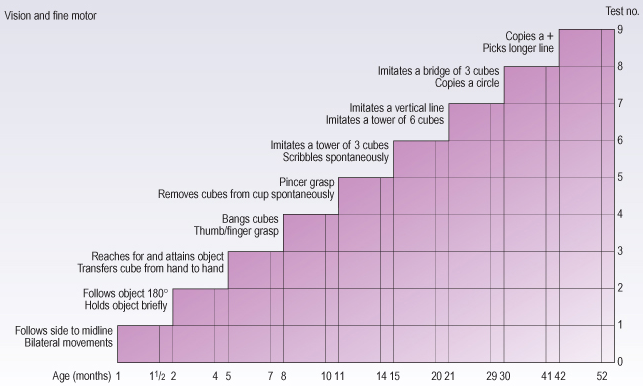
| **Age (Months)** | **Gross Motor** | **Fine Motor** | **Social Skills** | **Language** |
| --- | --- | --- | --- | --- |
| 2 | Lifts head/chest when prone | Tracks past midline | Recognizes parent, **social smile** | Alerts to sound, coos |
| 3 | Supports weight on forearms | Opens hands spontaneously | Smiles appropriately | Coos, laughs |
| 4-5 | **Rolls** front to back, back to front (5 months) | Grasps rattle | Enjoys looking around | Orients to voice, “ah-goo”, razzes |
| 6 | **Sits** momentarily unassisted | **Transfers objects**, raking grasp | Shows likes and dislikes, **stranger anxiety** | Babbles |
| 9-10 | Pulls to stand, crawls | 3-finger pincer grasp | Plays patty-cake, peek-a-boo, waves bye-bye | Imitates sounds, **mama/dada** (nonspecific) |
| 12 | Walks with one hand held, cruises, **walks alone** | 2-finger pincer grasp, releases object on command | Comes when called, imitates actions | 1-2 meaningful words, mama/dada (specific) |
| 15 | Walks backward | Uses cup | Temper tantrums | 4-6 words |
| 18 | Walks upstairs / downstairs with assistance, runs, kicks ball | Feeds from spoon, Builds tower of 2-4 blocks | Copies parent in tasks (e.g. sweeping) | ≥ 6 words, names common objects |
| 24 | Builds tower of 6 blocks | Plays in solitary, parallel play.  Follows **2-step command** | **2 word phrases** |
| 36 | Rides **tricycle**, climbs stairs with alternating feet | Copies a circle, uses utensils, brushes teeth with help, washes/dries hands |  | **3 word sentences** |
| 48 | **Hops** | Copies cross | Cooperative play | close to **adult** speech competence; counts to 10 |

* review family's *baby book* (milestones for child may have been dutifully recorded).
* neurodevelopment of girls is more accelerated for many motor tasks.

Motor

|  |  |
| --- | --- |
| Birth | Sleeps much of time; sucks, clears airway |
| 2-4 weeks | Moves head from side to side when lying on stomach; reflex grasp |
| 1-2 months | Lifting head up 45-90° from prone position |
| 2 months | Lifting chest up from prone position |
| 3 months | Holds head steady on sitting; opens and shuts hands; pushes down when feet are placed on flat surface; swings at and reaches for dangling toys |
| 4 months | Sitting with support; rises body on arms when prone; brief purposeful grasp |
| 5-6 months | Rolls over (usually from stomach to back); reaches for objects |
| 7 months | Sitting without support; bears some weight on legs when held upright; transfers objects from hand to hand; holds own bottle |
| 8-10 months | Standing without support |
| 9-10 months | Creeping on hands and knees; gets into sitting position from stomach; pulls self up to standing position |
| 11 months | Walking when led by hand |
| 12 months | Walks by holding furniture (“cruising”); may walk 1-2 steps without support; stands for few moments at time; drinks from cup; has pincer grasp |
| 15 months | Adept at independent locomotion |
| 18 months | Descends / climbs stairs holding on (may slide on belly); turns several book pages at time; partially feeds himself; throws ball overhand |
| 2 years | Can reproduce circle; climbs up and down stairs alone; runs well; turns single book pages; puts on simple clothing; kicks ball; holds cup securely |
| 3 years | Can reproduce cross, climbs up stairs alone, can stand on one foot, builds tower of 9-10 cubes; rides tricycle; dresses well except for buttons and laces |
| 4 years | Alternates feet going up and down stairs; throws ball overhand; hops on one foot; copies cross; washes hands and face |
| 5 years | Can reproduce square; catches bounced ball; dresses and undresses without help; walks on tiptoes |
| 6 years | Can skip, tie shoelaces |
| 7 years | Can reproduce diamond |
| 8 years | Can hop twice on one foot and then smoothly alternate to hop twice on opposite foot |
| 10 years | Can stand in feet tandem (heel-to-toe) with eyes closed for 15 seconds; can crumple paper into ball without using table surface (5 seconds for dominant hand; 7 seconds – nondominant) |

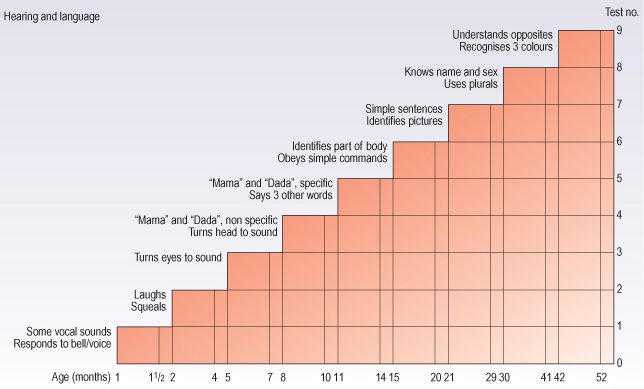




Vocal

|  |  |
| --- | --- |
| Birth | Responds with crying to discomforts and intrusions |
| 6-8 weeks | Cooing, precursor to later babbling and speech |
| 2 months | Development of 7 phonemes\* |
| 6 months | Development of 12 phonemes |
| 9 months | Says “mama” or “dada” (possibly appropriately in reference to parents) |
| 12 months | Development of 18 phonemes |
| 18 months | 10-50 words |
| 2 years | ≈ 50% of child’s speech should be intelligible; makes 2-3-word sentences; verbalizes toilet needs; questions “what’s this”; uses pronouns (me, you, I) |
| 3 years | More than 1000 words; ≈ 75% of child’s speech should be intelligible; counts to 10 and uses plurals; uses “me” and “you” correctly; questions constantly |
| 4 years | Style of adult language is established; almost 100% of child’s speech should be intelligible; can tell someone his name, discuss simple aspects of daily life; uses some plurals and past tenses |
| 5 years | Can tell simple story |

\*adult American speech has 35 phonemes (distinct sounds)



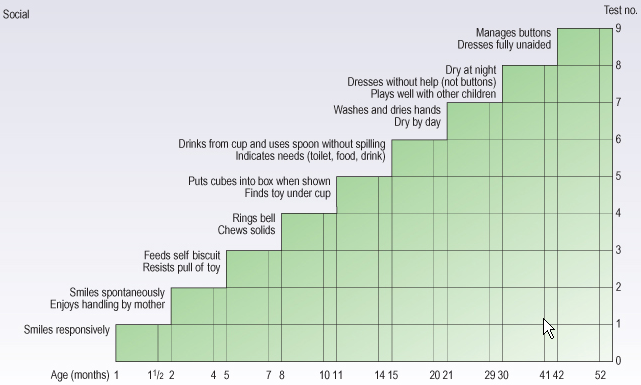
* at 3-5 years, average child learns two new words daily.
* *articulation errors* (e.g. substituting “w” for “r” in rabbit, or “d”for “th”) are common and normal in toddler age group.

Sensory

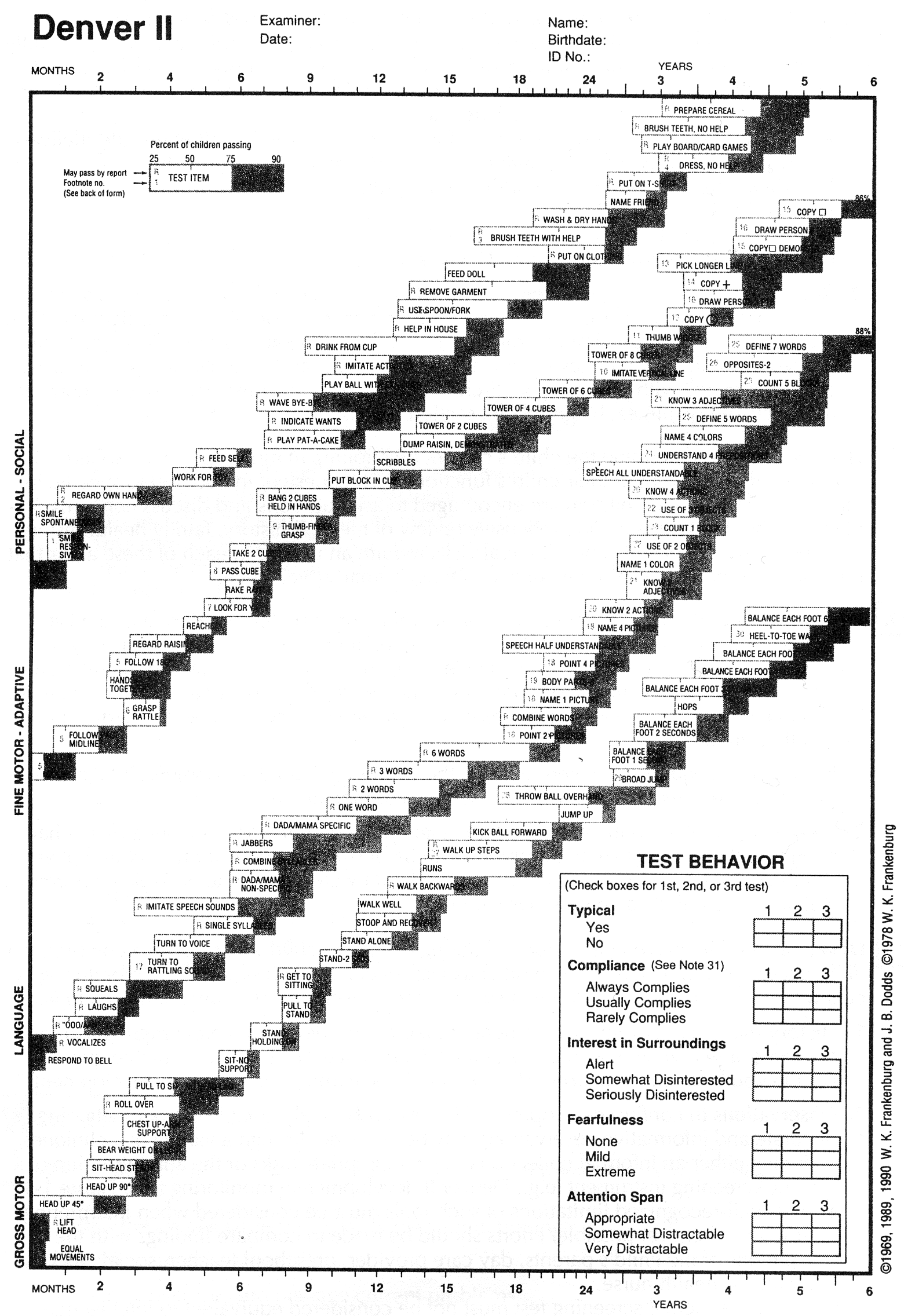
|  |  |
| --- | --- |
| Birth | Can discriminate sound and visually follow light; capacity for visual fixation within several hours after birth |
| 10 days | Can differentiate smell of mother versus nonmother |
| 4 weeks | Follows object as it is moved 90° to either side from midline about 15 cm above face; responds to noise with startling, crying, or quieting; may turn toward familiar sounds and voices |
| 6-8 weeks | Regards objects in line of vision; follows object as it is moved from side-to-side in 180° arch (i.e. past midline); turns head and eyes to sound |
| 3 months | Watches faces intently |
| 4 months | Can fully accommodate visually; visual fixation is increased if pattern is complex and especially if it resembles human face |
| 5-6 months | Recognizes people at distance; listens intently to human voices |
| 7 months | Looks for dropped object |
| 12 months | Looks for object hidden in his presence |
| 3 years | Recognizes at least 3 colors |
| 5 years | Knows 4 colors |

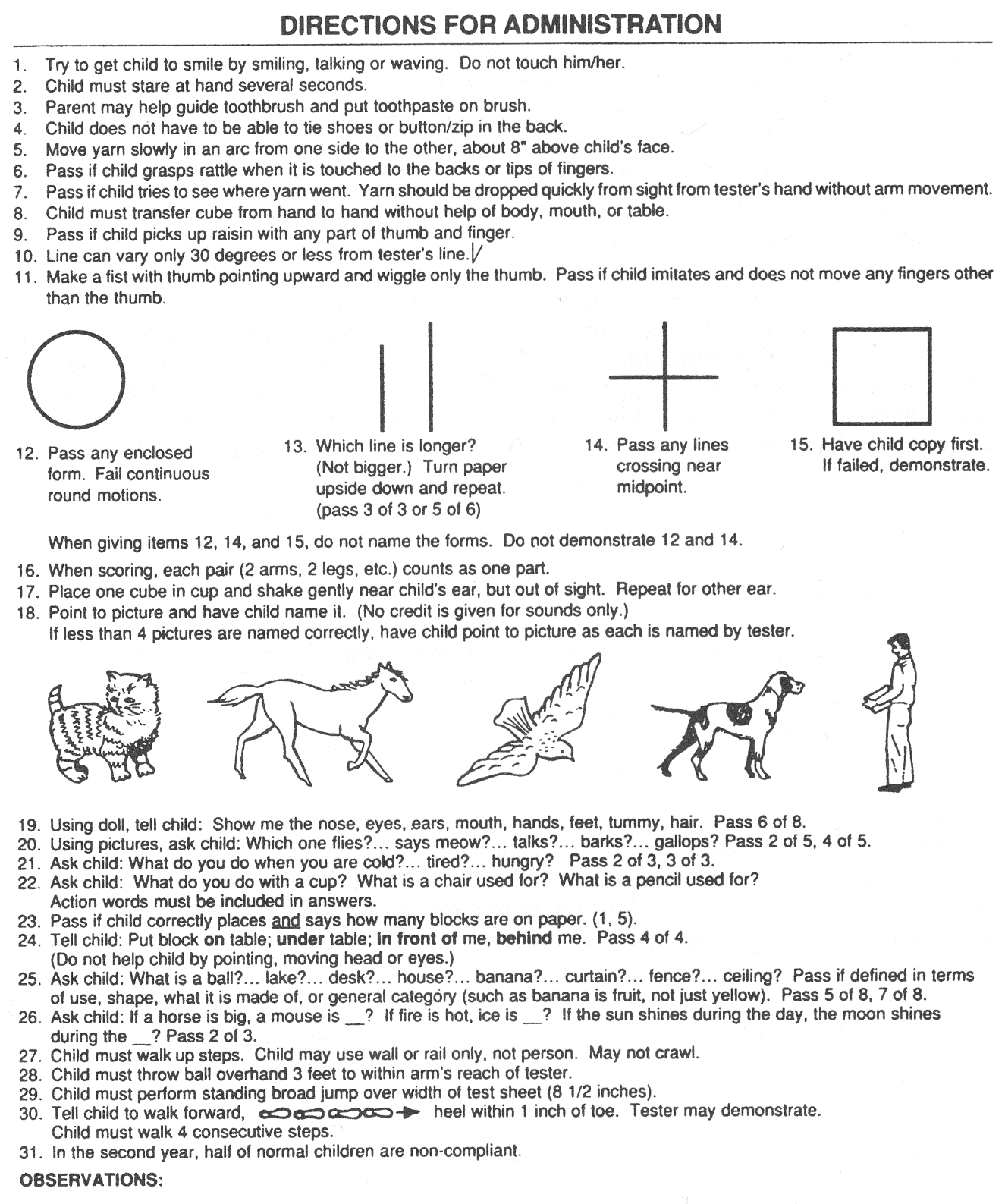
Social

|  |  |
| --- | --- |
| 6 weeks | Begins to smile when spoken to |
| 3 months | Smiles at sound of caretaker's voice |
| 5-6 months | Smiles spontaneously |
| 7-8 months | Plays peek-a-boo |
| 9 months | Objects if toy is taken away; plays pat-a-cake; responds to own name; understands “no” and waves “bye-bye” |
| 2 years | Engages in solitary or parallel play (not capable of sharing) |
| 3 years | Shares playthings, plays interactive games; sibling rivalry begins; ½ of children can take care of toilet needs |
| 4-5 years | Fixed and stable concept of gender; has imaginary friend |
| Time of school entry | Easily separates from mother |



Denver II developmental monitoring tool (identifies children at risk for possible developmental problems and confirms subjective suspicions of delay):





Bibliography for ch. “Diagnostics” → follow this [link >>](http://www.neurosurgeryresident.net/D.%20Diagnostics\D.%20Bibliography.pdf)

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