



Review article

ACTA FAC. MED. NAISS. 2004; 21 (4): 253-257

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DEVELOPMENT OF CARDINAL MOTOR SKILLS IN THE FIRST YEAR OF LIFE

SUMMARY

Motor development of a healthy newborn, infant and a small child goes on quite spontaneously, according to the natural laws and directly depends on anatomic and functional adequacy of the central nervous system (CNS). The course of this development is determined by genetically established patterns of development, but, at the same time, it is being stimulated by the stimuli from the outside world. The brain, as an organ responsible for integration and coordination, receives these stimuli and responds to them by automatic, complex reactions.

The adoption of the basic motor skills (maintaining and head control, lateral transfers into a lying position, then sitting, standing, walking, crawling, grasping) goes on quite spontaneously. A child learns all the motor actions by itself and that is why it is not necessary to "TEACH" a child to sit, stand, grasp, walk...

At eleven months of age, 90% of infants can independently assume the correct sitting position from which they pass into a slanted sitting to assume crawling position. From crawling position the infant returns into a sitting one.

At the end of the eleventh and during the twelfth month, 90% of children begin to walk sideways with leaning on the objects. More than 50% of children at twelve month of age can walk independently without support.

Fifty percentage of children at twelve month of age can hold two legos in one hand, which requires high degree of hand adaptation to the very object.

Key words: motor development, motor skills, infant

INTRODUCTION

Movement is a basic feature of life by which we express sensations, establish verbal and gesticulating communication (speech, gesticulation), control space and achieve biological independence.

In the youngest age, movement is a reflection of the state and behavior of a newborn. In newborns, motor patterns are of reflective nature. In infants, the patterns of voluntary movements develop through the patterns of postural control, and later on, through numerous neural connections, secondarily auto-

mated, coordinated voluntary movements are formed (1).

Motor development of a healthy newborn, infant and a small child goes on quite spontaneously, according to the natural laws and directly depends on anatomic and functional adequacy of the central nervous system (CNS). The course of this development is determined by genetically established patterns of development, but, at the same time, it is being stimulated by the stimuli from the outside world. The brain, as an organ responsible for integration and coordination, receives these stimuli and responds to them by automatic, complex reactions (2).

For a child, this means a constant improvement of motor skills which are used for achieving physical independence, as well as the ability of adaptation to the conditions of social environment (3).

The adoption of the basic motor skills (maintaining and head control, lateral transfers into a lying position, then sitting, standing, walking, crawling, grasping) goes on quite spontaneously. A child learns all the motor actions by itself and that is why it is not necessary to "TEACH" a child to sit, stand, grasp, walk... "Teaching" a child the basic motor skills stands for a rough, unnecessary and undesirable involvement into a spontaneous motor development, and, due to this, the normal adoption of motor skills is slowed down.

One should always keep in mind that there is a close connection as well as strong mutual influence between motor and psychic development. Therefore, instead of the term "motor" we often use the term "psychomotor" development (4).

DEVELOPMENT OF MOTOR SKILLS IN PRONATION- UP TO CRAWLING AND STANDING

Both newborn and infant lie on the chest in the flexed posture. The flexion comprises upper and lower extremities. Due to the strong flexion of legs, pelvis is lifted from the ground, which is the reason why the center of the body weight is on a cheek, chest and forearms placed laterally from the body (5). (figure 1).



Figure 1. Both newborn and infant lie on the chest in the flexed posture. The flexion comprises upper and lower extremities

From the third month on, and during the fourth, the infant begins to maintain the balance, and the precondition for this is that the both elbows are in front of the shoulders' line, that the strong flexion in pelvis has released and that the center of the body weight has been moved from the chest towards the abdominal area. This phase in motor development is

called the "elbow-pelvis support". Only from this posture, a child can freely turn the head.

In the fifth and the sixth month, the infant keeps on lifting the body from the ground to the higher extent than before, so that at six months of age it can stretch elbows and rest on the open hands. In this posture, the center of the body weight moves from the abdominal area towards the pelvis. This phase of the motor development is called the "hand-pelvis support".

After seven months, the function of leaning on hands is so reliable, that the infant moves backwards and body weight is carried on hands and haunches. In this way the infant learns to burden legs, while the lateral transfer is achieved by "the support: one hand-pelvis".

At eight months of age, the infant manages to lift the pelvis from the ground, performing in this way "hand-knee support" (figure 2). However, the infant still cannot crawl because the transfer of the center of the body weight to the flank is still lacking. This will be practiced in supine position by the crosswise movements: the infant turns around the umbilicus leftwards and rightwards. When it gets control of transfer of the body weight to the flank, all the conditions for moving forwards are provided (the ninth and tenth month).



Figure 2. "Hand-knee support"

At ten months of age the infant assumes the "all-fours" posture, sways back and forth putting pressure on hands and knees alternately. In this way, the infant practices maintaining the balance necessary for crawling and only now it is ready to crawl properly and with coordination. From the crawling position it will easily move into a slanted sitting posture, and again, from the sitting into a crawling posture (6).

If the infant is stable and secure enough, it will raise the body and exhibit "the hand-foot support" or the "bear-like walk". From this posture, the infant can pull the body to a standing position. All this occurs at the age of ten or eleven months (7).

MOTOR DEVELOPMENT IN SUPINE POSTURE-UP TO SITTING

In the first months of life (until the third), the infant has reflexive body movements – holo-kinetic phase, and reacts to all the stimuli coming from the outside world by the reflexive movements of extremities (Moro reflex).

In the third month, the infant lies symmetrically in supine position, brings both hands across the face: "the hand-hand play". The legs are flexed, they touch the ground with heels, or they are lifted.

At four months of age, the infant is able to keep the balance while lying on the back, the legs are flexed in knees and hips, and both with hands and feet it performs the action of grasping. The occiput and the upper part of the body are stretched. The line nose-umbilicus-symphysis is right.

At five months of age, the infant assumes a perfect "sitting posture" while being in the lying one. The legs are lifted, the infant touches its haunches with its hands, observes the feet which are getting closer to the head.

At six months of age, the infant grasps the feet with hands, and at seven months of age it puts them into the mouth. While performing this movement, the center of the body weight is being transferred. It transfers towards the head and at the same time the lumbar part of the spine is being stretched. (figure 3). Very often in this period, parents make great mistakes forcing the infant to sit passively (teaching a child to sit with support). This can cause the compression of the lumbar part of the spine, which can be very dangerous. During the seventh month, the infant can perform the body rotative over both sides (8).



Figure 3. At six months of age, the infant grasps the feet with hands

In the eight month, the infant eagerly plays while lying on the flank so as to discover the "slanted sitting" in the ninth and the tenth month, that is to say, it plays by itself.

At eleven months of age, 90% of infants can independently assume the correct sitting position from which they pass into a slanted sitting to assume crawling position. From crawling position the infant returns into a sitting one.

MOTOR DEVELOPMENT IN LATERAL POSTURE-UP TO WALKING

By observing the lateral posture, we can register the elements of "walking" in lying position. At four months of age, the infant can roll to the flank without transferring the body weight; hands and legs are below the body (9).

At five months of age, while lying on the flank the lateral transfer of the pelvis occurs. With lateral pelvic transfer dorsally and ventrally, the radius of hand moving is increasing and the proper legs' differentiation is achieved (figure 4).



Figure 4. At five months of age, while lying on the flank the lateral transfer of the pelvis occurs

At six months of age, when the infant rolls from supine to prone, we can notice a mode of walking in lying position (on the flank): the lower side (on which the baby is lying) is the supportive one while the upper side is movable. Legs follow the rhythm of walking.

At seven months of age, the infant rolls to both sides with equal success. The supporting side and the free – movable side are switching all the time. In all this process, the supporting or lower side corresponds to the phase of walking during which an infant steps on the foot, while the free side corresponds to the phase of stepping forward. Therefore, the infant "walks" while turning around the middle part of the body towards the opposite side (9).

At eight months of age the infant rolls from supine to prone and performs a counter movement from the shoulder – pelvis zone, that is to say, it performs the spinning of the spinal column. The adults perform this movement during walking.

At nine and ten months of age the infant has already practiced all the phases of moving and employed the muscle groups in lying position, so that now it can pull itself to the upright position, to crawl, to lift one leg and go to the upright position after kneeling, using thus the objects to support itself in standing posture.

At the end of the eleventh and during the twelfth month, 90% of children begin to walk sideways leaning on an object.

DEVELOPMENT OF GRASPING FUNCTION

A newborn usually keeps the hands closed often holding the thumb within. We can see that they exhibit the reflex of grasping the object with a palm: if we touch the palm of a baby with our finger or some object, it will close the hand firmly around it.

In the first month of life, the closed hands are the dominant picture, but they are still not clenched into fists (10).

At two months of age, the hands can be seen open more frequently so that the baby could open the hands completely at three months of age. The baby holds the hands right across the face and plays with them.

At four months of age, while in supine position, the baby tries to grasp the object given from aside. These first attempts of grasping are carried out by the method "attempt – mistake – new attempt". In this case the palm is turned downwards: ulnar grasp. Once the baby grasps the object, it brings it to the middle line, joins the other hand and puts the object into the mouth.

At five months of age the infant grasps the object and has a good "eye – hand" control. The infant grasps the object given from aside with fingers and the stretched thumb. It can move the object from one hand to another: It is an alternate play of both hands, which means that both brain's hemispheres function together.

At six – seven months of age, the infant grasps a toy above the middle body line, with transferring of the center of the body weight to the flank (with its left hand the infant grasps the object placed on the right side and vice versa). The radial way of grasping begins, and the reflex of palmar grasping has completely disappeared.

At eight months of age the infant can hold one object in each hand respectively, and also grasps the objects positioned to some higher level: from the prone posture the infant can lift one hand upwards to grasp something. It uses the index finger, middle finger and thumb for minor objects. It grasps the objects equally good with both hands.

At nine months of age the infant discovers the movement of throwing objects: very often, it drops an object and carefully observes the thing falling. In this way, it grasps the idea of depth, registers the sound and speed of an object falling.

At ten months of age the infant uses the thumb and index finger to grasp minor objects – "the pincer grasp". The baby points to all the objects with a separate index finger. It makes sounds by hitting two objects against each other (figure 5).



Figure 5. It grasps the objects equally good with both hands. It makes sounds by hitting two objects against each other

At eleven months of age "the pliers – grasp" develops. The infant grasps minor objects with the thumb which is in extension and with the flexed index finger (11).

At twelve months of age the infant achieves the high degree of muscular differentiation. It grasps an object with the thumb and index finger very precisely, drops the object and lifts it again. This requires a very precise coordination of movements in a delicate musculature of flexors and extensors of fingers. 50 % of children at twelve month of age can hold two legos in one hand, which requires a high degree of hand adaptation to the very object.

CONCLUSION

Motor development of a child is very individual and we should not expect every child to fit into statistic data. The baby will lift from the lying posture only when the conditions for the vertical position are provided. In any case, we should not force a child to sit or walk, especially not to use some supportive devices like baby buggy or baby jump. By imposing some posture to a child and by forcing it to use these devices, we deprive a baby of a normal development.

Children do not need these helping devices in order to develop. Helping devices suppress in children their natural urge to walk, complicate its development and may have harmful effects like equines feet, deformed feet and spine and so on.

REFERENCES

1. Capute AJ, Accardo PJ. The infant neurodevelopmental assessment: a clinical interpretive manual for CAT-CLAMS in the first two years of life, Part 2. *Curr Probl Pediatr* 1996; 26: 279–306.
2. Gordievič SM. The role of the proprioceptive afferent organisation of the child's movement. The use of the rapid impulse of low amplitude in the process of peripheral joints mobilization in the system of intensive neurophysiological rehabilitation for children with cerebral palsy. *Ukrainskii visnik psihonevrologii* 2000;8 (24):22–24.
3. Ilanković V. i Ilanković N. Psihomotorni razvoj deteta – vodič za procenu i stimulaciju razvoja. Medicinski fakultet, Beograd, 2001.
4. David RB. *Pediatric neurology for the clinician*. Norwalk, Conn: Appleton & Lange, 1992.
5. Hellbrugge T, von Wimpffen JH. Die ersten 365 tage im leben eines Kindes. Knaur, Munchen, 1976.
6. Vojta V. Die zerebralen bewegungsstörungen im sauglingsalter-frühdiagnose und frühtherapie. Hippokrates Verlag GmbH, Stuttgart, 2000.
7. Shulman LH, Sala DA, Chu ML, McCaul PR, Sandler BJ. Developmental implications of idiopathic toe walking. *J Pediatr* 1997; 130: 541–546.
8. Hellbrugge T. Munich functional developmental diagnosis for the first, second and third year of life. Theodor Hellbrugge International Institute for developmental rehabilitation and Jeevan Prakash child center, Kerala-India, 1995.
9. Zukunft-Huber B. Neometen razvoj odojčeta. *NIP Dečje novine*, G. Milanovac, 1998.
10. Vulliamy DG, Johnston PGB. *The newborn child*. Churchill Livingstone. Edinburgh, London, Melbourne and New York, 1987.
11. Illingworth RS. *The developmental of the infant and young child- normal and abnormal*. Churchill Livingstone. Edinburgh, London, Melbourne and New York, 1987.

RAZVOJ KARDINALNIH MOTORNIH VEŠTINA U PRVOJ GODINI ŽIVOTA

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SAŽETAK

Motorni razvoj zdravog novorođenčeta, odojčeta i malog deteta odvija se potpuno spontano, prema prirodnim zakonitostima i direktno zavisi od anatomske i funkcionalne adekvatnosti centralnog nervnog sistema (CNS). Tok ovog razvoja determinisan je genetski utvrđenim obrascima razvoja, ali je istovremeno stimulisan i nadražajima iz spoljne sredine. Na ove nadražaje, koje mozak kao organ odgovoran za integraciju i koordinaciju prima od čulnih organa, on odgovara automatskim složenim reakcijama.

Usvajanje glavnih motornih funkcija (držanje i kontrola glave, bočni transferi u ležećem položaju, sedenje, stajanje, hod, puzanje, hvatanje) odvija se potpuno spontano. Sve motorne radnje dete nauči i savlada potpuno samo i zato nije potrebno UČITI dete da sedi, stoji, hvata, hoda... "Učenje" deteta motornim radnjama predstavlja grubo, nepotrebno i nepoželjno uplitanje u spontan motorni razvoj kojim se ometa i usporava normalno usvajanje motornih funkcija.

Sa 11 meseci 90% dece može da samostalno zauzme pravilan sedeći stav iz koga često prelazi u puzeći preko sedenja ukoso i opet se vraća u sedeći.

Krajem 11. i u 12. mesecu 90% dece počinje prohodavanje u stranu uz pridržavanje za predmete. Više od 50% dece sa punih 12 meseci hoda slobodno bez pridržavanja.

Polovina dece sa 12 meseci može da u jednoj ruci drži dve kocke, što zahteva veliku sposobnost prilagođavanja šake u odnosu na predmet.

Ključne reči: motorni razvoj, motorne veštine, dete