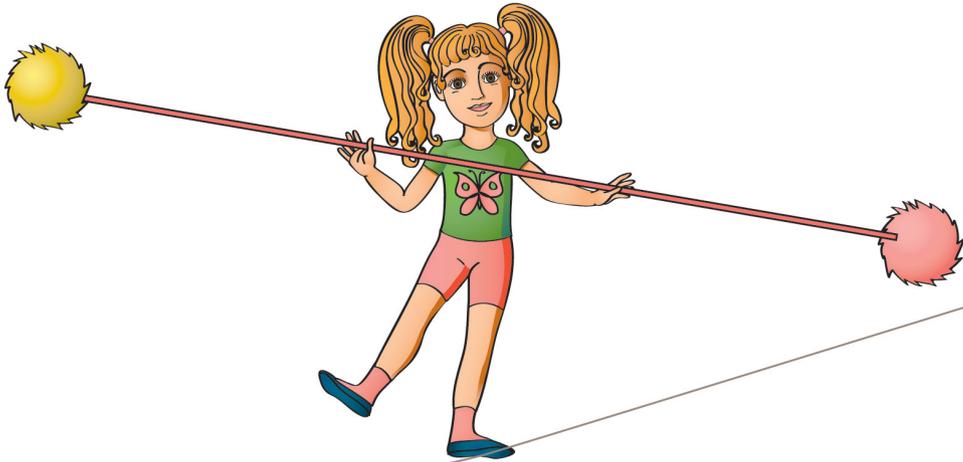


# Balance problems in children



For day-to-day comprehension and advices



# Preface

Providing information about deafness is one of the primary activities of the ACFOS (acronym in French for Action, Knowledge, Training for Deafness). ACFOS aims for an audience of professionals, hearing impaired individuals and their families. After having participated in the practical guide “*Deafness in children*” for parental use and publishing the booklet “*What is deafness?*” for children, ACFOS now presents a booklet about balance problems in children.

## Why expand our field of interest from deafness towards balance?

It has only relatively recently been acknowledged that balance problems are frequently associated to deafness in children. Testing the vestibular apparatus is now more often included in the clinical test for deaf children. It is estimated that 20% of profound hearing losses are associated with vestibular areflexia, and that 40% have a partial deficit.

Nevertheless, vestibular impairment can also be found in children with normal hearing, although much less frequently.

## Why use a booklet for families?

The success of our first booklet showed that a handy, didactic and illustrated support provides precious help and support for families. It helps parents to understand the day to day reactions of their child and adjust. It also is a link between parents and professionals who, so far, haven't had a knowledge base focused on balance to provide to parents. This document illustrates, explains, suggests, help to memorize information and to raise questions.

Professionals, specialists and pioneers in diagnosing and treating these problems suggested this booklet to ACFOS. They made major contributions to bring this project to fruition and we are so grateful to them.

We are also very thankful to the INPES who allowed it to be financed.

We hope that this booklet will provide simple and appropriate information, suggesting adapted actions to those confronted with sometimes disturbing situations.

We wish for this booklet to meet with the same success as did our preceding publications.

ACFOS

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# Introduction

This booklet is addressed primarily to the parents, but also to others in contact with young children with a vestibular problem.

It is the result of collaboration among professionals who work on balance problems in children. By bringing together their experience, they offer help to parents to better understand what the vestibule is, and what effects dysfunctions of this organ can have on the development and the daily life of their child.

A child with no vestibular sensory information will suffer from motor delay because he must find different points of reference and different solutions to build his equilibrium: stabilizing gaze and the body relative to gravity and movements drawing on other available sensory information.

Without efficient compensation of these difficulties, the child will have problems learning certain things like building a mental representation of his body and the space around it, as well as interacting, communicating, writing, reading, etc.

If he spontaneously finds ways around these difficulties, this can give rise to sometimes disturbing behaviours, which are often poorly interpreted by the people around him.

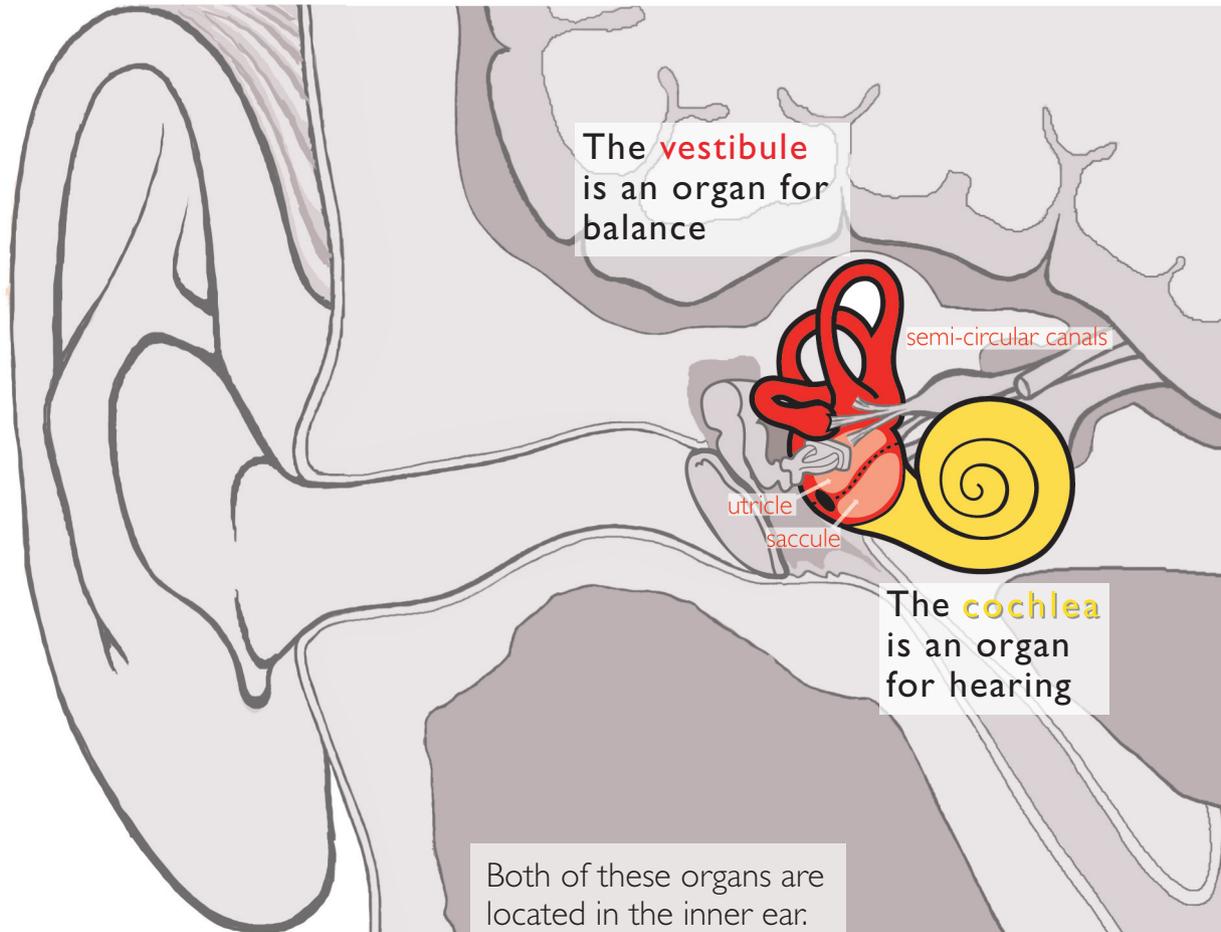
## Once the diagnosis is made, how can the child be helped?

The objective of this booklet is to employ daily activities (meals, washing, dressing, educational games, excursions, etc.) by adapting them in an enjoyable manner, to permit the child to better stabilize his body and to develop his capacities for attention and learning.

These suggestions are not exhaustive and are not intended to replace the interactions between parents and professionals who are treating the child for this. The child must be followed from an early age by a clinical service and a psychomotor therapist\* in vestibular rehabilitative therapy.

Each child reacts in his own way, adopting personal strategies. We must respect the child's own rhythm and creativity, and regularly adapt to the different steps of his evolution.

# The vestibule...



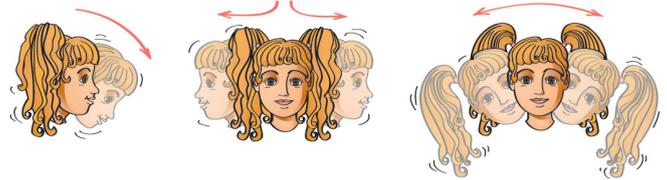
The vestibule is a little known sensory organ, the basis building block for equilibrium, a sixth sense hidden within the inner ear. This cavity bored within the bone of the base of the skull is truly a labyrinth sheltering both the auditory apparatus (or cochlea, shaped like a snail's shell) and the vestibular apparatus (called the vestibule). This common position within the inner ear explains why many pathologies (genetic, infectious, traumatic) can affect hearing (deafness) and the vestibular apparatus (equilibrium and gaze control problems) in the same patient.

## **The vestibule is a detector of head movements and position when the body moves**

It contains several types of **receptors**, which respond to different types of movements of the head in three dimensions in space:

- for the **semi-circular canals**:

- lifting and lowering the head (nodding 'yes'),
- turning the head left and right (nodding 'no'),
- leaning the head sideways.



- for the **otolith organs** (utricle et saccule):

- linear movements forward/backward, laterally or vertically,
- detecting the angle of tilt of the head relative to gravity, like a plumb line. Note that this perception of gravity allows the child to build concepts of verticality and spatial cues.



Movement information received by the vestibule is sent to the brain, optimizing the control of the:

- **Eye movements:** they stabilise the vision when the head moves. This permits the image movement across the retina to be slowed down, and avoids jitter,
- **Neck and back muscles: they stabilise the head and trunk in the body axis.** This axis provides a reference to modulate, organize and control arm and leg movements among our environment..

**These two reflexes facilitate both balance and vision.**

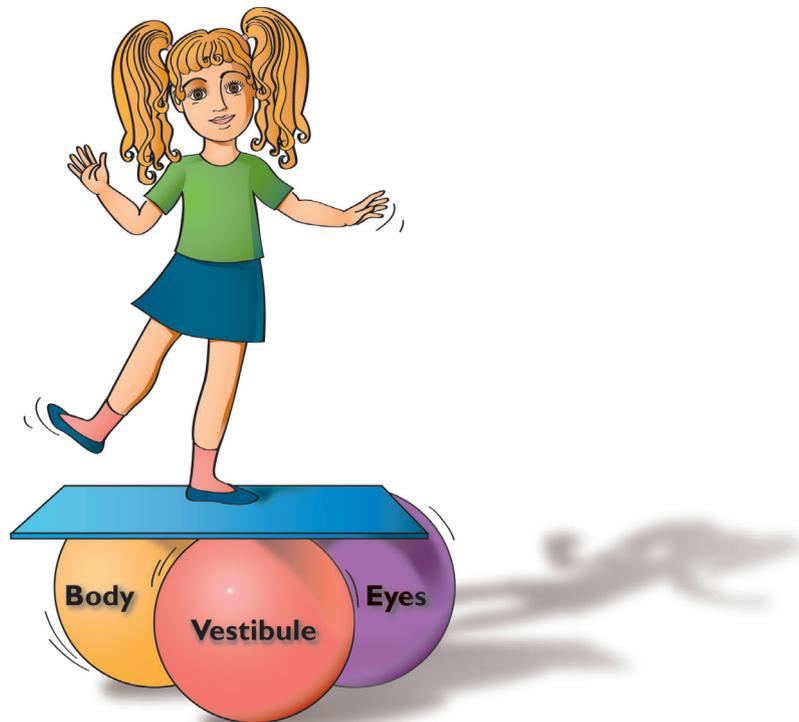
# ... And equilibrium

Several types of sensory information permit balance to be maintained. They come from:

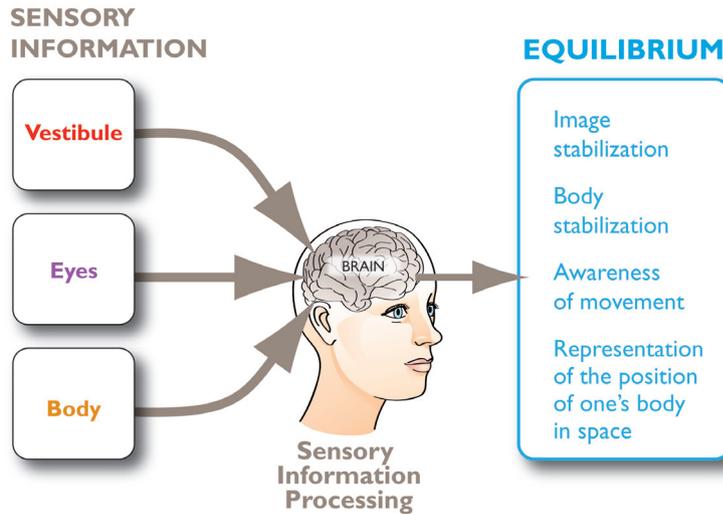
- the **vestibule**,
- the **eyes**,
- the entire **body**: the sense of touch, pressure on the skin, activation levels of muscles, tendons and joints, referred to as somesthetic\* et proprioceptive\* information.

The balance system integrates all information concerning movements and positions of different parts of the body. It permits responses to all variations of equilibrium, whether voluntary or involuntary, by **adapted postural** movements (regaining balance after stumbling) or **gaze** (keeping a stable image while turning about).

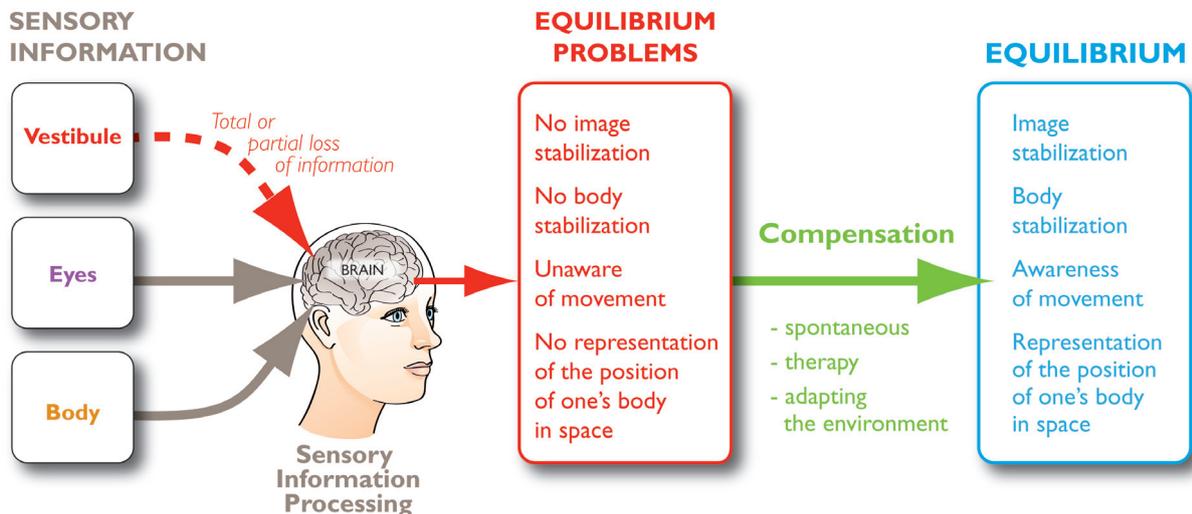
Clinical testing of the vestibular apparatus examines trunk and eye stabilisation, and this is also monitored during therapy.



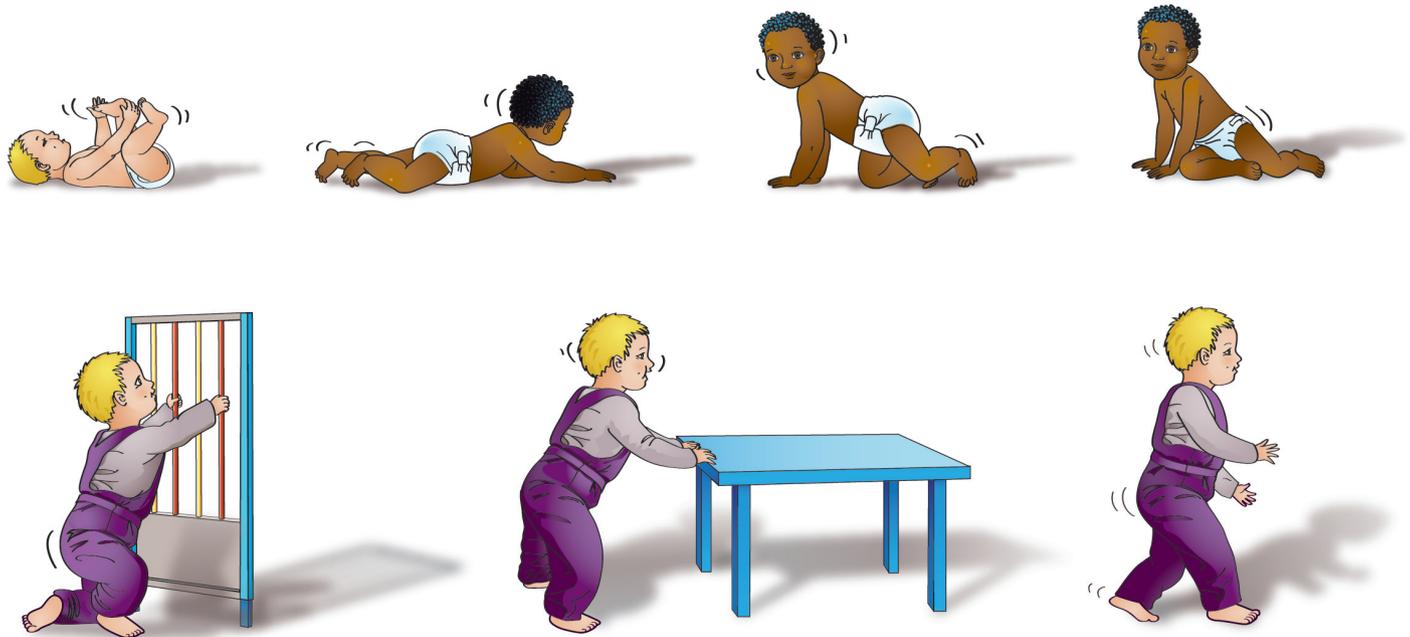
# Normal vestibular function



# Vestibular dysfunction



# Psychomotor development in children



A child with no neurological, sensory or motor problems progressively learns to control his posture up until the age of 12 months. He depends particularly on vestibular information to hold up the body axis (holding head up), rotations about this axis (dorso-ventral rotations), verticality (crawling on all four limbs, sitting up, standing up) and walking (before the age of 18 months).

**A child with a partial or total vestibular deficit goes through all of these stages of psychomotor development, but does it more slowly proportionally to the sensory dysfunction.**

# Vestibular deficits

**Total deficit:** complete absence of any vestibular information (areflexia\*)

## ***Areflexia from birth or acquired during the first year of life***

All stages of acquisition of motor and postural control\* are delayed. The child has no vertical references and no instantaneous detection of his movements. When he turns her head, the world wobbles around him.

## ***Areflexia after taking the first steps independently*** (as can happen for example after a meningitis)

The delays in posturo-motor\* development will not be as substantial. The child can employ that which was acquired previously. Meanwhile, he must relearn to stabilize his head and his body, and once again go through the classic developmental stages.

**Partial deficit:** certain vestibular information is more or less retained

The consequences are not always easy to detect. In this case, the child will develop almost normally until taking his first steps.

The brain takes input it can benefit from any partial vestibular information and built up compensatory reflex.

This can be experienced by the child as:

- a slight delay in acquisition of postural control,
- repeated inexplicable falls.

**Fluctuating deficit:** vestibular information can vary, sometimes suddenly, or deteriorate over time, as in the case of certain inner ear malformations.

The child has difficulties standing up, has nausea and vomiting, which could be mistaken for a gastro-enteritis attack. These incidents are often extenuating for the child and the people around her. This can also slow down the acquisition of postural control and be responsible of frequent falls.

# Consequences that can be observed



## **Delay of postural control and of psychomotor development**

The absence of vestibular information brings on hypotonia\* in the head-neck-trunk axis. The infant takes more time to be able to hold his head stable. He has difficulty getting up when laid prone. Mastering the transition to a sitting position, then to standing is laborious.

## **Delayed and uncertain walking, falling**

In the absence of vestibular information, independent walking will rarely be learned before 19 months of age. Falls will be frequent and often spectacular because the infant does not quickly enough perceive the rapid rotations of his body and doesn't have the time to put his hands out to cushion the fall.

The first steps are a delicate stage because it is necessary to overcome the disequilibrium accompanying each step.

To compensate for these difficulties, the child maintains maximal support, which limits his autonomy and his capacity to explore.

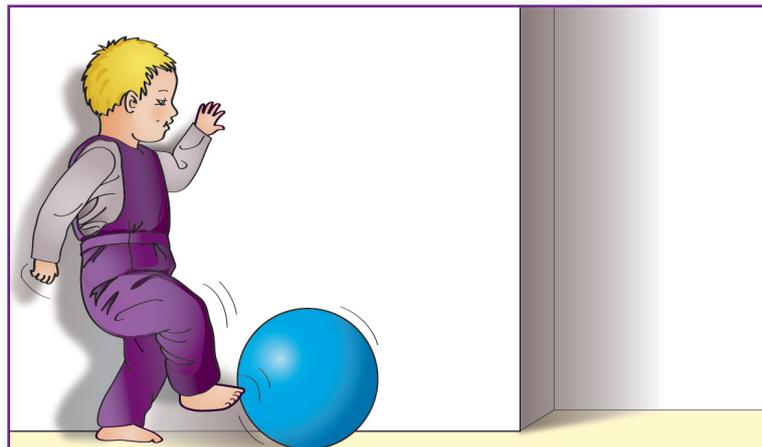
« My 3 month old is still flaccid. He has difficulty lifting his head to look at us. »

« I noticed that my baby clearly prefers being on his back than on his belly. He fatigues easily in this position »

« My baby can get up nicely while holding onto a low table or leaning on a wall, but she doesn't dare jump forward to make her first steps »

« My infant needs to press against a wall to walk or to kick a ball »

« Walking is clumsy – he spreads his legs and sometimes his arms »



## Discomfort for rapid movements

The younger he is, the less the infant can anticipate these movements (rocking, swinging, rotating, turning over). He doesn't yet know how to use gaze and supports to compensate.

To fight against permanent instability, many children block their head and neck, and stiffen up.

In daily life, and more specially **in group situations**, the environment is generally in movement. The child can not find stable visual landmarks and have no access to the information he needs. Examples include: following one child among many others, finding the ball, avoiding obstacles.

When there is too much information, the child can have difficulty following an instruction. He can appear 'absent'. In contrast, movement can excite him. He can be overcome by the situation. His agitation reflects his discomfort. If the body is not stable, maintaining attention is difficult.

**The playground** can, at first, disturb him because he doesn't feel ready yet to master complex situations like climbing a rope-net, sliding on a sliding board, see-sawing, swinging, taking the risk of being pushed, etc. Accompanying him will reassure him progressively.

## Avoidance reactions

The discomfort experienced in certain situations generally induces avoidance reactions which are often poorly interpreted by the entourage.

Also for sporting activities, the child with no vestibular information finds himself rapidly in difficulty, performing more poorly than the other children.

The psychological impact of this (loss of sense of confidence, disassociation, and aggressiveness) can be substantial and must be taken into account.

« My baby doesn't like it when I swing her back and forth, turn her over, and shake her legs. She turns away and wails »

« At the playground, my child has difficulty participating, he stands alone and stares at the other children around him »

« My child complains when we go to the park. He doesn't seem to appreciate these outings »

« He is not attentive, jumps from one activity to another, gets excited, moves about a lot. At school his behaviour is worsening and can be a problem »

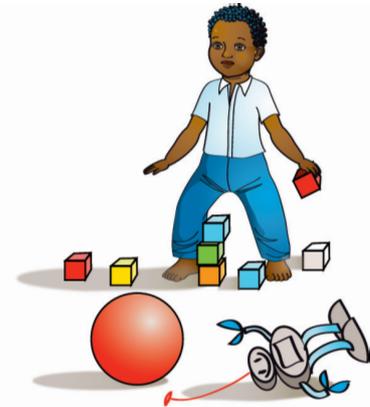
## **A great expense of energy, easily fatigued, global lack of attention for learning, a feeling of doing two things at the same time**

Without vestibular information, the child uses a great deal of energy to overcome the instability of the head and trunk. This makes him easily tired and inattentive for learning tasks. It is difficult for him to simultaneously stabilize his body, search for physical and visual supports, and remain available for activities such as manual exploration, drawing, reading or writing. He always has several tasks to deal with at the same time.

« My child often looks off into space. She stops playing and seems 'disconnected' »

## **Poor spatial representations**

Without any vertical reference, the child has greater difficulties situating the different parts of his body and representing up and down, front and back. Orienting in space becomes more complex and has repercussions on activities like drawing, building, puzzles, writing, etc.



The child spontaneously seeks for solutions to his discomfort and difficulty

## **Seeking proprioceptive information**

The child tries to reinforce his support information (back, hands, feet). When he starts to move about, contact pressure against the floor is important.

**Barefoot**, the child can better sense different types of flooring (carpet, tile, wood floor, lawn).

**On sand** or uneven terrains (gravel, slopes, etc.), he is destabilized. He no longer has the means to control the situation, and feels endangered.

« My child refuses to put on her beautiful, brand new shoes, specially made for 'first steps'. However she adores going barefoot »

« He cries when we take him to the beach »

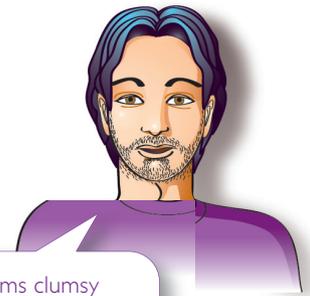
## Using gaze to stabilize the body

As soon as he can, the child uses gaze to stabilize his head and his body. This explains why these children don't pay attention when spoken to while they are standing or walking (requiring them to do two things at the same time).

This constant visual attentiveness distracts and reduces their vigilance. This attention deficit diminishes their capacities to absorb pertinent information from those around them - information which they need to understand a lecture, an instruction, or to explore a scene. In addition, visual acuity is diminished during head movements. Hence they often seem clumsy.

In a new place, the child loses the visual bearings that he uses at home to help move about.

In the dark, the child no longer has visual landmarks. He can only count on his tactile and proprioceptive sensations to maintain stability.



« My child often seems clumsy and doesn't enjoy construction games or those requiring fine precision (puzzles, beads, cutouts, etc.) »

« My child is afraid of the dark and he won't get up at night to go to the toilet. He is not comfortable when we walk outside in the evening and it is already night time. »



## Et pour l'enfant sourd : des conséquences particulières

For the deaf child, the existence of a vestibular deficit can aggravate the consequences of the hearing impairment on communication and the development of spoken or signed language.

« Why does my hearing impaired child have difficulty looking at me when I communicate with him? »

Reasons why:

- Gaze instability during head and body movements prevents him from perceiving information coming from different sources,
- It is difficult for him to maintain his visual attention on rapid sequences of gestures or lip movements necessary for using Sign Language\* and lip-reading\* with Cued Speech\*,
- Poor perception of verticality and of body orientations complicate analysis of signs that the child receives and also that he produces (inversion of left and right, forward/behind when facing the person communicating with him).

It must be taken into account that the deaf child must make **constant efforts** to overcome these difficulties. We must take into account the fatigue that this brings on: take pauses and be vigilant for body supports and the comfortable placement of the child.



# Basic principles of compensation

Without vestibular information the child, in order to maintain equilibrium, must strengthen two other sensory inputs:

- vision, searching for fixed landmarks to stabilize gaze and body posture,
- proprioception, seeking stable and secure points of support for the body.

## ***Think regularly about testing your child's vision***

Vision must be at its best so that he can use it for stabilization. It is essential to correct vision if necessary.

## ***Create adapted lighting conditions***

Avoid complete darkness (install nightlights, lamps, movement detectors triggering light illumination, etc.).

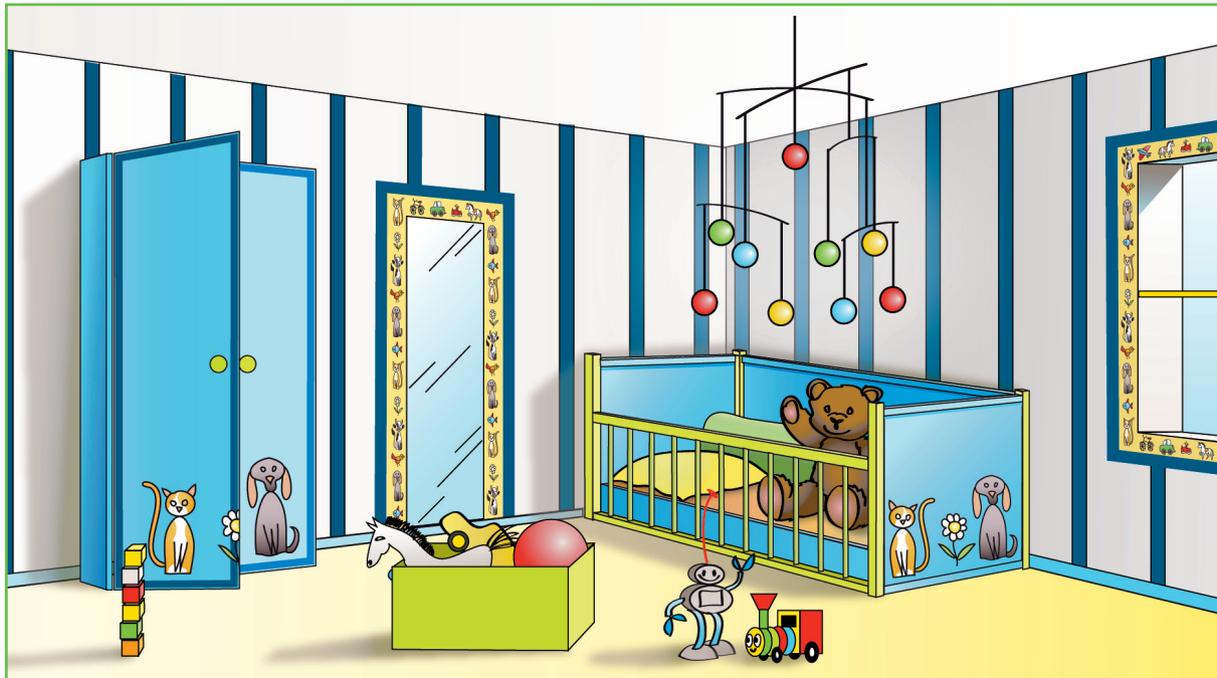
# Appropriate suggestions for daily life

## **Reinforce vertical and horizontal visual references in his environment**

The child has difficulty detecting in his body what is vertical, up, down, front, and behind.

By artificially adding visual structure to his environment, he can more easily detect orienting landmarks and acquire the notion of verticality. For example, one may install:

- a wall mural with contrasted colors,
- posters,
- darkened contours around doors and windows,
- a mobile above the bed,
- a large mirror,
- avoid uneven flooring (carpets, etc.).



## **Incite the child to look at fixed cues when changing position**

During movements (rocking, rotating, turning over), the child loses his sense of bearings. He doesn't have the time to stabilize his gaze. What he sees moves back and forth too quickly.

**Think of slowing down your movements and encourage the child to fix her gaze on a stable target.** He can thus anticipate the movement and no longer get carried away by the perceived flow of the visual environment.

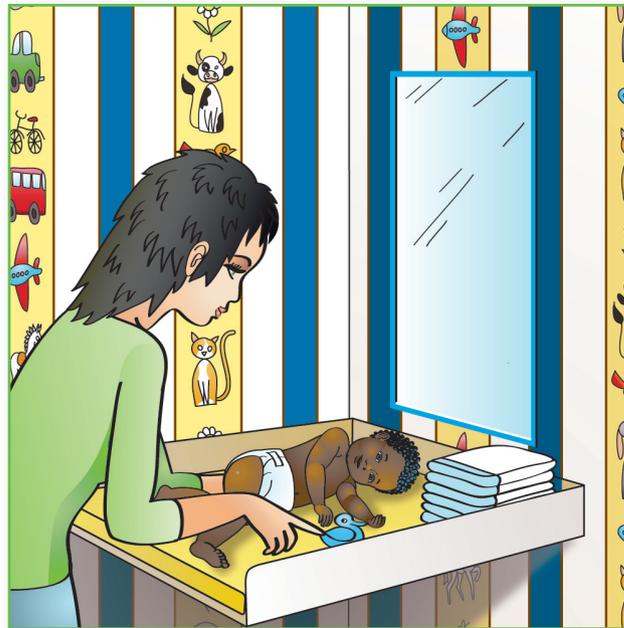
- For the smaller ones, attract their gaze on an adult's eyes or on a fixed object just before moving him (rocking, taking into your arms, turning over during changing).
- For the older child, at home and outside, during displacements (walking, running, turning about, etc.), train the child to fix his gaze on a stable object in his environment.



« I noticed that my baby cries a lot and I don't succeed at calming her by rocking.

When I take her too quickly in my arms, she seems to be afraid and might start to cry. I sometimes am confused and don't know what to do »

« My child runs without looking where she is going and often falls – on the playground particularly »



## **It is essential to position the child properly**

The child is making a constant effort to maintain the stability of his body at the expense of attention which otherwise would be used for listening, watching and learning.

**Be attentive that his back and head are supported** by using appropriate accessories:

- an enveloping infant car seat, a type of 'nesting' nursing cushion for the very small,
- a table and chair of appropriate dimensions with a high back and armrests for the older children.

**Be sure to:** put yourself at the level of his gaze when addressing him, placing him comfortably on your lap, with his back well supported against you when looking at a book together or manipulating toys (modelling clay, drawing, etc.)

**In the seated position,** assure that his feet touch the ground or, if need be, a footstool.

**When standing up,** permit the child to lean his back against the wall, or place his hand against it.

By minimizing his efforts to steady his body, the child will be able to be more attentive.



## **Reinforcing tactile and proprioceptive stimulation from the youngest age**

**Massages and caresses** will help the child to develop a finer awareness of the different parts of his body. Massage allows the child to relax, is calming and gently mobilizes the child so that he discovers his possible for movement in a re-assuring context. Naming the body parts touched during these exchanges helps him construct his internal representation of the body\*.

**Favoring manipulations** manipulations which refine his sensations en reinforce his capacities of prehension\*, (pressing, rubbing, stretching, flattening, rolling, etc.) with modelling clay for example, will prepare for manually supporting himself when he will need it to move about in the future.

## Encourage getting support from the hands and feet

Respect the child's need to get support manually until he feels capable of doing without it. Help the use of information from the feet:

- **at home**, let the child go about barefoot or in supple, anti-slip socks. The child gets used to managing different types of flooring (tile, carpeting, rugs, wood floors) in a secure environment.
- **outside**, supple shoes with thin soles are preferable so that the child may benefit from a maximum amount of information. The shoe must surround the foot but the ankle must remain mobile (no ankle covering shoes, no thong sandals).



« My child likes to lie on the ground for no reason, or to play. He likes staying glued on the sofa and watching everything going on about him. He even moves about crawling on his back or belly to look for something, rather than getting up »

## Let the child move freely about and experiment taking risks

The more he can exercise his motor functions in security and experiment with taking risks the greater he can establish strategies to spontaneously stabilize his body and gaze.

- Don't hesitate to take the baby out of his car seat to let him play, move about on a carpet, in the playpen, crawl, turn over, climb, etc., under a watchful eye.
- Incite the baby to lift herself up and stand while grabbing on the bars of his playpen, of his bed, leaning on a sofa or a low table. Then, incite him to move about while retaining his supports. Think of attracting his gaze to help him stabilize himself.
- Try and give the child a small truck that he can sit on and thus feel more secure. By pushing with his legs he becomes conscious of the sole of feet giving support and gains autonomy.
- Encourage the child to push a slightly heavy (weighted) cart or a large box when she starts to walk.
- Don't discourage him from carrying a large pillow or a heavy object in his arms when he walks; this will permit him to become conscious of gravity and adjust better his equilibrium.

« My baby gets up well by holding onto a low table or pushing herself against a wall, but she doesn't dare take the leap for her first steps. How can we help her? »

**The stairs.** Let the child go up and down on all fours, or on her bottom, taking as much time as he needs. Stay below him while going both up and down. When he starts go down standing, encourage him to hold onto the wall. It is ideal is to have a continuous banister, or bars at his height that he can hold onto.

« Going up and down the stairs are quite complicated. How do we do it? »

## Helping the child orient himself in space

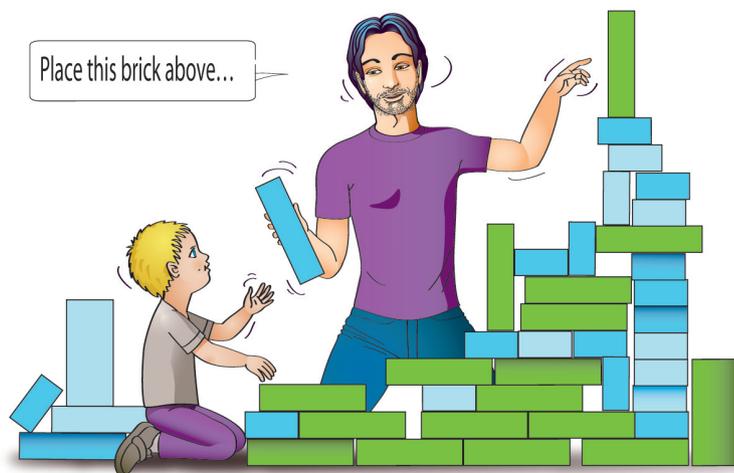
Naming (via speech or in sign language, according to the child's mode of communication) the different body parts in relation to the concepts of up/down, in front of/behind, above/below, within/outside, helps the child to find spatial bearing, to make directed movements, put objects in place, and later to manage space on the blackboard, or on the page where he is drawing.

### And playing!

Transform a cardboard into a house, a tunnel for the concepts of inside-outside, closed-open.

Use large cardboard or foam bricks to build things. Constantly describe the necessary orientations.

Make use of a large mirror during these games to permit the child to see his body moving in space.



### Take pauses, give him time

Your child gets tired quickly! Slow down the rhythm of these exchanges and give him plenty of time to respond. Let him take pauses without being disturbed. Give him as much time as possible in a calm spot to rest.

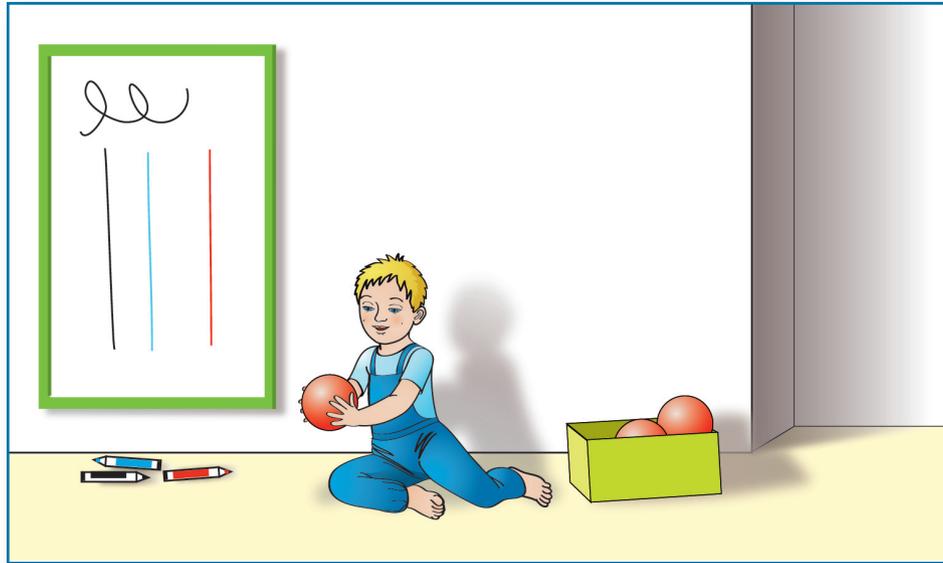
# Some games to facilitate compensation

All games or activities which make the child lower himself, raise himself, turn around, continuously fix gaze at objects in the environment and anticipate a movement while fixating on a target help to compensate for disequilibria.

Thanks to games, we can help the child to overcome his difficulties in certain situations. If he refuses, it's just that he isn't yet ready or doesn't feel secure. Offer his support (sitting, leaning back, etc.) or propose playing later!

## Games with balls or balloons

Passing a ball back and forth, sitting face to face with an adult, the child may lean his back against the wall if need be. Roll the ball to the child, alternating sending it straight or from the sides so that the child releases his supports to catch it. Without losing sight of the ball, he leans over to grab it. Then either he throws it back to the adult or places it in a box beside her.

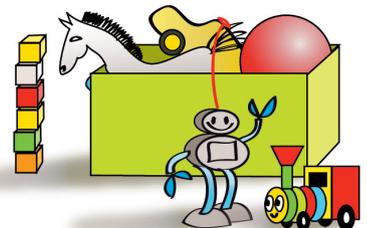


**Objective:** visual pursuit and rotation about the body axis

**Another game:** knocking down light bowling pins with a ball

## Activities of picking up and putting things away

These activities develop the use of visual landmarks during head rotations. They can be done as soon as the child is sufficiently stable while standing. He will be encouraged to put away his toys, empty laundry from the (front-loading) washer or dryer, etc. The weight of the objects to pick or put away promotes equilibrium.



## Keeping equilibrium while standing on a flexible surface

Standing on a mattress, in a bed with bars, the adult shows the child the components of a poster hung next to his bed, encouraging him to point out details. If necessary, the child can hold on.



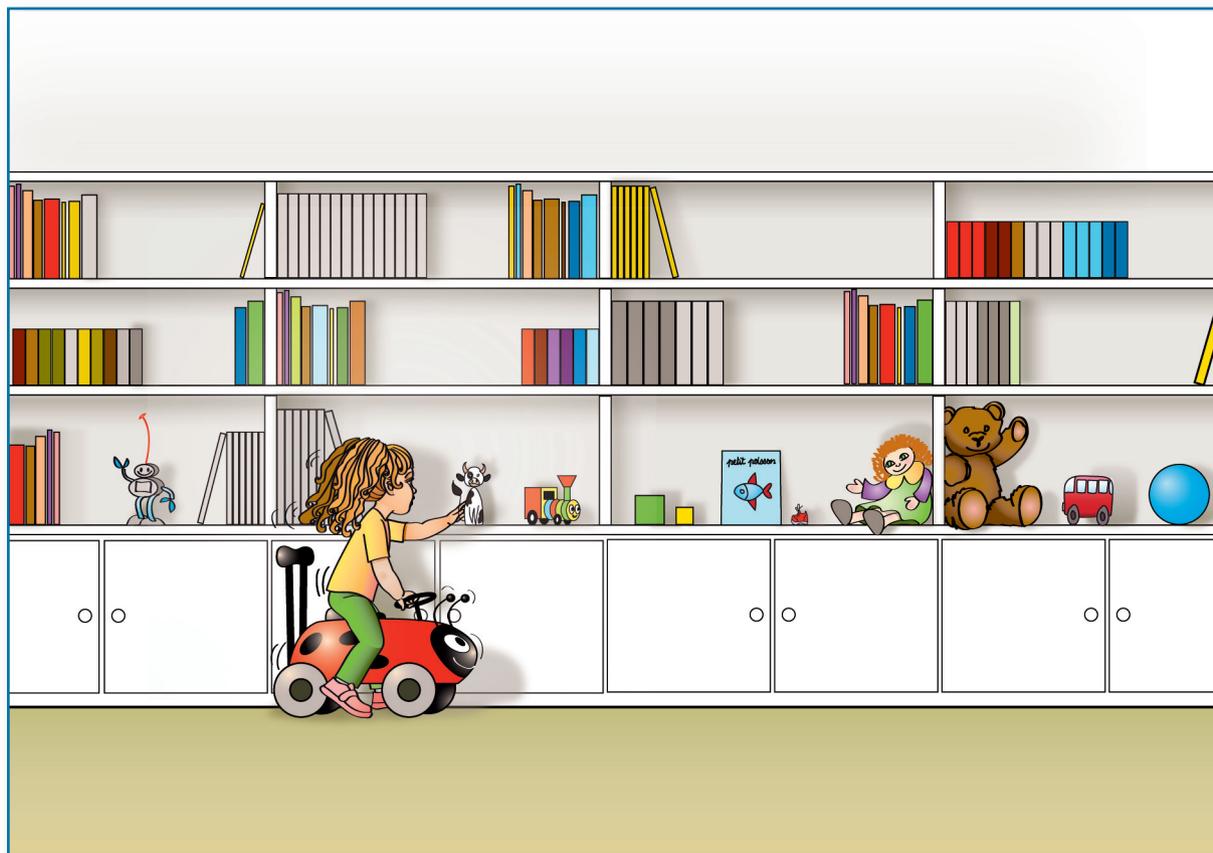
**Objective:** fixing gaze and keeping balanced despite contact with a destabilizing surface.

**Another game:** walking on the grass, the sand, or a thick carpet.

## Fixing his gaze during displacements

In a hallway, for example, ask the child to go look for objects and to bring them back.

The displacements can be made while seated on a toy truck, while pushing a cart, a small stroller, or running towards someone.



**Objective:** organizing his movements while moving towards a target.

**Another game:** turning around the table while rolling a small car, or while trying to catch someone (playing tag).

## Games with moving targets

These activities are rather difficult to perform. At first, the child can only do it in a seated position. He must follow the soap bubbles with his gaze, then try to pop them.



**Objective:** to favor control and coordination of gaze/movement towards the targets whose movements are random.

**Another game:** playing catch with a balloon, playing with illuminated bouncing balls, playing with gymnastics twirling ribbons.

There are other challenges which the child refused at first, for example, moving back and forth (rocking, swings, seesaw, etc.), the sliding board, rotating platforms, somersaults, etc. which he will seek when he better masters his equilibrium.

# Glossary

**Vestibular areflexia.** (term often used by physician) means a total absence of vestibular information.

**Vestibular test battery.** Set of test for evaluating vestibular apparatus function (canalar and otolithic function). It is carried out by a physician in specialized clinic. This test is as comprehensive as possible permitting to detect vestibular areflexia.

**Motor and Postural control.** Control of the position of the body against gravity to maintain equilibrium. This is the basic referential position from which movements can be initiated. Posture will serve as an anchor for elaborating and carrying out all movements in the environment (exploration, communication, etc.) and thus participate to motor control as well.

**Cued lipreading: cued speech.** Visual assistance for lip reading. The speaker adds hand signals at the level of the face to help the hearing impaired person to distinguish phonemes. For example “meat”, “peat” and “beat” all elicit the same lip configurations, and CLP allows one to distinguish these three words.

**Sign language (ASL, BSL...).** A gestural language used by deaf persons. It is a visual language with its own grammar and syntax. Each idea is expressed by a gesture, a configuration of the fingers, a position in space and an associated mime.

**Prehension.** The act of taking or seizing.

**Proprioception.** A deep (somatic) sense transmitted by receptors in the joints, tendons, ligaments, and muscles indicating the relative positions of the parts of the body relative to one another (and in relation to gravity).

**Postuomotor.** ‘Posture’ is the position of the body when it is immobile at rest and when it moves and displaces itself. ‘Motor’ describes movements and motor activity. The two are permanently interactive to maintain our equilibrium, since resting stably upright or moving while maintaining one’s equilibrium requires both maintaining posture and different muscle activities in order to avoid falling (motor activity of the limbs, but also of eye muscles which stabilize vision).

**Psychomotor therapist.** He is a medical support staff member, like physical therapists, speech therapists or nurses. His activities are prescribed by a physician or an audiophonologist (depending on the country). With a psychomotor evaluation, he establishes the child’s developmental level and motor abilities (coordination, equilibrium, fine motor activity, writing and drawing), his tonic organization, handedness, level of spatial and temporal organization, representation of his own body (body schema), and behavioural adaptation. He can then propose, as necessary, objectives for taking charge of the child’s needs in a well-adapted manner.

**Psychomotor function.** The concept of psychomotor function originated at the beginning of the 20<sup>th</sup> century in order to provide complete care of the individual as a single entity composed of body and mind. Psychomotor therapy thus focused on the body in function of the age and the needs of the patient. With children, all is done through games. Through these sensory and motor experiences the child develops, constructs his points of reference and his personality.

**Body schema.** The representation that one makes of his or her own body and of the space it occupies in the environment. This representation evolves with age and growth, depending critically upon sensory afferents and motor experiences. Also somesthetic, visual and, in part, vestibular information intervene for integration of a spatial reference.

**Somesthesia.** Sensitivity for the body including all pressure and stretch receptors located either at the surface beneath the skin (superficial sensitivity) and indicating particular types of contact of the skin with the environment (touch, hot/cold, pressure on the ground, etc.) or from deep body regions (deep sensitivity such as proprioception and visceral sensitivity).

**Tonus.** ÉPermanent state of muscle tension, which is involuntary and of variable intensity. It is the basis of posture and motor activity. It is evaluated at rest (resting tonus), in situations of postural control (supporting tonus) and during activities of fine coordination like writing or drawing (action tonus). During the first years of life, tonic organization evolves. At birth, the baby naturally has an **axial hypotonia** (flaccid back and falling head) and **limb hypertonia** (arms and legs in flexion). Progressively, tonicity will reinforce itself from head to feet, allowing the child to get up and to stand. In parallel, the child loses the limb stiffness, gaining mobility and developing voluntary prehensile movements.

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