Vojta method – the second generation

Václav Krucký / 2016

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Preface

This booklet prepared with the help of Norway Funds is intended as a textbook for physiotherapists. However, it is also a source of information and encouragement for parents who exercise with their children. I have tried not to present the Vojta method as a complicated science but to help them understand why this therapy is necessary as well as what the therapy itself consists of.

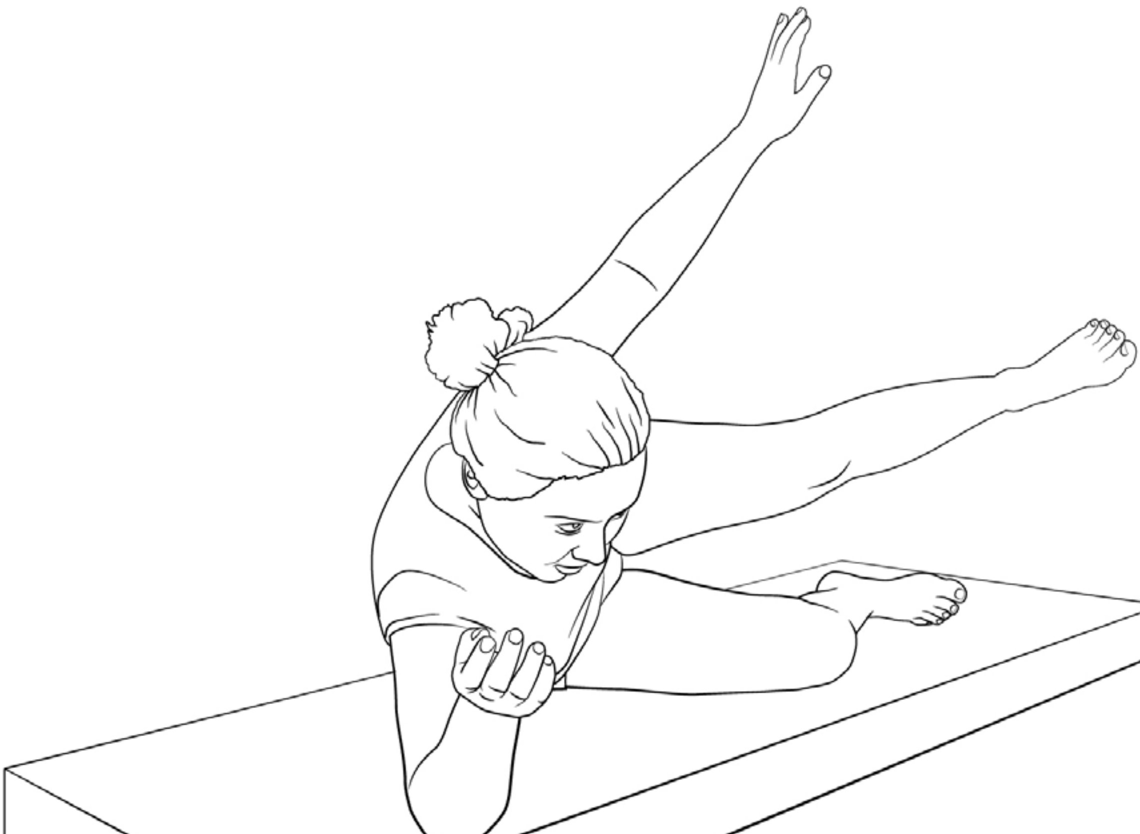
Primarily, I want to demonstrate how the Vojta method works based on many years of my practical experience. However, to explain this method, other branches, such as anatomy, neurophysiology, developmental neurology, kinesiology (the study of body movement mechanics) or biomechanics need to be included. I have strived to present them in an understandable form.

Dr. Václav Vojta started publishing his first insights into how “reflex locomotion” could be used in the mid-1950s. Over the years, a quite original concept of diagnostics and therapy has been developed which, at the beginning, was intended for children affected by cerebral palsy. Step by step, the spectrum of diagnoses where Vojta’s method could be applied has expanded, and the early diagnosis has also become more precise.

I asked myself: are we – the therapists who use the Vojta method – the second generation already? The first generation, to which professor V. Vojta belonged, is gradually disappearing. That is why it is necessary to take over the “baton” and with it the responsibility. It is customary for every subsequent generation to contribute something new to the good things inherited from the previous one. My desire too is to promote and develop the extraordinary progress yielded to us by Prof. Václav Vojta.

The success of my endeavors will be judged by the “fruit they will bear”.

For instructive purposes and in order to distinguish between the “classic” Vojta method (VM) and the current “2nd generation” method, I have used the term “the Vojta Method of the 2nd Generation” (abbreviated: VM2G) in this booklet.



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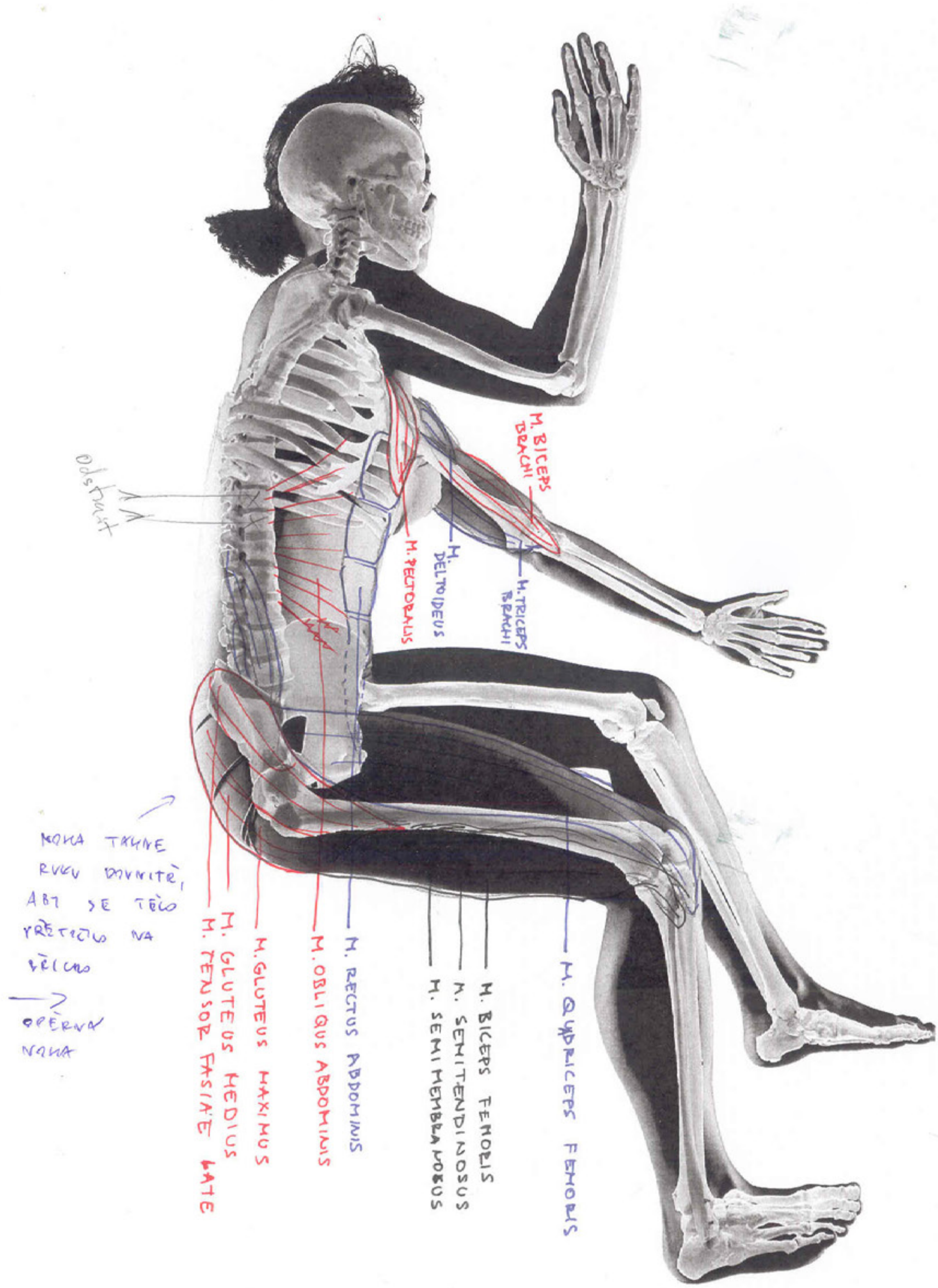

M. BICEPS BRACHI
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M. TRICEPS BRACHI
M. PECTORALIS
Odstranit
NOHA TAHNE RUKU DOVNITŘ, ABY SE TĚLO PŘETOČILO NA BŘICHO
→ OPĚRNÁ NOHA
M. TENSOR FASIAE LATE
M. GLUTEUS MEDIUS
M. GLUTEUS MAXIMUS
M. OBLIQUS ABDOMINIS
M. RECTUS ABDOMINIS
M. SEMIMEMBRANOSUS
M. SEMITENDINOSUS
M. BICEPS FEMORIS
M. QUADRICEPS FEMORIS

Theoretical Information about the Musculoskeletal Apparatus

Itis necessary to "read" the musculoskeletal apparatus as a whole. Like in a mosaic where each small stone is not significant until the work is finished, each muscle functions only within the movement pattern. In these patterns, the functions of particular muscles vary continuously. The current understanding of muscle functions does not take into account the complex patterns necessary for the most fundamental functioning of the body, such as righting, standing and gait.

A person would remain at the holokinetic level of limb mobility, supine or prone, as he/she would not be able to turn round by him/herself. In other words, individual would be like a newborn. According to Plato, God is a geometer and it is necessary to look for a way out of chaos – only this way can order arise. This is my inspiration for seeking order in our body.

The Neural Regulation of our Musculoskeletal System (its Software)

BIOS – Basic Input-Output System

We will use a metaphor in order to illustrate the programs that control motor skills of humans by comparing body programs to those which control a computer.

Like a computer, the human brain has a quite elementary start up BIOS program. An ordinary computer user does not come into contact with it.

The BIOS is a system providing the most elementary functions.

It is "hard-wired". Thus possibilities of configuration are strictly limited.

BIOS is the basic driver for the motherboard.

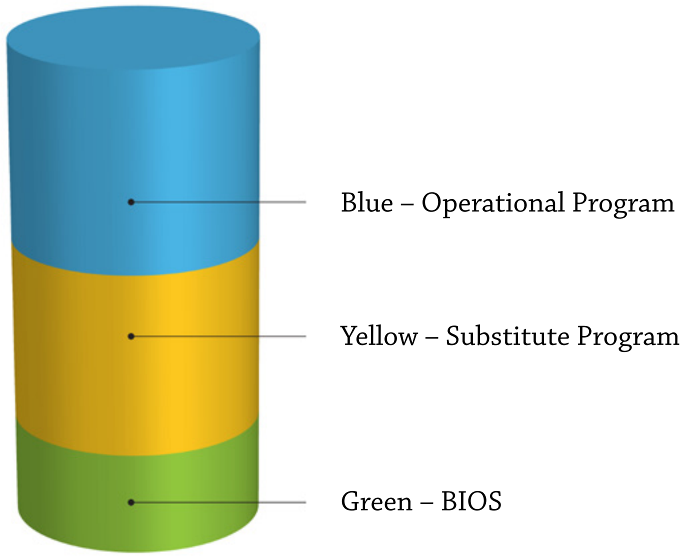
It is a suite of the basic functions which are necessary in order that the computer can load an operating system (i.e. to introduce the operation system into its memory – e.g. DOS, Linux, Windows). Moreover, it influences its own performance and stability.

When the BIOS is damaged, the computer does not work.

The "BIOS" of the human brain is its basic program and it is responsible for controlling the so called vital functions:

- Body temperature – the thermoregulatory center is located in the diencephalon, in the part called the hypothalamus (It influences e.g. the contraction and expansion of skin blood vessels.)
- Blood pressure and pulse control.
- Respiration control (The respiratory center is located in the medulla oblongata and in the pons Varolii.)

This program is developed during the first weeks of intrauterine life. Similar to the computer BIOS, it is "hard-wired" and in practice it cannot be changed. As in a computer, the "BIOS" also influences "performance and stability" of the human body. The function of the BIOS in people is the precondition for activating the "operational program of his or her motor skills". And, as with the computer, should the program regulating the vital functions be damaged, it will result in death.



The illustration of the stratification of individual programs during brain development in the first year. During this period, application programs are absent. This is a schematic illustration of the distribution of the infant motor skill programs from birth up to six months. In normal development, the individual layers (programs) are separated. The Substitute Program is considerably large and it takes up a lot of space in the brain.

A further control layer which already influences the motor skills is the "Basic MOTOR SKILL Program".

This program is responsible for our elementary motor skills.

In order to explain it, we will again use the analogy of the computer.

The operational system represents the basic software of every computer. This software starts up all technical parts of the computer, and it creates the working environment for other programs.

Simply put – the operational system gathers and controls all operations. If it did not do so, each application would have to perform these tasks separately which would cause many problems.

The operational system of the computer is activated at the start and remains active until the computer is turned off.

It consists of a center and of auxiliary system instruments. The main task of the operational system is to ensure that the user can control his or her computer. Moreover, it creates a stable application interface for the processes as well as allocating system resources to them. The operational system is a very complex piece of software, the development of which is much more complicated and demanding than with ordinary programs.

Windows, MAC-OC, LINUX, ANDROID are the best-known computer operational programs. DOS belongs to the older generation.

A similar construction and functions can be found in the Basic Motor Skill Operational Program.

There is a "program core" which is responsible for controlling the motor skill base. This base incorporates some essential building blocks, which are indispensable for normal motoric development.

1 The autonomic posture and "secondary programs" for the regulation for the autonomic body

- Autonomic regulation of muscle tone in idle state
- Autonomic regulation of the inactive muscle coordination
- These two programs form the autonomic regulation of the centration of inactive joints

2 "Secondary programs" for autonomic regulation of basic stereotypical movements

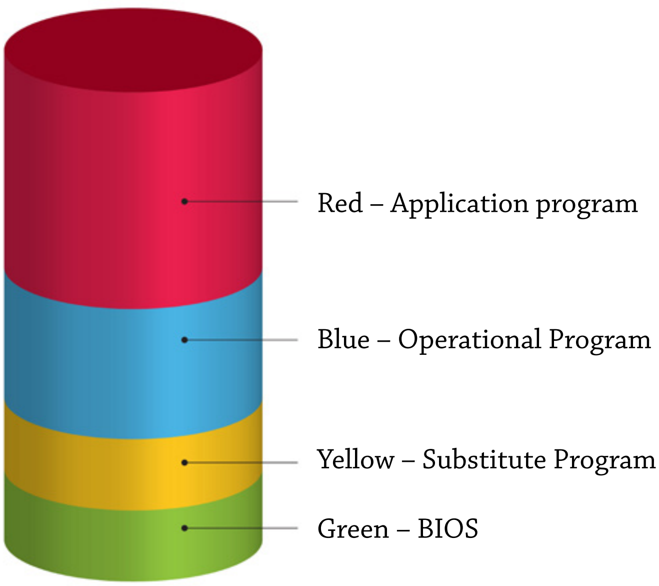
- Autonomic regulation of anti-gravitation and righting programs
- Autonomic regulation of balancing programs
- Autonomic regulation of muscle tone while moving
- Autonomic regulation of muscle coordination while moving
- Autonomic regulation joint centration while moving

3 Stereotypical movements:

- Autonomic regulation of stereotypical gait
- Autonomic regulation of stereotypical grip
- Autonomic regulation of stereotypical respiration
- Autonomic regulation of stereotypical swallowing
- Autonomic regulation of stereotypical eye movement

Similarly to the computer operational system, a person has in his OS its own auxiliary system tool, which enables and facilitates the activation of the application programs and their continuous tuning.

The operational system of human motor skills is an immensely complicated, very extensive and genetically encoded movement plan. The first year of life is crucial for the development of the brain since during this period all the basic programs are activated. The programs are fully autonomous and do not depend on the conscious will. The full and correct "booting" of the programs enables a human being to have the optimal autonomic posture as well as the optimal autonomy of basic stereotypical movements. These basic motor skills are preconditions for the smooth development of "superstructure" programs of fine and gross motor skills.



A representation of the ideal stratification and tuning of all programs, which enable the execution of the most demanding motor activities. e. g. ballet.

Application Program

It is the application programs – e. g. Word, Excel – which make our computer work interesting. In a similar way, BIOS and the OPERATIONAL PROGRAM are used so that we can open an application and use it for work or play. There are thousands of application programs already and their number keeps growing.

Similarly, human motor skill programs have their application programs which are not innate but learnt. A learnt motor skill enables a very diverse range of body movement. Gross motor skills provide a range of sporting skills, such as throwing, jumping, hitting or kicking etc.

Fine motor skills provide even more extensive skills, from writing, drawing, painting and artistic creativity to playing very complicated musical instruments. Orofacial fine motor skills make speaking, singing and playing wind instruments possible. All these human motor skill application programs can be perfected until very old age by continuous training.

There is another important similarity to computer programs: the working quality of application programs is completely dependent on the flawless operation of BIOS and the operational programs.

Learning or starting any application program (gross and fine motor skills) is severely restricted or completely unable to function if the operation program of the human musculoskeletal system is in any way damaged.

Thus, a well "tuned" and operational program working flawlessly is a fundamental requirement for quality of life.

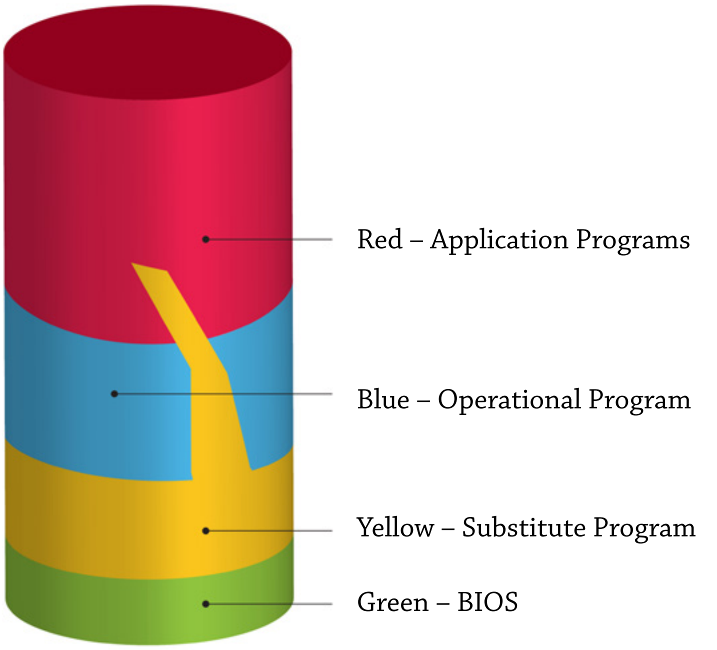
There is another program, which we decided to name a "substitute operational program" or "Substitute Program".

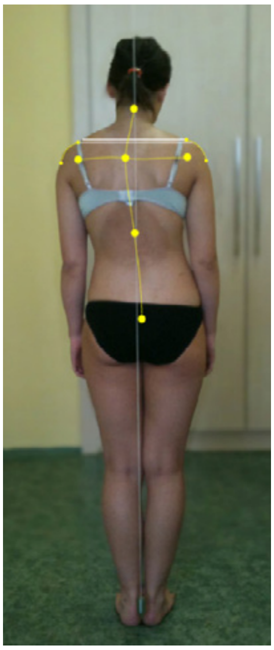
Substitute Program

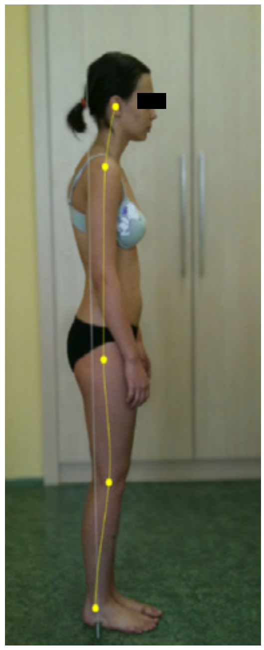
When motor development is normal, the presence of the Substitute Program is noticeable only indistinctly during the first three months of life. This is the so-called "holokinetic motor skill" period when the infant reacts to objects with uncoordinated movement of all extremities. Therefore, any regulation by this program is uncontrolled. When the unfolding and "booting" of the Operational Program runs without difficulties, the Substitute Program gradually winds down. Around six months it practically disappears.

The Substitute Program is meant for emergency situations, i.e. if for any reason the Operational Program is damaged. In this case, the Substitute Program is "uploaded" and "booted" to the extent that the operational program has been damaged. Depending on the damage to the Operational Program, the Substitute Program can control the body to various degrees, from one extremity up to the whole body. The Substitute Program acts to preserve life. The starting application program (for both fine and gross motor skills) is significantly reduced or completely impossible.

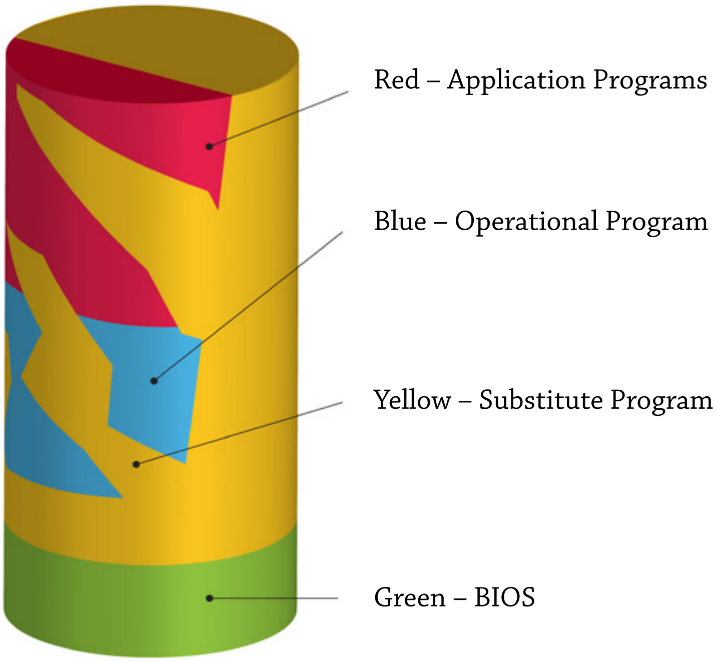
Using the computer analogy again, we can compare the Substitute Programs to the first primitive operational programs, for instance MS – DOS. It did not provide the range of functions provided by current programs. The Substitution Programs are similarly limited.

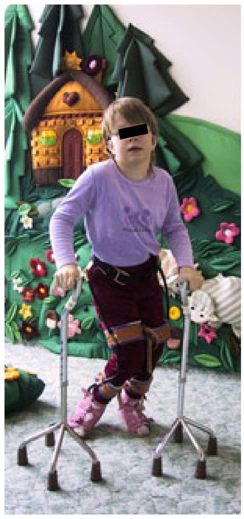






Presentation of a quite common situation when the Substitute Program is not completely "turned off" but becomes involved in the Operational Program where it interferes with the posture's automatic regulation as well as interfering with the Application Programs, thus restricting their activity.





Presentation of a situation when the Operational Program is seriously damaged and extensively completed with the Substitute Program. The Substitute Program significantly interferes with the operation of the application programs.

From a clinical point of view, one can view the individual levels of the nervous system which include:

Level of the higher neural activity which consists of

- general intelligence
- specific motoric intelligence
- voluntary processes
- incentive and instinctive processes
- emotional processes
- memory processes of recall
- gnostic function

Level of fine motor skill application programs

- eye movement motor skills (reading, writing…)
- vocal apparatus motor skills (speech, singing…)
- mimic and orofacial area motor skills and tongue motor skills (speech, facial expression, biting and swallowing)
- hand and finger motor skills (writing, painting, playing musical instruments…)

Level of gross motor skill application programs

- sports and gymnastic skills, manual work habits…
- general acting skills, "body work"…

Level of basic motor skills (Operational Program) basic stereotypical movement

- gait
- grip
- autonomic righting and postural reflexes (postural reactibility)
- autonomic posture
- basic stereotypical movement of respiratory mechanism
- swallowing and evacuation stereotype

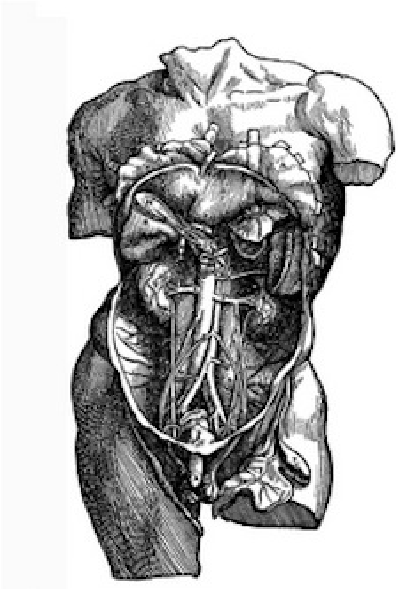
Level of Substitute Program motor skills, which enables a basic mode of living using alternative stereotypes for

- gait
- grip
- autonomic righting and postural reflexes (postural reactibility)
- autonomic posture
- basic stereotypical movement of respiratory mechanism
- swallowing and evacuation stereotype

Level of basic vegetative function regulation, on the level of the "BIOS" brain stem

- cardiopulmonary functions
- blood-vessel movement
- basal metabolic control
- defensive reflexes (coughing, sneezing, corneal…).

Bones and Muscles of the Musculoskeletal System



An alternative view to the classical descriptive anatomy of bone and muscle apparatus.

The existing view of the musculoskeletal system is somewhat reductive. It derived from an anatomical view which originated in the 16th century based on the descriptions of the anatomist Andreas Vesalius. This concept is only two-dimensional (2D), and it was used for the practice of surgical (and later orthopaedical) interventions in the musculoskeletal system. For this purpose, for instance, the muscle activity was reduced to the formula: “start + fixing = function”, and it was sufficient.

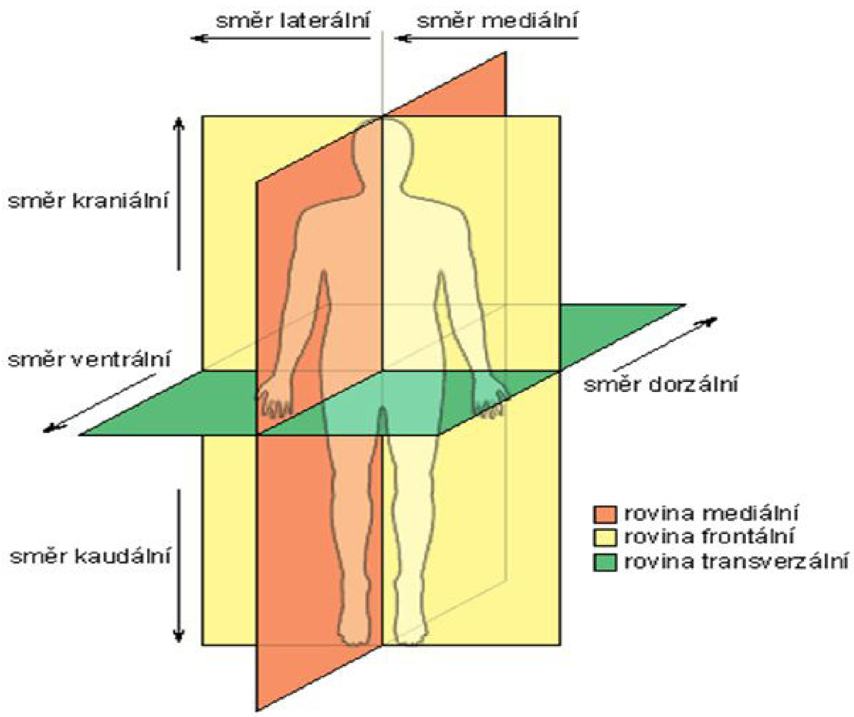
The gradual increase of demands on the musculoskeletal system, augmenting and intensification of sporting activities requires more training and methodical procedures. Their aim is to improve not only general condition but also specific movement skills.

However, all these principles of training, sport-performance-related or sport-recreational activities, fitness, as well as consequent therapeutic interventions in the musculoskeletal system are based on a 2D concept of anatomy.

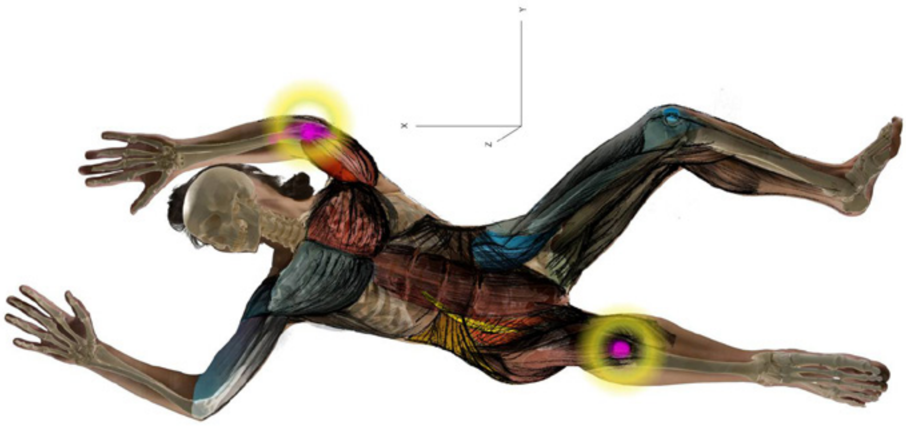
The 2D concept is greatly simplified, analytical and, in fact, it was meant for a quite different “use” of the musculoskeletal system. Accordingly, it is obvious that this anatomical basis cannot very well serve contemporary demands made on the musculoskeletal system. The 2D anatomy system gives rise to other branches which attempt to clarify functions and correlations of the musculoskeletal system – biomechanics, kinesiology, sports medicine and others.

The analytic view is based on the presumption that muscles in a living body behave according to the parameters (start, fixing, function) assigned to them by the anatomical description of a corpse. It follows that muscles have to be trained accordingly, unfortunately, regardless of both their actual local functions and their functions in terms of the whole musculoskeletal system biomechanics.

Within the framework of such a system, the movement of extremities and the axial skeleton and muscles can be only horizontal or vertical. The concept of the anatomic planes of the body reduced the possibility of viewing the body in any other way. However, the functions “assigned” to particular muscles and muscle groups are derived from the dissection of a corpse. This includes the depiction of the body and its muscles in the standing or reclining body with open palms. Regulation within this simplified view of the system is reduced to the regulation of single muscles or muscle groups.



Anatomical Planes – Coronal (Frontal) Plane, Sagittal Plane, Axial (Horizontal) Plane.



Biomechanics and Anatomy

The musculoskeletal system in the 3D and functional anatomy

The musculoskeletal system uses muscles connected to muscle chains even for the most simple movements. In other words, the muscles are connected functionally into the movement chain so that they enable two elementary movements. Firstly, creating support and resistance against gravity, secondly, movement which enables placing the extremities in other positions.

In addition, the muscles perform fine and gross motor skill movements within the application programs. This is only possible when the muscles work properly in the basic Operational Program.

Symmetry is crucial for the proper performance of movements. As in physics, biomechanical symmetry creates limitations. Symmetry helps to create stable systems with minimal expenditure of energy. In addition, symmetry removes redundant elements from the system.

Deviation from the symmetry leads to decentration of joints, shifts, blocking and herniations – thus, generally, to very serious conditions which are frequent nowadays.

Retaining symmetry both in the rest position and in movement is regulated automatically. Therefore, it is not possible to renew and retain symmetry by external intervention. Symmetry depends absolutely on the complex system of muscle tone control, righting and postural reflex control, automatic poise and elementary stereotypical movements.

The symmetry of the human body is ensured by spiral muscle chains. There are two types of muscle chains – right to left and left to right. At the same time, these chains are craniocaudal (from head to heel) and caudocranial (from heel to head). This depends on the position of the body's center of gravity or the position of the extremities.

In terms of strength and speed, the chains can also be divided into:

- fast, with a steep helix – intended for high-speed movement
- strong, with a low-pitched helix – intended to develop tensile strength

In this way the body can balance deviations from the center of gravity. These deviations arise in the idle state around the axial skeleton and muscle and are balanced on three basic levels.

In movement, balancing of deviations is more complicated because the body is not stabilized and when balancing, it has to deal with:

- kinetic energy of the axial skeleton and muscles and the extremities
- acceleration or slowing down
- degree of surface adhesion (on which the extremities rely) and with many other factors.

These complicated calculations to control balance and symmetry are automatic and intentional. Control can only happen on the margins. Only in individuals who undertook specific training is it possible to develop an ability to intervene actively in the process of automatic movement. However, this ability decreases gradually after the termination of active training and the control becomes automatic again.

During the development of movement, a person goes through a genetically encoded phases.

During the period of verticalization (learning to stand up) (from 0-1.5 years) the programs intended for the body's ability to move in space and gravity "are unpacked".

In the prenatal phase, gravity was not acting so noticeably on the fetus nor was it possible to activate the programs for regulation of movement in a gravitational field.

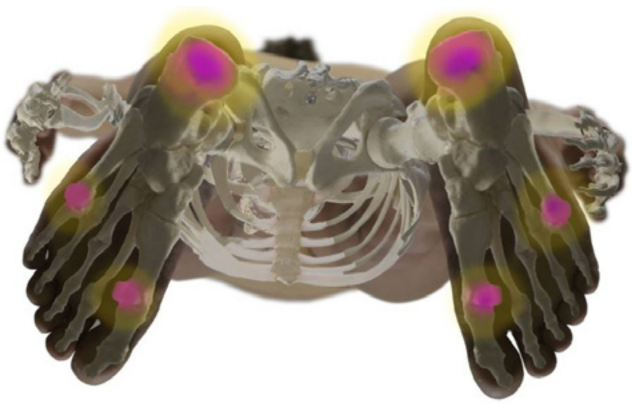
When the basic righting, anti-gravity and balancing stereotypes are developed, other basic movement stereotypes, mainly gait, grip, respiratory and orofacial, are activated.

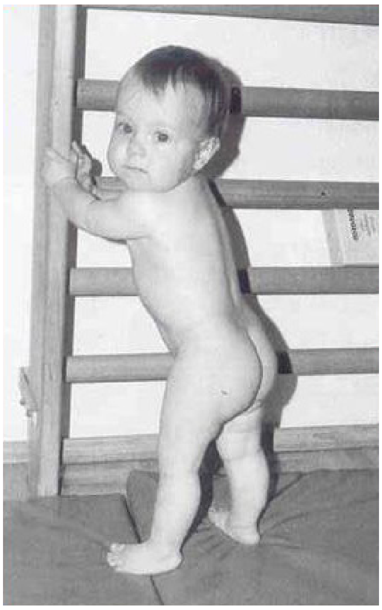
These anti-gravitational programs and basic movement stereotypes mature while the body grows and their development is completed when the individual stops growing.

The automatic software for movement (the brain) is completed at the same time as the completion of the hardware (the body). During this period, sportsmen can achieve their best results, mainly in sports in which the gross motor skills are paramount.

Middle age usually enables the "use" of both software and hardware without problems. This depends on the potential for the conception and care of the next generation. Should some errors occur during the first year of life while the basic software is being "unpacked", hardware disorders in the movement apparatus begin to be noted.

In middle age it is possible to observe the rise of a number of disturbances which had their origin in the errors during the unpacking of software during the first year of life. The disturbances of automatic body posture, righting, balance and anti-gravity mechanisms as well as defects





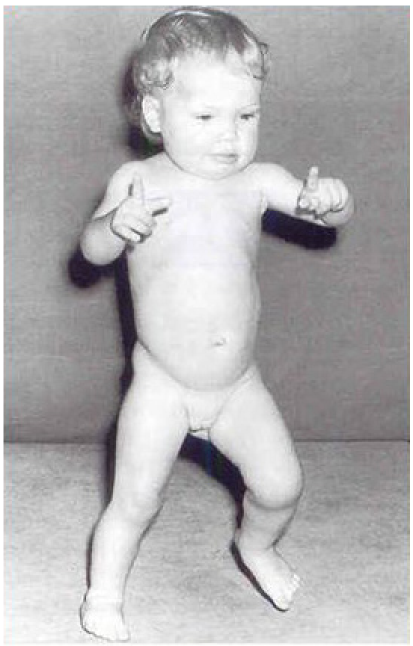
Weight-bearing points in a standing position.

in the basic movement stereotype become ossified. The most frequent pathological disorders are herniations (slippages) of spinal discs.

In later years, the defects in the musculoskeletal system increase notably, caused by premature degenerative processes in joint cartilages. They are also caused by incorrect software control, which becomes evident in the faulty development of the hardware. The faults in the hardware (HW) and the software (SW) do not only increase arithmetically, but most likely exponentially.

Under the influence of the increasing entropy in the HW and SW, the following the degenerative processes take place:

- increasing faults in the systemic regulations
- progression of degenerative processes in joint cartilages
- diminishing bone density
- decreasing elasticity of ligaments and joint capsule
- reduction in and shortening of muscles
- The aforementioned points are also a frequent cause of falls and subsequent bone fractures as well as other serious injuries.



Weight-bearing points in a walk.

The biomechanics of the locomotion motor skills could be compared to the architectonics of a bridge.

In order for the body to move, either on all fours or erect, certain condition of the transferring of gravity are necessary. The body moves by means of transferring its center of gravity outside of the weight-bearing points. Mammals predominantly use all four extremities, non-human apes very occasionally use only two. The biomechanic construction of the human body which enables the upright gait is the most demanding type of locomotion known to man. Locomotion on two extremities has a number of advantages. Firstly, it is economically efficient, as it uses the kinetic energy of the moving extremities for "pulling" the body's center of gravity ahead. It makes change of tempo and direction of movement very easy and enables movement on different types of terrain, including the changes of the incline of the terrain. An erect gait improves the conditions for optical and audial direction sense.

On the other hand, walking upright entails many disadvantages and complications. In order for the circulatory and lymphatic system to work efficiently, auxiliary valves had to evolve which help to return the venous blood and lymph from the lower extremities. When circulation is inadequate, swelling in the lower part of the legs occurs. The joints of the lower extremities are exposed to extreme stress which is transferred to relatively small surfaces of the hip, knee and ankle joint cartilages. These are sources of many pathological changes and, subsequent disorders in the biomechanics of gait and body posture. The long bones of the lower extremities – indispensable for the long step and economic locomotion – are prone to fracture. The vertical position of the pelvis increases the strain on the lumbar vertebrae and is often the cause of spinal disorders. The lower extremities are equipped with the largest muscles, which demand the greatest expenditure of energy. The neural supply of large muscle areas requires strong nerve fibers and a wide plexus of nerve branches. These are often the cause of disturbances in locomotion. Very complicated knee joints are prone to damage to their soft and hard structures. Ankle joints are less prone to these damages; however, hip joints are much more prone to degenerative changes.

Movement regulation of the upright gait is highly demanding and can easily be damaged. For flawless walking, fine tuning of a whole number of parts is indispensable. First of all, the regulation of automatic posture while standing shows the following physiological markers: the frontal body axis passes through the ideal midline. The sagittal body axis (view from the side) passes through the external auditory channel, midpoint of the shoulder, hip, knee joints and through the heel midpoint.

Further condition for normal gait is fine – righting and balancing reflexes. The proper "unpacking" of the automatic gait during the first year of life is another very important condition for the correct development of the stereotypical automatic gait.

Gait as well as the automatic posture are among the mechanisms which are regulated in the unconscious CNS structures. The possibility to influence it consciously is very small. Conscious regulation of gait and body posture is possible only for a few seconds. Afterwards, the body reverts to automatic regulation.

The defects in the automatic regulation of body posture and gait are responsible for the majority of functional disorders of the musculoskeletal apparatus. Training and straightening the body apparatus thought techniques deriving thought the 2D anatomical concepts not only miss their targets but can often make the situation worse. Muscle misbalances increase and worsen the functioning of the "hardware" of the already disturbed stereotypes. As a result, muscle groups can be partially strengthened; however, they are rather a hindrance then a help to the proper functioning of the stereotypical movements and automatic regulation of body posture.

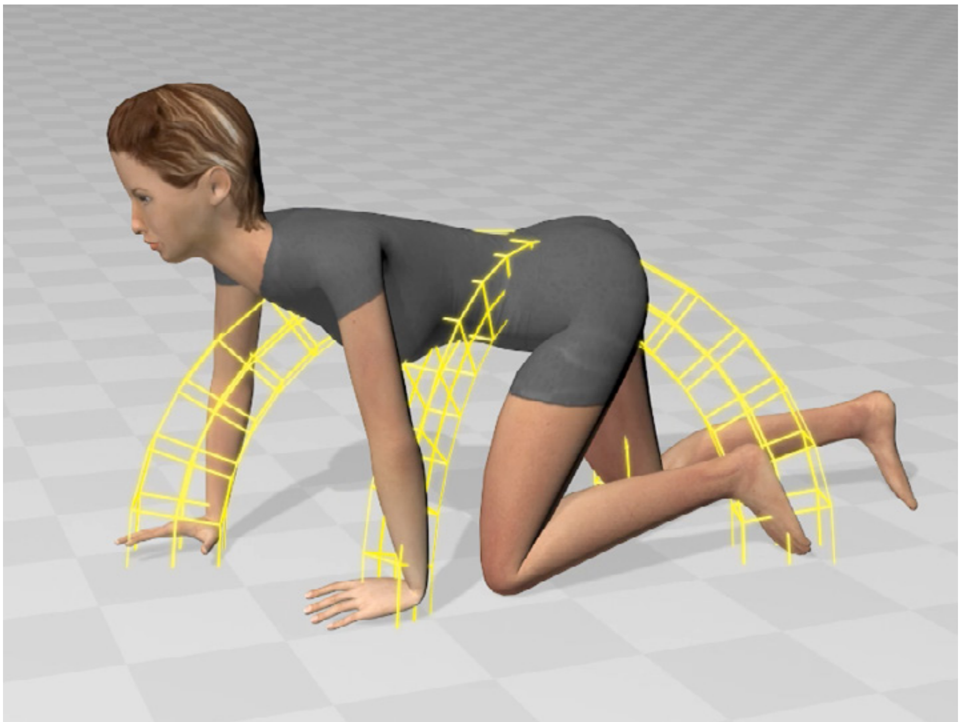
As an example, we can compare this to an actual study of two groups carrying a load. One group consisted of well-trained American marines, and a second group consisted of Nepalese Sherpas and women of the African Sahara. The first group carried the 50kg load in backpack specially made for military engineers. The second group carried the equal load in bags carried by one strap across the forehead or the upper part of the chest. They usually wore simple sandals. The second group did not train in gyms and their muscle development was quite below average. The soldiers in the first group reached the end of their physical strength by the limit of the first day, while the Sherpas in second group were preparing food for the next day, as was their custom. After the third day, the majority of the soldiers had to finish the experiment due to total exhaustion. All those in the second group reached their goal without any visible sighs of exhaustion.

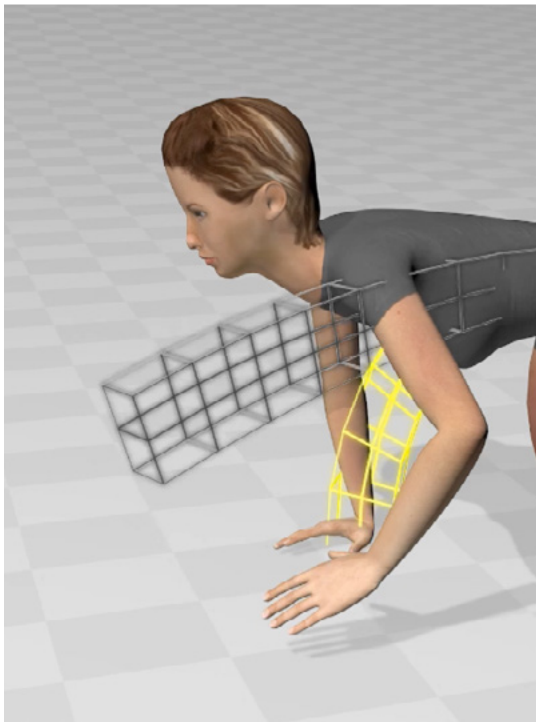
The evaluation of the kinematic scan showed that the soldiers' marching methods with a load were largely ineffective and that the load was slowing them down significantly. In contrast, the results of the kinematic scan of the gait of the second group showed that the way of carrying their load increased their kinetic energy which helped them in their walking.

Weight-bearing points in a jump.

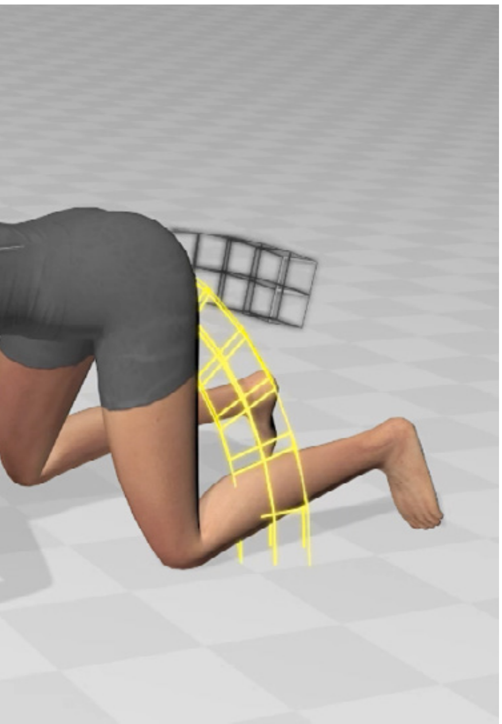
Genesis and Sequence of Motion

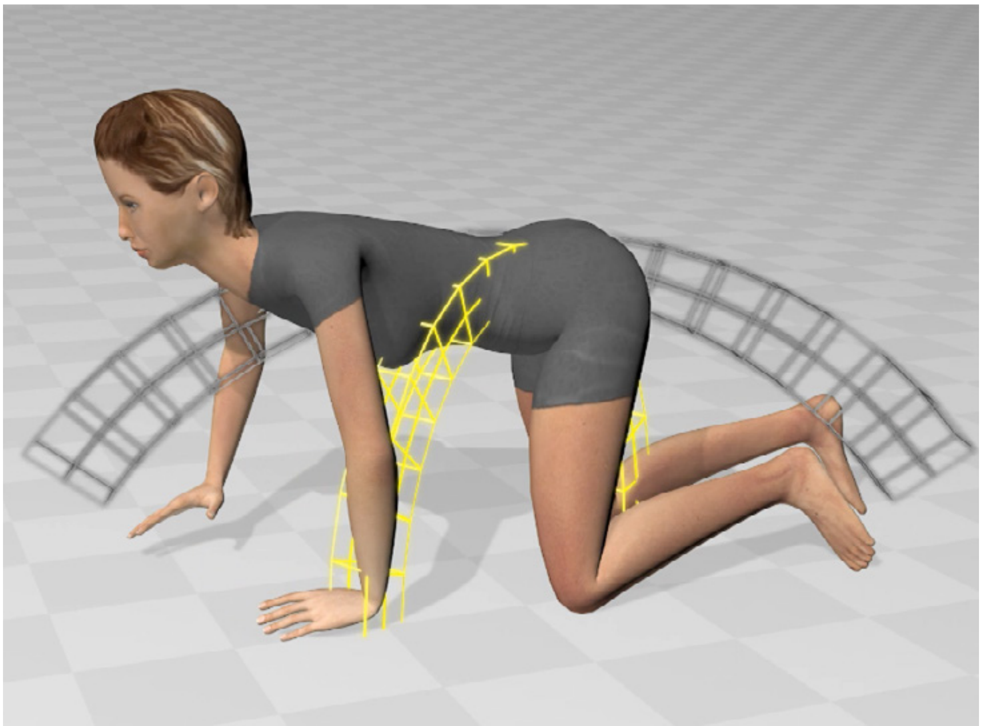
What does our posture depend on, if not "a bridge" or bridge model of the apparatus?





The figures above are trying to express the function of the alternating support through the "bridge model"





Muscles as a spirals braided into chains

During motion, it is interesting to watch the possibilities of the functional muscle “metamorphosis” in the sequence of basic stereotypical movements and their sequence in space as well.

V. Vojta used to repeat very often that “position accompanies motion like a shadow”, thus the spatial arrangement of the body’s position has to enable the sequence of movement that will always contain all three spatial vectors and will more or less be close to a spiral trajectory.

Clinical observations carried out by V. Vojta allowed him to describe the muscle chains that are responsible for the motion of the body. He divided them into straight and oblique movements. In great detail, he described their functions within the development of motion from the birth to independent movement, both during the physiological and pathological development.

The sequences of individual muscles indicate that the biomechanical construction of the musculoskeletal apparatus is built with regards to the combination of the two following components: firstly, strength and secondly, speed.

This system could be divided so that the strength components are oriented medially (to the centre), predominantly on the axial skeleton and muscles and distally (towards the shoulders and hips) on the extremities. Components responsible for speed are located more laterally (from the centre) again predominantly on the axial skeleton and muscles, and proximally (from the shoulders and the hips) on the extremities.

By combining the strength and speed components, the musculoskeletal apparatus attains the maximal efficiency possible, for which it has been designed i.e. predominantly the speed movements of the extremities and predominantly the strength movements of the torso. Moreover, there is a wide range of precise and adjusted movements in the fine motor skills of the hands and vocal cords.

It turns out that the sequence of almost all individual muscles, muscle groups and muscle chains is curved into a spiral. According to the steepness or the flatness of the respective spiral, it could be distinguished whether it was designed to perform predominantly speed or predominantly strength movements. Thus, steep spirals are designed to make a fast movement with a high rate of acceleration but small degree of strength. The spirals of a flat sequence are designed for slow motion with a small rate of acceleration, but with the ability to magnify the strength exerted.

Muscle spirals wrap both the axial skeleton and muscles and the extremities in such a manner that the right to left and left to right spirals rotate around the central axes (the spine and chest constitute the axis of the axial skeleton and muscles and so do the long bones of the extremities). For example, the strong expiration represents the manifestation in practice of the “tightening” of the right to left and left to right spirals of the chest.

Balanced control of the spiral motion of the musculoskeletal apparatus enables the locomotion of the body and all other extrinsic motor creations. Spiral motion enables permanent centration of joints during both normal physiological movement and in the case of pathological lesions found in the peripheral joints, i.e. weight-bearing or spinal joints, respectively. Correction of dislocations is possible this way, including the pathological shifts of intervertebral discs.

Spiral trajectory is highly economic for the performance of movement, and it is also safe for the musculoskeletal apparatus. Spiral trajectory is expressed in all types of movements and every stereotypical movement and its components are executed through it. Spiral trajectory that approaches the physiological optimum also approaches the rotatory ideal. The greater the trajectory’s deviation gets from the physiological optimum, the greater the deviation gets from its rotatory “shape”.

The economic demand of motion also increases with the deviation from the physiological ideal. The wear rate of the kinetic components of the skeleton rises. Fatigue increases and efficiency decreases at all levels.

Basic conditions for the performance of normal stereotypical movement

- To perform any stereotypical movement in an ideal way, it is necessary to join the muscle chains together in a COORDINATED CONTRACTION WAVE.
- Control of the muscle coordination during the contraction wave occurs according to predetermined algorithm.
- To perform the correct coordinated motion, it is necessary to provide IDEAL biomechanical conditions.

Artistic representation of human movement within the dynamics of spiral loops.

The sequence of the stereotypical movement in the contraction waves of the muscle chains uses all types of muscle contractions.

These are:

- Isometric
- Dynamic contraction (formerly referred to as Isotonic)
  - Eccentric
  - Concentric

Current conceptualization of the muscular kinematic chains or muscular loops is based on the notion of the classical descriptive anatomy, meaning it is two dimensional. That is why the conception and illustration of the chains and loops is represented as though on a plane.

During every more complex movement, different muscles and muscle groups form functional units – i.e. the functional chains, which are also called muscular loops. These loops may generate completely different kinetic expression that would not correspond with the contractions of individual isolated muscles that create the respective loop.

A kinematic chain is formed by adding more segments to a kinematic couple. The kinematic chain is specific for each movement and even changes during a more complex motion sequence. Based on the ending of the chain, we distinguish between open kinematic chains (the last link is free; it does not contain a loop) or closed kinematic chains (there is no free ending).

Correct Development – Physiological Developmental Kinesiology

As it matures, the musculoskeletal system of the human body goes through significant changes, particularly during the first year of life. That is what distinguishes us from other mammals, whose young essentially possess a miniature version of the musculoskeletal apparatus of adult individuals.

From the perspective of bipedal gait, the musculoskeletal apparatus of a child after the birth is substantially incomplete. Only through intensive maturation do the angles of bones change predominantly in the lower extremities. So does the curvature of the spine so that the child is able to stand and walk by itself at about one year of age.

This maturation is a result of two underlying factors – the external effect of gravity and intrinsic activation of the genetically encoded program of motor skills.

In other mammals, unlike in humans, the basic motor skills stay the same in young animals and adult individuals as well.

In the course of intrauterine life, the motor manifestations of the child could be noticed during the first weeks after conception. The complex coordinated movements are apparent in the last trimester. In this period, the child is able to perform rotational motion of the whole body in the uterus. It can grip with its hands and feet in a coordinated way. However, all these motor skills suddenly disappear after the birth of the child.

The explanation why this inevitably happens lies in the transition from being suspended to feeling gravity's pull directly. Gravity becomes a very powerful stimulus, and it can be said that it "switches off" the former motor skills of the child. Under normal conditions, a new-born child is not capable of coordinated movements.

Control of the coordinated movements seems to be switched off, and the primitive reflexes take over control of the child's body, i.e. the Substitute Program. This control can manifest only through so called "homokinetic (uncontrolled) motor skills". This overview is only valid in the ordinary, let's say operational, conditions of life of the new-born child. However, as early as 1950, Arshavsky and Kryuchkova presented a completely different view with their research. Their observations showed that the instinctive control of posture and the motion of the new-borns may be global and precisely coordinated, provided that optimal conditions have been created for such movement. Until now these findings have not been sufficiently known in the field of developmental neurology. The claim that the movements of the new-borns were uncontrolled was clearly disproved by the Arshavsky's observations. These results enabled V. Vojta to build a new and reliable foundation of developmental neurology and developmental kinesiology.

A formative influence on the whole musculoskeletal apparatus is achieved through the gradual maturation of the schedule of motor skills. At this point, we reach the basic divergence in the view of the upcoming development of the musculoskeletal apparatus morphologically and functionally.

After the birth of the child, the musculoskeletal apparatus does not bear any signs that could predict whether the upcoming development will be accomplished completely successfully or whether it will impose any restrictions, morphological anomalies or severe functional limitations.

Only further development is going to show how the body will develop – particularly the accomplishment of its basic phase in about the twelfth to sixteenth month of age of the child.

After birth, the schedule of motor skills of the child is completely immature and unable to adjust to demands imposed on the musculoskeletal apparatus by movement in a gravity environment. Unlike in other mammals, this Operational Program is extremely complex. Its complexity is based on demands imposed

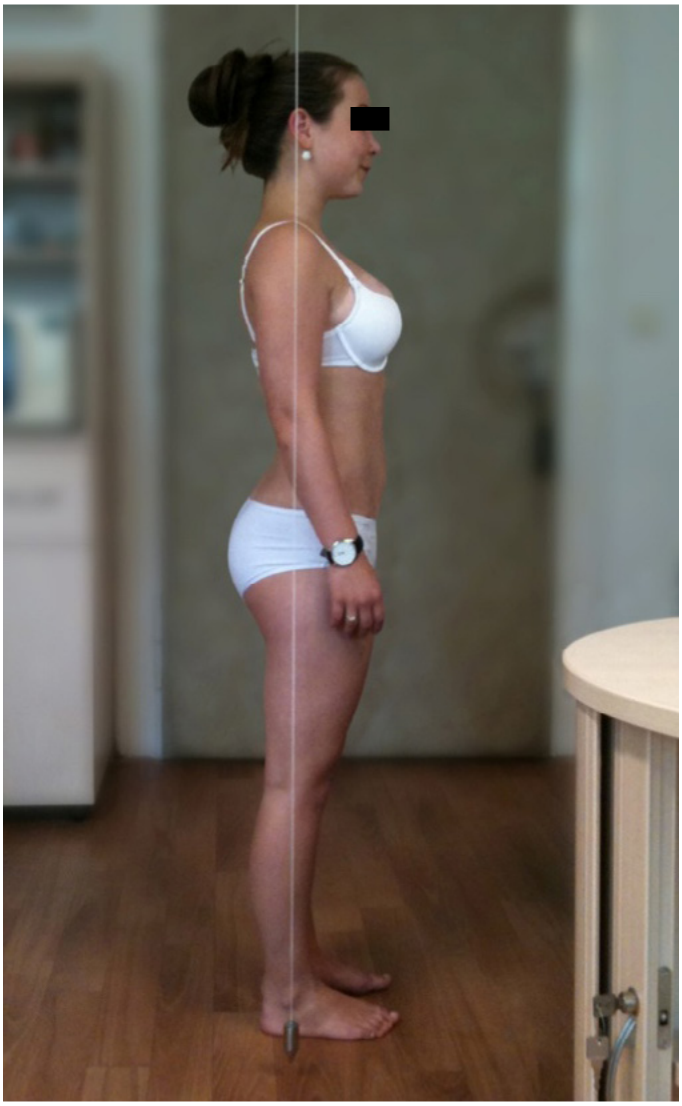


Figure showing the physiological body posture

by bipedal locomotion, which releases the upper extremities from a supporting function when walking. This enables the upper extremities to enjoy the privilege of highly varied activities.

In terms of size and necessary "computing capacity", the Operational Program is so huge that it cannot fit in the space provided by the unborn child's brain. V. Vojta used a simile that the human individual was born prematurely, if compared with other mammals that were capable of independent quadrupedal movement within a few hours (as in ungulates) to several weeks (in felines).

The schedule of other mammals imposes incomparably lower demands on the possibilities of the musculoskeletal apparatus regarding basic kinetic stereotypes and the ability of further motor learning in particular.

Formative and deforming influence of the schedules controlling the motor skills of the musculoskeletal apparatus.

The deformations of the musculoskeletal apparatus we would like to discuss are not concerned with the primary disorders caused by teratogenic influences (developmental defects arising during intrauterine period), but the developmental disorders formed postnatally. These types of disorders is far less apparent than the teratogenic disorders, and their development is also slow.

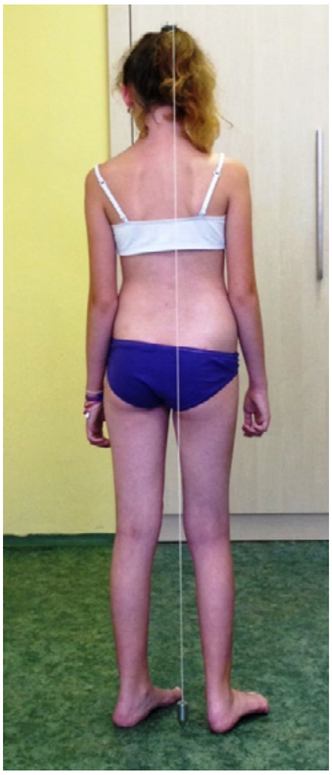
Analysing the movement patterns that enable human locomotion from place and the purposeful movements, e.g. grip, begs a question: "When exactly can we talk about locomotion from place?" And the answer is: "It is the moment when the body is able to move from point A to point B." Between points A and B, there is a journey that has to be made.

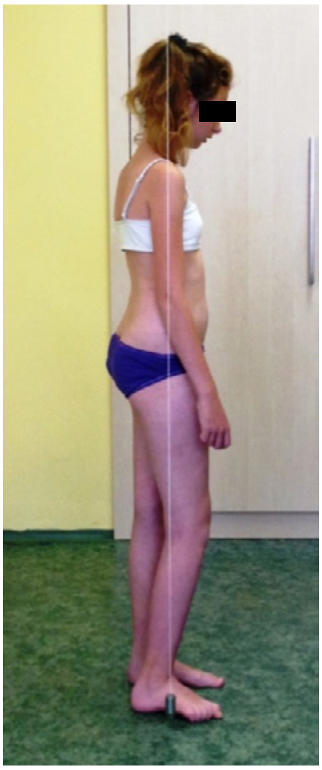
The movement from place usually means walking, running, crawling or jumping. Generally, it means locomotion on two or four extremities. At this moment, an observer records predominantly large or small movements. Indeed, these movements are the clearly visible outcomes, but they are not the core of locomotion.

Analysing the mechanism of gait reveals a movement in the beginning of the step. It is a quite tiny movement in the spinal region, which enables the support of the centre of gravity and the subsequent change in corresponding posture. This movement of the spine consists of several individual movements of the vertebra. These movements are very small and slow and are hard to notice. When viewed, these tiny and tiniest shifting and rotatory movements of the spine create the movement from a place themselves as these tiny three-dimensional movements of the vertebra carry out a particular "journey".

Movements of the individual vertebra against each other and within the whole spinal region vary in direct relationship to, and are dependent on, the movements of the extremities because the full range of movements in the shoulder and hip joints is only enabled through free movement of the spine.

Defective Development – Pathological Developmental Kinesiology





- Disorder of normal spinal rotation subsequently distorts standard rotations in radicular joints. Furthermore, the disorder spreads to the joints of the extremities. This causes significant pathological changes in global motor skills of the body.
- Joint disorders are manifested as follows:
  - Disorder of autonomic joint centration in terms of both static and dynamic centration
  - Predominance of inner rotation (particularly in radicular joints)
  - Predominance of adduction
  - Predominance of flection
  - Predominance of ulnar deviation
  - Restriction of supination
  - Restriction of physiological range of motion in the joint
- Disorder of muscle tone in terms of global hypertonia or global hypotonia, or the hypertonic-hypotonic “mosaic” syndrome

If defective, the basic Operational Program of motor skills of the human individual leaves part of the regulation to the Substitute Program, which also constitutes the “emergency response” for motor skills. Since the Substitute Program is a part of BIOS, damage to it would lead to deterioration of basic vegetative functions, i.e. the biological death. The Substitute Program activates autonomic regulation of the uprightness of the body, postural reactivity, autonomic regulation of the stereotypical gait and grip and other stereotypical movements within the “emergency mode” and significantly reduces the activation of applied kinetic programs.

When maturing, the Substitute Program is gradually overlapped by the Operational Program, which is being “zipped” (or compressed) during the neonatal period, as it gets “unzipped” during the first year of life so that all autonomic (innate) functions can be implemented. Implementation of these functions (myelinisation, creation of neuronal connections, creation of neuronal networks and “virtual maps”) is determined by genetically encoded

Developmental kinesiology – pathological symptoms

Developmental kinesiology – pathological symptoms

- Basic spinal uprightness problem; it can be safely recognized in the spontaneous motor skills in the 3rd month of life (photo compares physiological and pathological uprightness).
- Diagnosis of the developing CCD (Central Coordination Disorder) is a necessary prerequisite to start physiotherapy on time.
- Disorder of the rotatory abilities of the spine or its individual segments is obvious during the rolling over of the infant during the 6th month of life (photo compares the physiological and pathological rotation).
- For example, in cerebral palsy, the rotation of spinal segments is completely obstructed. It is only partially preserved in the craniocervical, cervicothoracic and thoracolumbar transitions.

information without a conscious or targeted process of learning – only through the result of maturing.

BIOS contains an inner component, “a cluster” that is inactive under ordinary circumstances. Its fully specific activation [reflex locomotion] can be used as a “repair program”. It has the ability to reconstruct the Operational Program by providing missing information that had not developed during the first year of ontogenetic development or information impaired in old age regardless of the aetiology of the disorder.

This specific repair program probably contains a certain form of complex information on the Operational Program. We can assume it would also contain extension applications and other information from the SNA (Superior Nervous Activity). In its active state, the repair program performs the status check-up of the Operational Program, adds missing information and performs reconstruction. Information files are stored in the Operational Program during the repair so that they can be used during the start-up and implementation of the autonomic regulation of the uprightness of the body, postural reactivity, autonomic regulation of the stereotypical gait and grip and other stereotypical movements. Subsequently, the repair program can influence the start-up of other extension applications, including the SNA. The clinical start-up of the repair program has been known so far through the activation of the system of reflex locomotion (reflex rotation, reflex belly-crawling, reflex crawling on all fours). This activation can be divided into a system of “locks” and a system of “keys”.

The system of LOCKS contains:

- precisely defined body positions (of the axial skeleton and muscles and the extremities)
- position of the body in relation to the effect of gravity
- weight-bearing points – or more or less precisely defined weight-bearing zones

The system of KEYS contains:

- stimulation of the precisely defined activating points and zones
- ways of stimulating these points and zones by pressure, traction and vibrations in precisely defined vectors
- combinations of these activating points and zones

Only if the system of “locks and keys” begins to fit together precisely, the activation of the repair program will take place. In the course of the repair program, the “application programs” of fine and gross motor skills are being switched off, and subsequently, centres of superior nervous activity are being “switched off” too. Conscious processes are suppressed to a state of relaxation, down to the border between consciousness and sleep. Gradually, the centres of conscious proprioception and kinaesthesia are being disconnected to the edge where the sensation of the body scheme ceases to be felt. Activation of the repair program through reflex locomotion is completely independent of the functions of the superior nervous activity. This is obvious during the therapy of children under one year of age and in patients in a vegetative state.

Stimulation by reflex locomotion activates all components of the Operational Program – i.e. autonomic uprightness of the body, postural reactibility, stereotypical gait, stereotypical grip, stereotypical respiration, swallowing and excretion, but only in the “emergency mode”.

The development of the autonomic uprightness of the body, uprightness and balance mechanisms during the first year of life is also called postural ontogenesis. Its monitoring is of crucial importance particularly after the birth, as the child has to cope with gravity from this very moment.

At birth, these inborn kinetic programs are being switched on. This enables other kinetic patterns (stereotypes) to cope with the gravity.

The aim of developmental ontogenesis is to create the ability of CNS (Central Nervous System) to ensure and coordinate adequate posture, uprightness and balance for the bodily movement from place to place and to vary, and thus adjust, to certain new situations. This lets the genetically encoded basic Operational Program for movement to firmly enter the neuronal network of the CNS. Patterns of posture, uprightness and movement from place to place may be indicated as preformed kinetic patterns, whose purpose is to suppress the individual struggle with gravity.

Due to it, the child learns to recognize its surrounding world. Subsequently, it can acquire special fine and gross motor skills with this precondition. Posture and motion depend simultaneously on each other. Every change in bodily position requires adjustment of the body’s posture to maintain balance.

The Vojta Principle describes the normal inevitable development of motion and posture (postural development) in a child during the first year of life and, subsequently, uses it to diagnose and to treat disorders. Normal development of the skeleton, ligamentous apparatus and tissues and the development of muscular apparatus are proportionally dependent on the ability of the CNS to develop the basic operational program for movement. Without this "software", the development of the "hardware" is somewhat impaired, although nonetheless partly reversibly.

Within the postural ontogenesis, it is necessary to take into account the status of the mental development of the child and the level of motor intelligence, respectively. This level is directly responsible for the ability of the child to show interest in the outside world and its capacity to react adequately to stimuli. This specifically means ideomotor skills or motor ideation. Ideomotor skills are the basic instruments that involve the whole musculature in incalculable variations. They are connected with the actual status of the postural control.

Differentiation of the muscular function (anti-gravity, phasic) takes place in all muscles that contribute to the motor development within the postural ontogenesis, i.e. the most of the skeletal muscles.

As an example, we can take a child that lies on its belly, raises its head and turns it towards an object. Normal postural activity establishes a precondition for the coordinated turn of the head, i.e. it is the automatic regulation of the position of the body. It is provided by the muscle group in the neck and nape region that raise the head by extending the nape in a coordinated manner of both the dorsal and ventral group (including the hyoid muscles, which are used for swallowing within its phasic function). Only if this precondition of the coordinated lifting of the head is met, will the cervical vertebra be set within favourable biomechanical parameters (centred) and the phasic movement might be implemented, i.e. the free turning of the head to both sides. The automatically set and secured supportive base is a part of the whole process.

Defective automatic regulation of the body posture is depicted in three stages, before the beginning of the therapy, after a year and half and after three years

Substitute autonomic regulation of the body posture, substitute rightings and balance reflexes

Abnormal posture template – pattern – form – stereotype
Description of the development of the global disorder of the posture of the musculoskeletal apparatus:

- description
- depiction of the initial state from the developmental phases through the definitive pathological posture
- ontogenesis of the rotatory directions of the extremities
- ontogenesis of the curving of the axes of the axial organ
- ontogenesis forming the shape of the chest
- ontogenesis of the building of the supporting arches of the feet and the position of the toes
- ontogenesis of the hip joints
- ontogenesis of the pathological development of the shoulder girdle, upper extremity and hand
- ontogenesis of the pathological development of the posture of the pelvis
- ontogenesis of the pathological development of the lower extremity and the foot
- ontogenesis of the pathological development of the posture of the head and mandible

Depiction of the state before the beginning of the therapy and after three years of treatment

Development of many pathological disorders of the musculoskeletal apparatus in children and adults can be traced back to the period of early developmental ontogenesis in the first year of life. An imperfect body posture pattern constitutes the characteristic deterioration, which is manifested with missing or insufficient straightening function. The more severe the disturbance, the more noticeable is the prevalence of primitive templates of posture and development of pathological substitution patterns.

Disharmony that arises during the postural straightening ontogenesis always extrapolates to the target phasic gross and fine motor skills. In terms of CNS regulation, the following disorders manifest at the level of dysfunctions: Attention Deficit Hyperactivity Disorder, specific learning disorders (dysgraphia, dyslexia, etc.), disorders of the central coordination of the highly specific fine motor skills and intellectual activity. The activity of the oculomotor muscles, phonation apparatus and small muscles of the hand can be listed among the highly specified motor skills. The standard function of gross motor skills is essential for normal activity of those fine muscle groups, including the automatic regulation of the body's posture, straightening and balance reflexes.

While examining the musculoskeletal apparatus in children, who suffer from the specific disorders mentioned above, we necessarily find disturbances of the central coordination. They manifest in the defective posture of the body and also with defective basic stereotypes of gait, grip and respiration.

Obstructions that prevent the normal development of the righting mechanisms with balance reactions are responsible for several disorders of the skeleton and the disorders of the phasic motion. These are the defects of the basic stereotypical movements, application programs of the gross and fine motor skills, as well as disorders that are less connected with movement at first glance, i.e. specific learning disorders.

While assessing the development of many disorders, it is necessary to assume that the pre-existing genetic program is prepared to get involved in the postural ontogenesis, but obstructions of various aetiologies inhibit the program reaching the central neuronal

Defective posture of the shoulder girdles

Defective automatic regulation of the pelvic posture

networks, partially or at all. As a consequence, incorrect function and deviation of the motor skills appear. The child affected by a disorder of central coordination cannot properly react to stimuli from its surroundings, which, under normal circumstances, attract a child's curiosity and attention. Its CNS cannot provide the necessary motor skills. When the function of its postural, and subsequently also, physical motion is impaired, the child is at risk of remaining within its substitutional stereotypical movement patterns, which harm its postural development.

Trophic status and the development of the extremities are proportionally dependent on the posture of the body or the normal function of the programs of postural ontogenesis. This fact is quite obvious in e.g., expressed syndromes of infantile diparesis or hemiparesis, in which hypoplasia of paretic extremities often occurs. Hypoplasia also appears in traumatic postpartum paresis of brachial plexus.

Defective autonomic regulation of the posture of the knee joints and calcanei, including the collapse of the arches of the feet.

With regular daily exercise, which is performed several times a day, the disproportions tend to normalize. The prognosis is also better, if the ratio of the length of the lower extremities to the length of the body improves favourably for the lower extremities in the course of the exercise, e.g. in diparesis.

With the use of reflex locomotion, the centre of gravity of the body shifts and thus influences and changes the load on the extremities. This leads to stimulatory, formative and growth influences.

In a traumatic spinal cord lesions or strokes, but also in central paresis, the secondary changes play a major role. However, the influence of the central regulation on the motor apparatus is well known as it develops with the use of reflex locomotion. Early commencement of treatment – particularly in the pre-school age – will lead to fewer occurrences of secondary changes.

As we are familiar with the influence of the reflex locomotion, we are only going to describe the muscle cooperation because they can be observed at the moment of their genesis. It would cause a delay to search for the answer to the question, which regulatory circuits influence the reflex movement forward.

During the reflex locomotion, there will be an overall activation of the skeletal musculature, smooth muscles in digestive and urinary apparatus and the skin.

The fact of postural ontogenesis concerning muscle function ensues that the spinal segmental plane of the reflex crawling is placed under the highest coordination control. This plane belongs to the region of postural centres that a fully-developed new-born child has at its disposal. If we assume that the cerebral paresis of infants, which starts its pathological development in the first three months of life, implements its pathological development through the disorder of development in various planes of the CNS, the delay in development would be signalled by symptomatically missing motor skills.

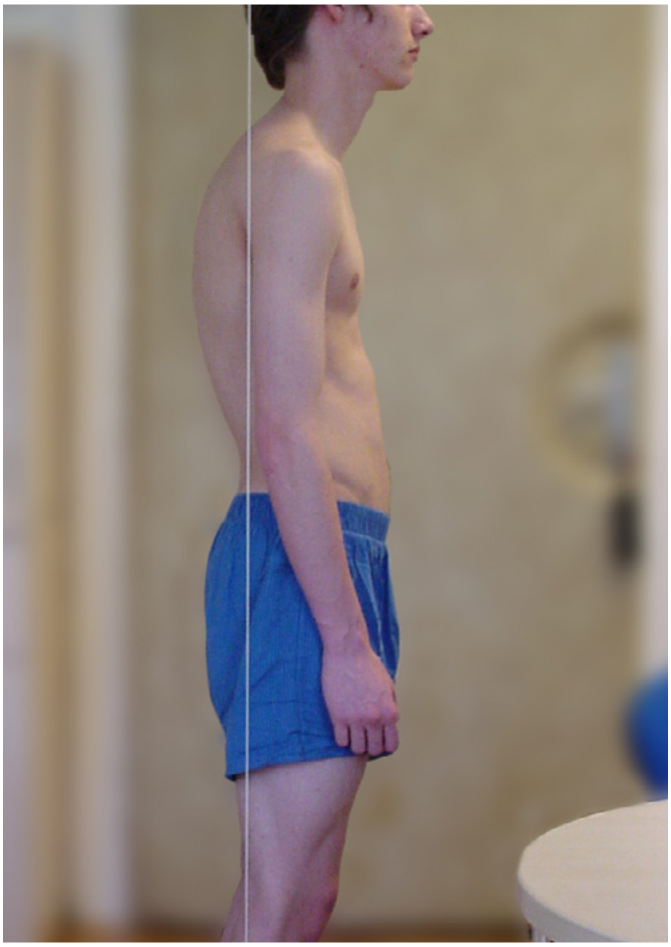
Aetiology of the disorders of the musculoskeletal apparatus

Functional disorders of the musculoskeletal apparatus in adults

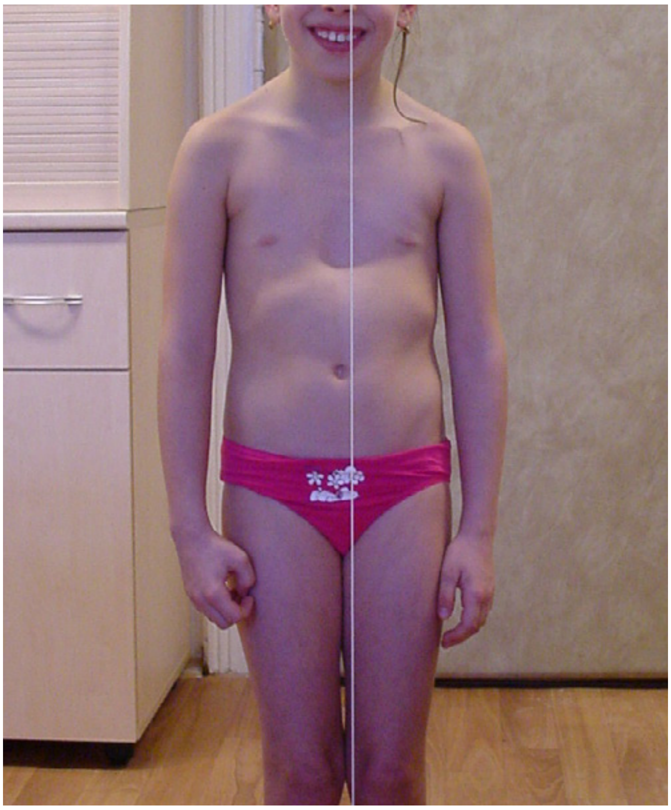
Posttraumatic and postoperative disorders of the musculoskeletal apparatus in children and adults.

The musculoskeletal apparatus is a very common place of origin of disorders, which are felt and registered by our consciousness very quickly if compared with the disorders occurring in other biological systems, e.g. the cardiovascular, digestive or urinary apparatus. The urgency of permanent monitoring and registering of even mild disorders is based on the high degree of complexity of the regulation of the musculoskeletal apparatus, on the complexity of the stress that is loaded on the locomotive apparatus and also on the need of permanent reliability. These considerations are practically based on the need of survival of the respective individual and on the need of the long-lasting care of offspring.

As with any other highly complex system, the musculoskeletal apparatus tends towards a gradual increase in entropy. Degrading the regulation of the musculoskeletal apparatus is its primary manifestation, leading to reduction in the functional capacity of the efficiency of the apparatus as a whole.



Depiction of the collapse of the ribcage



Depiction of the thoracic hyperkyphosis

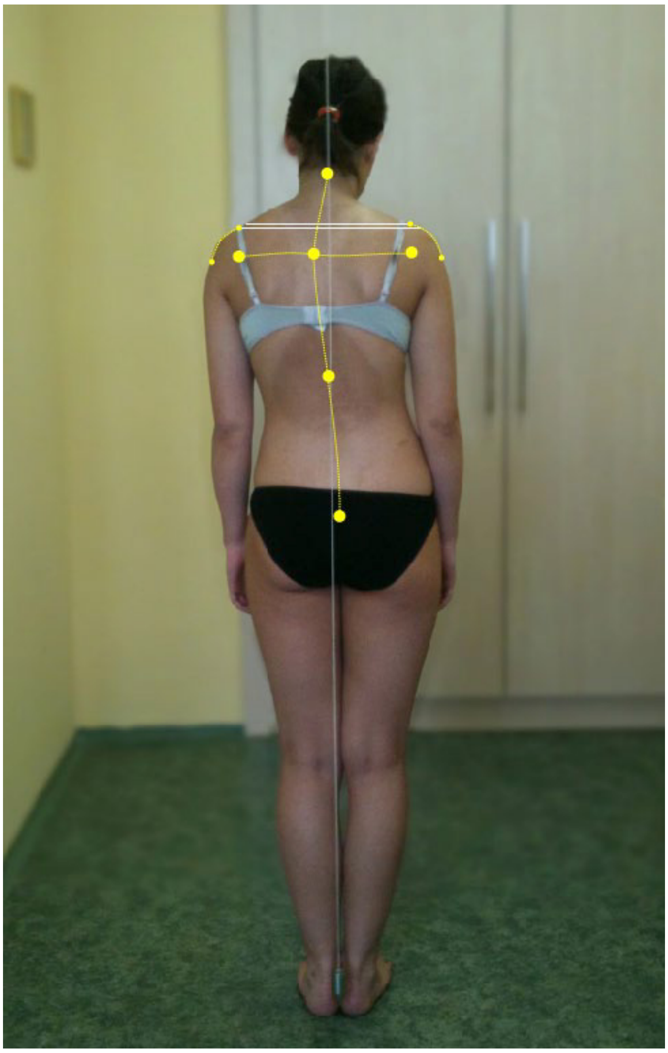
The General Kinesiology of Adults – Its Correct Appearance

The ideal development during the first year of age is the essential precondition for maintaining the body's correct posture in adulthood. If the development was disturbed anyhow during this sensitive period, it is very probable that some disorder of the statics or dynamics of the musculoskeletal apparatus would appear in adolescence or adulthood.

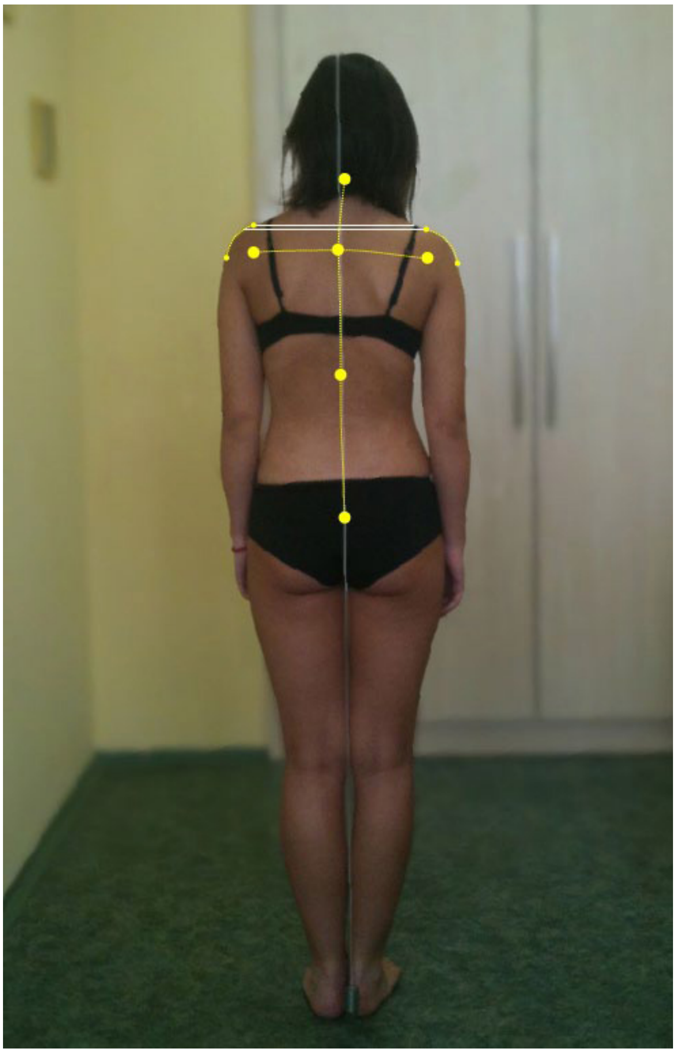
As the development is completed between 17 and 19 years of age, it will be obvious, whether the musculoskeletal apparatus is able to tolerate the stress, and eventually, which disorders could be expected to appear.

If the motor development was defective during the first year of life, the subsequent growth during adolescence would lead to further development of these disorders.

If the defect was severe, the progression of the disorders would be quite visible and the subsequent care is predominantly orthopaedic (e.g. elongation surgeries of shortened tendons) and rehabilitative.



The patient prior to therapy



One year after the therapy

Fortunately, these cases constitute only a small percentage of the population. These disorders are often not really obvious or they are considered irrelevant due to their supposed minuteness. Thus, they are not properly treated. Unfortunately, the imperfect final development of the musculoskeletal apparatus and its subsequent petrification come as a result. The disorder of the locomotive system appears in terms of HW, i.e. the musculoskeletal apparatus, as well as the regulation of the locomotion of the body, i.e. the SW disorder of the CNS.

Myoskeletal disorders are visible in the incorrect posture of the body at all levels: (photographs of individual disorders follow...)

- Posture of the arch of the foot
- Axes of the lower extremities, predominantly of the foot
- Posture of pelvis
- Posture of the spinal axes
- Configuration of the ribcage
- Posture of the shoulder girdles
- Posture of the upper extremities, predominantly of the hand
- Posture of the head
- Posture of the mandible
- Position of eyes

Apparent disorder of the motion of the body in terms of SW defect:

- Defective regulation of basic stereotypical movements
  - Gait
  - Grip
  - Respiratory movements
  - Orofacial stereotypical movements
- Defective regulation of gross motor skills – throwing, jumping, hitting, kicking – sports in general
- Disorder of fine motor skills – writing, drawing, painting, arts, playing musical instruments
- Orofacial fine motor skills – speech, singing, playing wind instruments

Basic terms and the critical building blocks of the voluntary motor skills

Automatic regulation of the body's posture is independent and fully unconscious. We can intervene in the regulatory system from a certain age with deliberate correction, but its long-term influence and modifications with conscious "repairs" is quite limited and hard to automate.

- The ability of the body to assume a position in the space would ensure dynamic stability of its centre of gravity within the potential of transition to the new position.
- It develops from birth and it can be observed from about the 4^{th} month of postnatal development.
- Thus, the automatic regulation of the body uprightness begins in horizontal planes in supine position, in the position on the side and on the stomach.
- Quality of the course and the development of the automatic regulation of the body straightening is the necessary precondition of the motor skills of the musculoskeletal apparatus in its basic and extrinsic programs.
- Programs of automatic regulation of the uprightness are primarily "targeted" at the autochthonal musculature of the spine, which forms the very core of the motor skills
- Disorder of the activity of this muscular system (or the regulation of the autochthonal musculature, which has been fully developed since 3 months of age, leads to motor disorders of the Central Coordination Disorder type with subsequent consequences for the automatic regulation of the body posture and its motor skills

These disorders subsequently lead to insufficient extension of the spine and to the disorder of the development of the natural spinal curve; furthermore, they lead to disorders of rotation of individual spinal segments and the key points in particular, – i.e.:

- Craniocervical transition
- Cervicothoracic transition
- Thoracolumbar transition

Automatic regulation of the body posture always contains points of support – Punctum fixum

- The more there are, the more stable the position.
- The less there are, the more labile the position and the more prone to change; of the labile position enables change.

Automatic regulation of the body's posture always contains points of motion – Punctum mobile

- The less there are and, the closer to the centre of gravity they are, the more stable the position.
- The more there are and the farther from the centre of gravity they are, the more labile the position.
- Puncta fixa and puncta mobila create spatial geometric objects that fundamentally aim to make the centre of gravity of the body stable or unstable.
- Initially, transitional phases from the stable position to the labile position and back to the stable position are performed only by the basic stereotypical movements and subsequently, as the motor learning develops, by the "overlapping" application programs.
- The regulation of the transitional phases happens automatically and unconsciously. It is provided by the basic operational program of the motor skills.
- Subsequent motor learning happens partially unconsciously through gaining motor experience, and partially consciously through motor learning.

Automatic joint centration happens automatically and is fully unconscious. It is an integral part of the following:

- automatic regulation of the posture of the body
- basic stereotypical movements
- all the extension application programs of motor skills

Its distortion by the deviation of the joint axes is manifested in the statics and the dynamics of the motion

- The disturbance happens due to external causes:
  - the disorder of the regulation of the basic motor programs (cerebral paresis, stroke, multiple sclerosis)
  - the disorders of regulation of the extrinsic application programs (distortion of the form of motion, overload…)
  - the disorders from general degenerative causes (arthrosis, muscular debility, osteoporosis…)
  - the disorders based on the traumatic changes (both HW and SW), diseases and malnutrition.
- Normalizing the automatic regulation of joint centration is an essential and necessary precondition of the correct function of the basic and extrinsic motor skill.
- Normalizing the joint centration by external manipulation (mobilizing) without subsequent maintenance of such centration by normalizing of the regulation only has a short-term effect; subsequent stress of the musculoskeletal apparatus would lead to deviation of the joint axes and the following development of motor skill disorders.

Automatic regulation of the muscle tone also happens autonomously and is fully unconscious.

- It is a fundamental precondition of the following:
  - primary provision of the automatic regulation of the body's posture
  - basic provision of the automatic regulation of the joint centration
  - performance of the basic stereotypical movements
  - economic performance of the extrinsic application programs.
- The external stimulation may lead to changes in the muscle tone in the short term.

Basic stereotypical movements are innate automated programs

Early Diagnosis by Means of the Vojta Method (Or he who diagnoses early has (almost) won.)

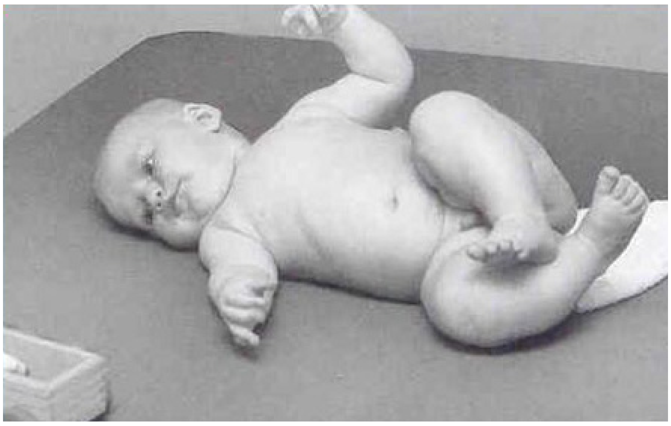
Spontaneous motion – The joy of movement

Analysis and examination of the spontaneous motor skills of a child is used to estimate its motor developmental age. Thus, it is particularly important to observe the movement patterns the child is able to perform. While examining the movement patterns, we concentrate on the patterns commonly performed by approximately one half of the normally developing children during the first year of life. They are used as approximate measures to assess the degree of development. Developmental level is also a marker of the status of the regulatory motor centres in the child´s brain. It shows whether the development goes as it should.

We observe the positions:

Supine position

Position on the belly



Position on the side in older children

Semi-sitting position on the side (so called oblique sitting)

Apart from these static positions, we of course study the active motion of the child,

i.e. the turning from the position on the back to the belly and the opposite direction back to the position on the back.

The next studied activity is crawling on the belly. Quadrupedal crawling on the knees

Verticalization next to furniture. Unaided standing and the ability to walk along the furniture (quadrupedal gait)

"final developmental product", the bipedal gait

Every normal upright stance and locomotion needs undistorted automatic regulation of the body's movement.

Spontaneous motor expression of a child from birth to the accomplishment of the development of verticalization and unaided gait at about 1 year of age.

Supine position

- Punctum fixum (PF) – the weight-bearing points are the following sites (see the picture of a skeleton depicted from below):
  - Nape
  - Both scapulae
  - Both pelvic alae
  - Both calcanei
- Punctum mobile (PM) – points of motion occur during the elevation of the hands (e.g. towards an offered toy) and feet subsequently (also while trying to grip something).
- The position is highly stable – support in 7 PFs or 5 PFs respectively.

Turning

Initiation of turning from the supine position to the side is followed by a change of points of support and the points of motion; the movement is initiated by turning the head and the movement of the eyes, respectively.

- PF – on the head; it is released from the support to let the head turn;
- PF – the pelvic and scapular PFs is released from the support at the mandibular side of the body so that the mandibular half of the thorax and pelvis elevates;
- PFs – at the nape they shift from the scapular region to the shoulder joint and from the pelvic region to the hip joint;
- New PF origins – at the elbow of the upper extremity at the mandibular side of the body;
- Is how the support in three points forms, which is less stable, but it enables the transition to the new stable position in four points;
- PM – the hand on the mandibular side becomes the "leading" PM;
- PM – both lower extremities become "aiding and balancing" PMs.

Position on the side
(see the photograph taken from below and from above)
Stable position that enables the hand on the mandibular side to become the "exploring" hand in the space in front of the face. First functional differentiation of the upper extremities for weight-bearing and physical function is being formed. The support has 4 points.

- PF – the occipital upper extremity has its PF at the shoulder and at the elbow;
- PF – the occipital lower extremity has its PF at the hip and at the knee;
- PM – the head gets out of the support (for a while), and the visual perimeter is elevated;
- PM – the hand on the mandibular side has the range of motion above and to the front;
- PM x PF – foot on the mandibular side varies between the possibility of leaning on the knee and the possibility of the movement that would enable returning to the safe position on the back.

Turning
Turning from the position on the side to the belly and back

- Leaning on the PF at the elbow on the occipital side would release the load at the shoulder and the whole chest becomes a PM;
- PF at the hip joint at the occipital side becomes the support for this unstable situation;
- PF at the knee on the occipital side starts to shift caudally, as the leg extends;
- PM on the hand on the mandibular side accomplishes the turn onto the belly;
- PM of the foot on the mandibular side helps to turn the pelvis on the belly, while the lower extremity extends fully.

Position on the stomach – 3rd month of development
Stable position on the stomach is provided by the support of the upper extremities at the forearms

- PF – these are the elbows, including the whole surface of the forearms;
- PF – pelvic symphysis forms another important support;
- PM – this is the head and its free posture on the extended nape, which enables significant widening of the visual perimeter.

Position on the stomach – 4th month of development
A change in the support takes place

- PF – is shifted to the open palms of both hands;
- PF – at the symphysis shifts caudally;
- PM – the head enables the child to look around from "the upper floor"; the extension of the cervical and thoracic spine increases the range of rotatory movement.

Position on the stomach – 5th to 6th month of development
There is another change in the support that enables the releasing of one hand from the weight-bearing role to enable the grip

- PF – stays at the occipital upper extremity and the whole surface of the forearm;
- PF – is shifted from symphysis to the hip joint on the occipital side;
- PF – there are new ones appearing at the knee on the mandibular side;
- PM – the head;
- PM – the hand on the mandibular side is released from a weight-bearing role and becomes the "grip organ".

Transition from the position on the stomach to the oblique sitting – 8th month of development
The oblique sitting position enables the transition to the crawling on all fours.

- PF – is at the open hand on the occipital side;
- PF – is at the hip joint on the occipital side;
- PF – includes the whole surface of the thigh and the knee on the occipital side;
- PM – the head goes to a higher position again; whole cervical and thoracic spine is extended and enables increased rotation and wider view;
- PM – the hand on the mandibular side gets into the vertical axis above the head.

Crawling on all fours – 9th to 10th month of development
It is enabled by full differentiation of the function of the support and movement both on the upper and lower extremities. It is a basic precondition for the imminent bipedal gait.

- PF – support in the extended occipital hand
- PF – support in the knee of the mandibular leg
- PM – mandibular hand
- PM – occipital leg

Verticalization of the body to the standing position – 10th to 11th month of development
If there is the opportunity of vertical support from the furniture, the child will use the mandibular hand to grip and pull itself upright.

- PF – the hand on the mandibular side
- PF – the sole on the occipital side
- PF – the knee on the mandibular side
- PM – the hand on the occipital side searching for the support above the level of the support of the hand on the mandibular side
- PM – the head with the full range of rotation; the cervical, thoracic and lumbar spine fully extended.

Standing position with support and the transition to the quadrupedal gait

Unaided standing with no support

Unaided bipedal gait

What do neurologists examine in children

Primitive reflexes during the first year of life

After birth, the child goes from the apparent weightlessness of the aquatic environment into one where it can feel the pull of gravity. However, it is not mature enough for such a burden. Dr. V. Vojta used to say that we were born prematurely. To cope with the demands imposed by gravity, the new-born uses the Substitute Program to regulate its motor skills, i.e. the primitive reflexes. The gradual slow development of the Operational Program of motor skills leads to the switching off of the Substitute Program and the "dying out" of the primitive reflexes.

Examination of the primitive reflexes is difficult. Also thanks to Dr. V. Vojta, we can be pleased that paediatric neurology has a real tradition in the Czech Republic, known as the Prague method of examination of new-borns.

Primitive reflexes are those to support survival – respiratory reflex, blinking reflex, swallowing reflex, suckling reflex, chewing reflex, orientation reflex, excretion reflex and several others.

The reflexes that are regulated by the subcortical region of the brain, i.e. by the primitive brain structures, are also called primitive reflexes. Naturally, they disappear by the first year of age. This is a sign of normal neurological development.

The following reflexes are listed:

- Swimming reflex – It fades within 4 to 6 months. The child holds its breath and swims with its eyes open.
- Grip reflex (palmar) – It disappears within 4 months. The child can hold the offered fingers and hang for one or two seconds.
- Grip reflex (plantar) – It could be elicited beneath the toes.
- Reflex of Babinski – It regresses within 8 – 12 months. The pressure of the tip going down the sole of the foot leads to a fan-shaped spreading of the toes.
- Reflex of Moro – It disappears within 6 months. If upset by a noise or sudden movement, the child spreads its arms and bends its back like a bow. After putting their hands back together, the child is laid in the supine position on a warm mat. Then, we pull the mat quickly. The child should spread its arms and fingers and slowly return to a "hugging" position afterwards.

- Gait reflex – Child imitates walking, when it comes in contact with a mat.
- Tonic neck reflex – the so called fencing position – The child turns its head towards the side with the extended upper extremity.
- Investigative reflex – When you touch the child's cheek, it will turn its head towards the sensation.
- Crawling reflex – The child laid on the belly makes movements that resemble crawling. (It is easier to elicit when it is laid on its mother's stomach).
- Reflex of Landau – You hold the child under the arms when it is on all fours. When you pretend to let it fall, it will bend and spread its limbs "like a plane".
- Smiling reflex – Initially, the child smiles reflexively. The smile is reinforced by its surroundings and so it persists. If the smile is not reinforced in institutionalized children, they will forget it. They have to learn it once again under different conditions.

Positional reactions or Dr. V. Vojta was a genius

Since the mid-1950s, Dr. V. Vojta had been looking for a way how to early identify the risk of pathological development of motor skills in infants. It had been known at that time that children who developed cerebral palsy showed some abnormalities observed by their mothers and paediatricians during the first year of life. Nevertheless, it was impossible to assess whether the development of the individual child would be pathological or not.

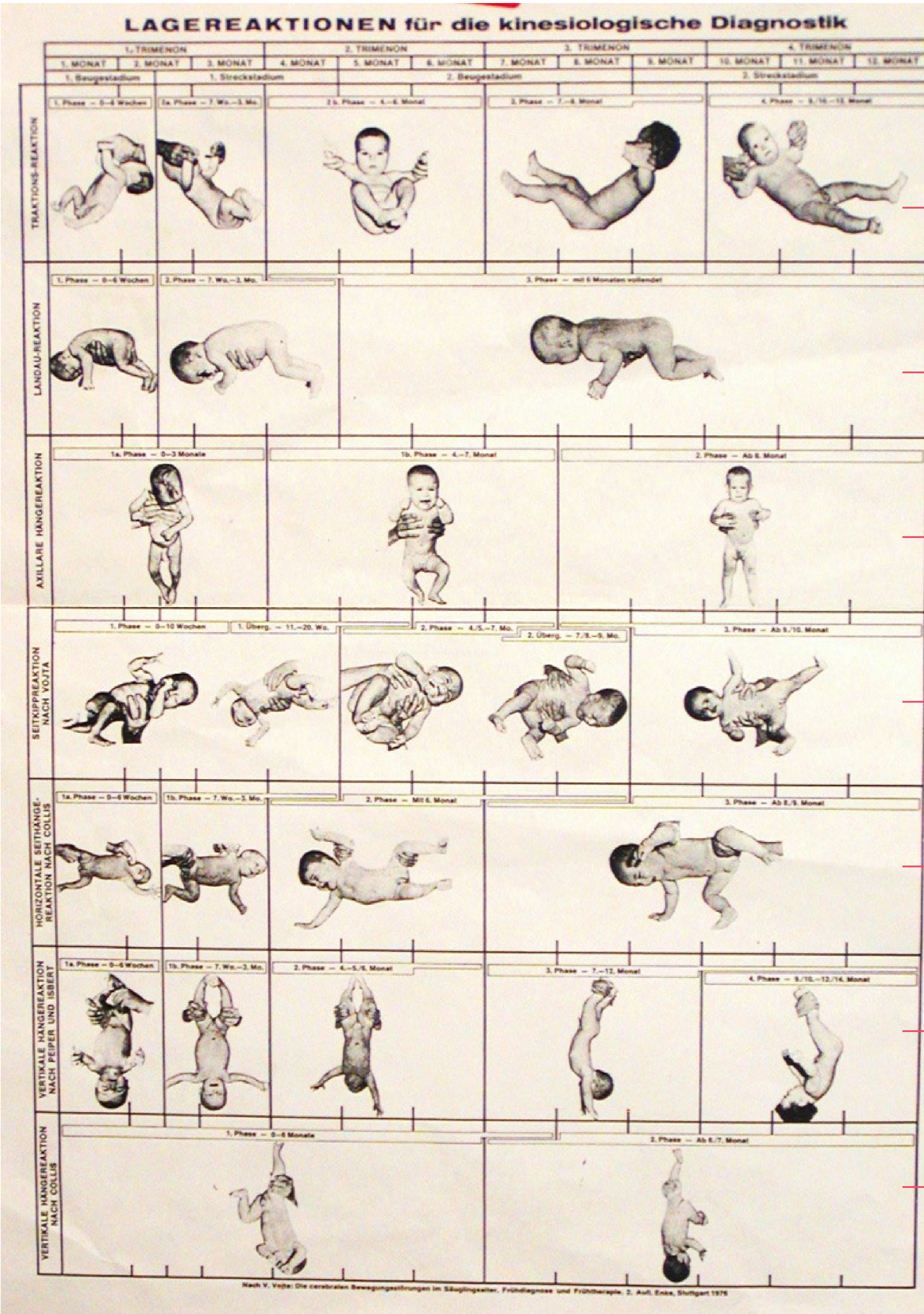
Neurological reflexes show abnormalities, but basically, they cannot sufficiently predict the upcoming pathological development. It was the extensive work of Dr. V. Vojta that enabled him to develop a screening set, which would enable this prediction. Most of the positional tests had been known since the mid-twentieth century, but Dr. V. Vojta made the necessary step – he sorted the results of the test into the timeline. That's how the table of Positional Reactions was made. It was first published in 1972. Many trials have proved that "Vojta Screening" has high sensitivity and specificity and could be clearly recommended in the diagnosis of developmental disorders of motor skills.

According to this table, what the actual status of the child's development is can be determined, i.e. whether his responses in individual positional tests correspond to the normal results in the respective age or whether they deviate.

According to the number of divergent responses, it could be estimated whether the child was healthy or whether its motor development was at risk to some degree. The number of abnormal responses determines the level of risk. If the motor development was endangered, we would talk about so called Central Coordination Disorder (CCD), which does not represent a definitive diagnosis. It is an evaluation of the condition, which is important for the decision concerning the necessity of either therapy or careful monitoring. It is necessary to start the therapy in children who show signs of mild CCD.

- Mildest CCD 1-3 abnormal response in positional tests
- Mild CCD 4-5 abnormal responses in positional tests
- Moderate CCD 6-7 abnormal responses in positional tests
- Severe CCD 7 abnormal responses in positional tests with concurrent severe tone disorder

Of course, the tests serve as a very good indicator for the therapy's progress and chance of successfully leading the child towards normal motor development. If the child showing signs of severe CCD started the therapy, the number of abnormal responses should decrease with correct therapy, thus the degree of CCD gradually decreases to normal.


LAGEREAKTIONEN für die kinesiologische Diagnostik
1. TRIMENON
2. TRIMENON
3. TRIMENON
4. TRIMENON
1. MONAT
2. MONAT
3. MONAT
4. MONAT
5. MONAT
6. MONAT
7. MONAT
8. MONAT
9. MONAT
10. MONAT
11. MONAT
12. MONAT
1. Beugestadium
1. Streckstadium
2. Beugestadium
2. Streckstadium
TRAKTIONS-REAKTION
LANDAU-REAKTION
AXILLARE HÄNGEREAKTION
SEITKIPPREAKTION NACH VOJTA
HORIZONTALE SEITHÄNGE-REAKTION NACH COLLIS
VERTIKALE HÄNGEREAKTION NACH PEIPER UND ISBERT
VERTIKALE HÄNGEREAKTION NACH COLLIS
Nach V. Vojta: Die cerebralen Bewegungsstörungen im Säuglingsalter. Frühdiagnose und Frühtherapie. 2. Aufl. Enke, Stuttgart 1976

Extensive studies have shown that if the CCD was identified within first 3 months of life of the child and adequate therapy followed, 99% of those children could be brought back to normal. The later the diagnosis and the lower the intensity of the therapy, the higher the percentage of children developing a motor disorder is.

Traction test

Landau test

Axillary suspension

Vojta's lateral tilt

Horizontal lift of Collis

Peiper-Isbert test

Vertical lift of Collis

Determination of the degree of CCD is not only a result of the positional tests that are especially sensitive in evaluation of the status of the child's brain. The responses responses to primitive reflexes and spontaneous motion of the child are also taken into account. Such a complex view is sufficient to decide on the need to start therapy.

Observation of these functional connections lets the therapists assess the child holistically in its spontaneous manifestations. Concurrently, it is possible to discover the faulty patterns that would significantly influence further development. These findings set the goals of therapy.

Therapy – Correcting the Causes of the Problem and How Does Vojta Therapy Work?

The Vojta method has been widely distributed, despite the fact that most of the basics of VM have not been sufficiently understood. It has been passed like a “craft”, which has brought satisfactory functional results.

As the difficulty, overlap and abstraction increase during the performance of the practical therapy, the need for an extensive conceptual theoretical framework that would help the creators and users to understand the process of therapy increases as well.

Within the medical community, the Vojta method is well accepted as a therapy, which has treated many disorders and has brought very good results in children (for more than 50 years) and in adults (for about 30 years). Unfortunately, there is absolutely no need and effort to understand the essence of the method. It is quite astounding that a method that has worked for more than 50 years has not been subjected to any research at all in terms of physiological mechanisms. No study has been published to explain what can be the reason for its functionality. For more than 40 years, the work of V. Vojta has been sufficient, having never been subjected to real laboratory verification, even though the Vojta method has been a standard lecture topic at all schools of rehabilitation therapy, mentioned at the medical faculties and even influenced tens of thousands of patients.

The goal of VM is to intervene with an organization and thus, the functions of the CNS, so that the child/patient could access their genetically encoded motion program, which was so far unavailable due to motor disorder.

Thanks to Vojta therapy, the innate movement programs are being activated. These movement programs are made of different movement types, which could be combined. Different functional relations between the skeletal and muscular system and sensory system converge into the concept of a sensorimotor pattern. We call them patterns because the voluntary movements are possible only due to the orderly cooperation of many muscles, joints and relevant nerves. CNS provides this organization and coordinates the movement.

Damage to CNS may influence the innate movement programs. Such a disability may develop due to incorrect intrauterine development, due to brain damage during the delivery or after birth, e.g. due to hypoxia or bleeding or due to injury that damaged the spinal cord or the brain.

Damage to the peripheral nerves (palsy of the brachial plexus) or injury to the muscles or skeleton may lead to considerable disorder of movement regulation.

The child with central coordination disorder has its access to innate movement program and circuits necessary for mediation of information in the CNS closed. It can use its motor skills only insufficiently in the substitution – emergency program. As a result, partially deviated movement patterns are significantly restricted. Their usage usually leads to other secondary impairments. Such influence is especially severe during the first year of life. It strongly restricts the very start of the somatic and psychic development, which stagnates without corresponding motor skills. As early as within the first 3 months, extensively significant effects may appear.

Along with the reflexive locomotion, Vojta discovered the therapy that can overcome these obstacles. Intact or at least partially intact connections of nerves and muscles provide an important precondition for the peripheral and nervous systems to communicate through special stimuli.

The new insights, introduced by the approach initiated with the clinical observations of Václav Vojta, create a potential and open up possibilities instead of definitions of facts and objects

Vojta's approach does not aim to "process" an imperfect body but to unravel new opportunities that the brain and the body provide. Subsequently, it allows clinicians to transfer all this into reality. My conviction about the correctness of Vojta's theory results from its long-lasting therapeutic fecundity and the ability to predict the imminent development of a disorder while simultaneously predicting and explaining the new and unexpected phenomena connected with musculoskeletal apparatus, apparatus, though this is not the only benefit by far.

In 1995, Dr. Vojta discovered the possibility of starting the "repair" program through a system of reflexive locomotion.

It contains the following:

- Reflex turning
- Reflex belly-crawling
- And the less known reflex crawling on all fours

The reflexive locomotion uses the following:

- Completely ideal motor patterns...
- ...that are strictly individual;
- It sets the level of stress on muscles, joints and nerves precisely in accordance with the current physical condition, innate dispositions and biomechanical proportions of the respective individual;
- It practically excludes the possibility of overload of the musculoskeletal apparatus.

Characteristics of the reflexive locomotion system:

- The program cannot be "switched off" by any disease or traumatic condition, even up to the state of deep unconsciousness;
- In terms of neuronanatomy, the "core" of the program is probably situated above the region of the brainstem, i.e. right above the place of regulation of the basic vital functions ("BIOS program");
- The program utilizes permanent multifunctional feedback, by which it enables the utilization of all available reserves of the musculoskeletal apparatus;
- "The program" is encoded genetically, thus it may be utilized or "started" in every individual from birth until the end of his/her life;
- The program is able to distinctly positively influence the "application" kinetic programs for both fine and gross motor skills.

The basic premise of reflex locomotion is: function consists of a body.

Through reflexive locomotion, individual muscles may participate on the process of motor development and thus influence the maintenance of posture.

Reflexive locomotion programs, the bio-cybernetic model of Vojta method

Vojta's principle works with movement patterns, within which the individual oversees the whole body within the perimeter. That is why they are usually called **global patterns**. This term indicates that the movement of individual body parts is usually viewed within the kinetic context with the whole body. These patterns that concern the whole body are composed of several parts (partial patterns). Arms and legs have to be well-tuned with the torso. Only if all parts of the body cooperate can the individual straighten out and move from the spot.

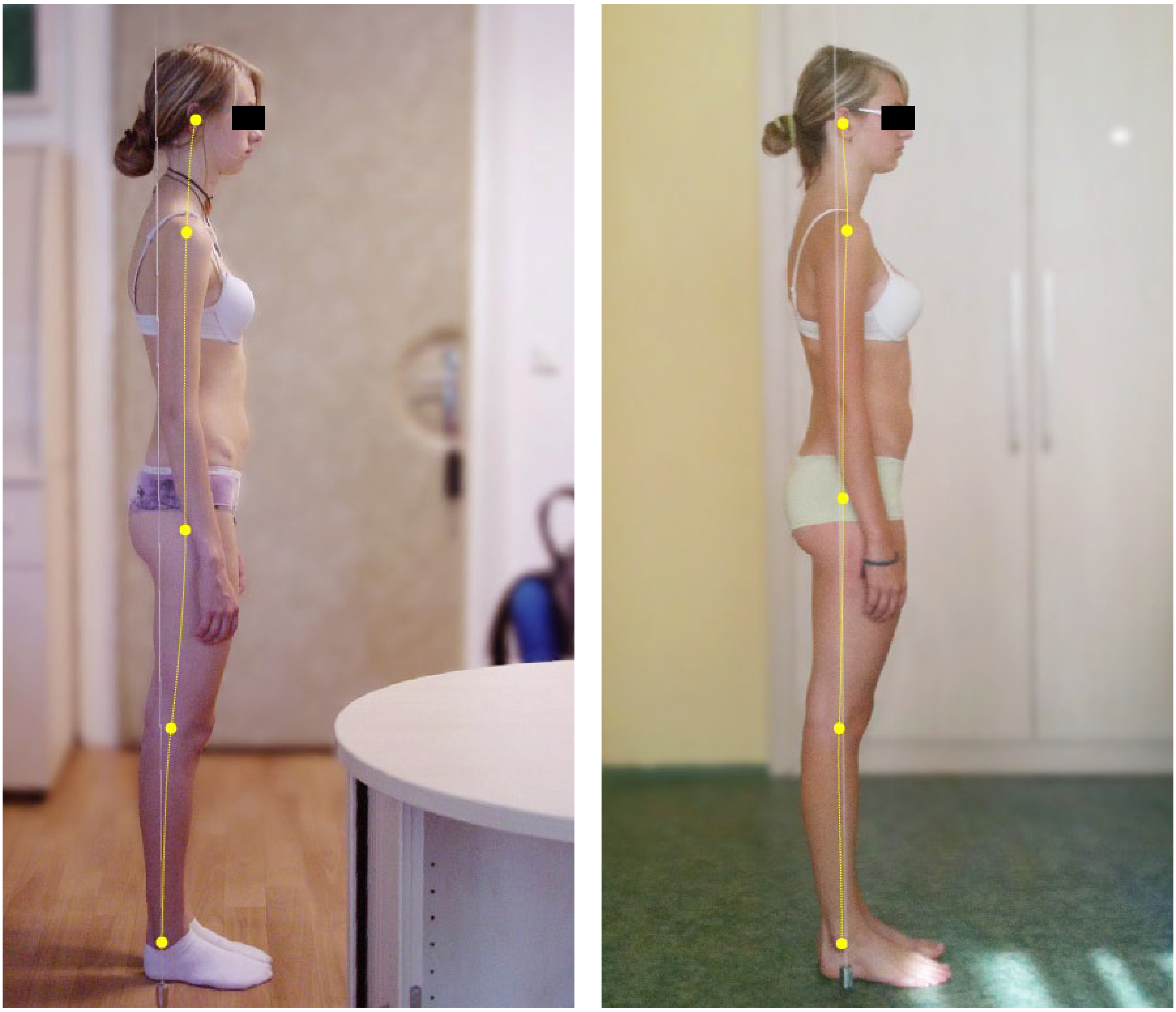
If any part of the body changed its arrangement towards the remaining parts, the other parts would react and arrange anew.

This seems necessary if we realize that the balance of the body during each movement, even a small one, must be regulated. It resembles a scale. If one weighing pan was loaded with some substance, the other pan has to be loaded correspondingly to attain equilibrium between the two. The human body shows similar dependency, but in a much more complex manner. We talk about the coordination of the musculoskeletal apparatus. In a balanced state, the individual parts of the body are arranged and situated in a balanced manner and the centre of gravity is situated above the points of support. That is why every small change within the body that is related to weight carrying activates the whole sensorimotor system of the body in order to maintain balance.

As mentioned above, permanent **regulation of posture** during uprightness and movement requires common cooperation of practically all muscles. An individual muscle is guided by an established movement pattern which is regulated according to a common goal that the body wants to reach.

The movement patterns can be analysed and described. For example, hand grip is a part of a common pattern. It is a part of the movement of the arm and it depends on the posture of the whole body because the quality of the posture is basically dependent on the posture of the torso and the spine. Diagnostic and therapeutic interventions find their overwhelming justification only when the movements relate to the background "essence", i.e. the posture of the torso and the autonomic regulation of the posture of the body.

The sequence of the movement of the crawling child that tries to reach the table might be roughly described within the above mentioned relations as follows: the child has the idea of reaching the table. To accomplish her goal, she mobilizes the general motor skills.

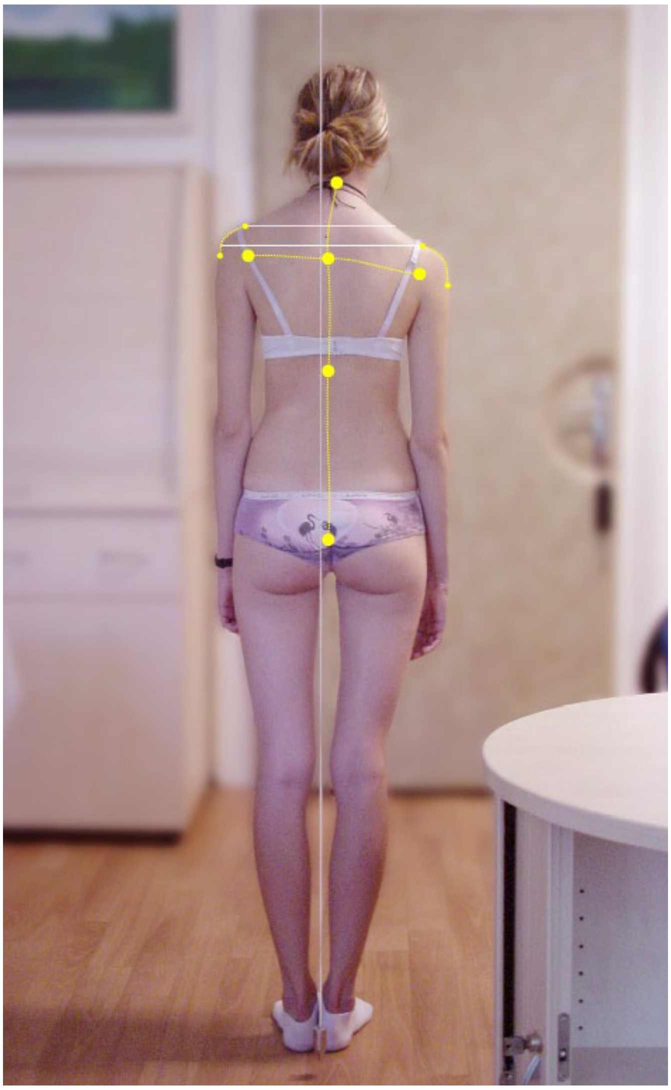


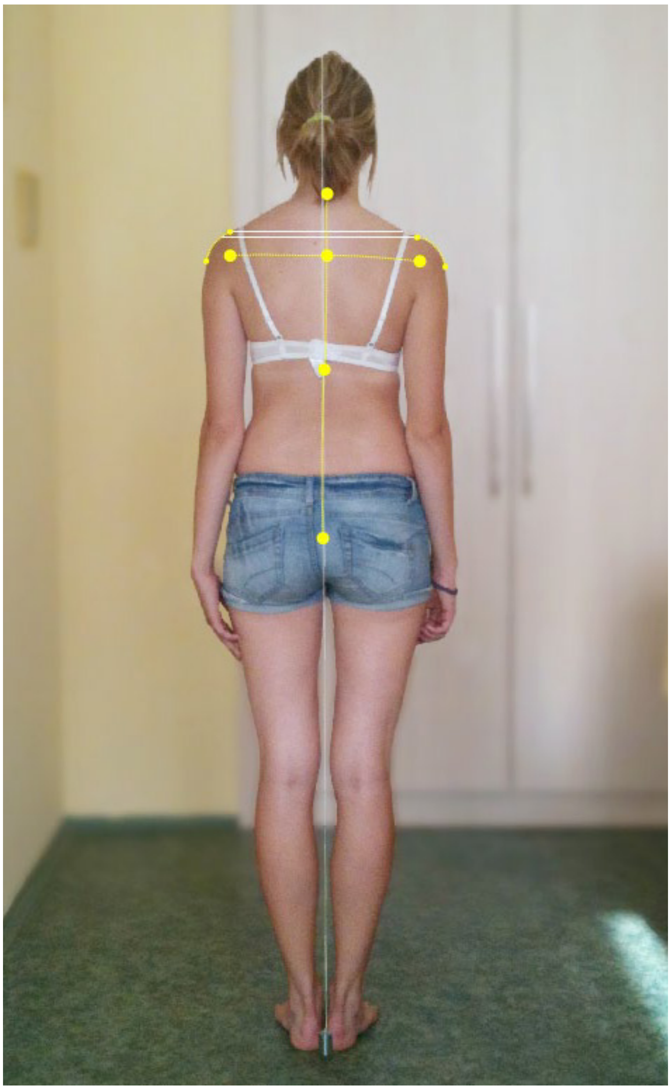
Výsledky terapie po třech a půl letech

She has to separate one hand and arm from the crawling movement pattern to reach the table above. She has to hold the body in an upright posture to shift the centre of gravity of the body from four extremities to only three. The spine slightly tilts to the side, she stretches and turns to release the needed space for the arm. If the extension of the arm towards the object were not sufficient, the child would pull herself towards the table and lean back on her feet. The child would also use the hand that she originally meant to extend to pull itself upwards and lean on her feet. Only when her body is surely standing on both feet and leaning on the arm, the child extends the arm again towards the object on the table. If the child was close enough to its goal, it would grasp the object. The sequence of movement described in this example becomes a targeted global pattern, within which the arms, the legs and the spine cooperate together in agreement.

The basis for further development

The approach to the whole body helps the child to gain basic experience. Only when she acts by itself and copes with her own body this way may her experience and perception widen. The child has to grasp to understand. She has to hear to comprehend. She has to test the objects with mouth and tongue to find verbal expressions. When the child in the 8th to 9th month of age throws away a toy repeatedly to pick it up again and throw away again, we have to step back and appreciate this activity. This experience is possible due to different movement patterns. Initially, the child has no idea how far her surroundings can reach, how it tastes or what is behind the space it sees. She does not know how herself little feet taste and how painful it is to hurt herself.





Results of the therapy after three and a half year

Initially, the gait is unknown, just like hopping or crawling. The ability to do such things is partially innate. Adoption of these abilities through learning the other skills that are being substituted by these abilities happens extremely intensively in the first year of life. The development of the motor skills proves that the child is curious and wants to explore and change her environment. This is the only way for the motor skills to become inventive within all their achievable diversity. This is how their intellectual potential shows up. Mentally challenged children usually exhibit impairment and reduced creativity in their motor development.

The interdependence of autonomic posture and targeted movement

The autonomic regulation of the body's posture is a basic element for the child and for the adult as well. Due to it, we can move in Earth's gravitational pull. The posture provides support during motion. Without posture, no purposeful movement can happen, not even a tiny one. It has to cope with the gravitational force. This requires permanent adjustment of the autonomic regulation, so that the body could permanently maintain the balance and muscle coordination.

For example, when a person extends his or her arm to reach for a cup and brings it to his or her mouth, the posture of the body is responsible for the continuous movement of the arm away from the torso, intentionally guiding the cup. The moving musculature of the arm must engage both the gripping parts and the moving parts. Only then can the undisturbed continuous movement be accomplished, as it reaches the cup and guides it further toward the mouth. If the moving parts of the musculature were not tuned adequately, the movement might be undone by, e.g. unmetered movement. The famous neurologist R. Magnus put it aptly when he said, "Every movement begins and ends with a posture. Posture follows the movement like a shadow." In the case of an arm that wants to hold out the cup the posture begins in the torso and with the support of the lower extremities, which have to maintain resistance directed against gravity and allow passage of the arm away from the body. Furthermore, the musculature of the arm carries the arm against the gravity and moves towards the cup concurrently. This movement of the arm is secured, e.g. while sitting, by the pelvis, legs and feet.

Security within the posture

If we watch an infant during her first 6 months of life, we would see that the security within the posture outweighs the movement. The infant shows it in the supine position and also on the belly. If the child grasped a toy, e.g. in the 5th month of age and put it in her mouth, the movement of the arms and legs would seem to be suppressed, depending on the regulation of the posture. However, the arms and legs cannot be intentionally raised above the mat, without the posture of the torso that leans on the back.

Later, in the upright positions, the principle seems to be even more obvious to the observer. When the child is crawling or walking, we first see the movement of the arms and legs, which carry the body forward. We might think that posture lost its importance. The opposite is true. The body requires a dynamically adjusted posture of the torso and the extremities to move this way. The more the body is upright, the less it uses the weight-bearing surface, and the maintenance of balance gets more difficult. The posture has to be regulated even more finely compared to lower positions on the back or on the belly so that it would not stagger or fall and could move intentionally.

To overcome the pull of gravity is a fundamental and permanent task. The centre of gravity is being transferred with every movement and balance has to be set anew. The movement requires permanent regulation of support, as the firm support allows the movement towards, or away from, the target. That is why regulation of the body is required to develop adequate posture and enable the movement. It can be seen in new-borns, whose posture is not adequately regulated and cannot provide the support. Gravity pulls them to the mat and they cannot use it as a weight-bearing surface. During the next stage of development, e.g. the back takes over the function of the weight-bearing surface.

If the infant has learnt to turn, the shoulder and hip joints and also the whole side of the body, over which the child rotates, will become the weight-bearing surface on the side position, for example.

If the child develops an independent gait, the centre of gravity is set against the small weight-bearing surfaces on the soles.

Sports such as figure skating and gymnastics, which are admired because of the performances of jumps and pirouettes, place high demands on coordination and are possible due to the exceptionally powerful regulation of the body's posture. Ensuring this prerequisite allows these athletes to execute stunning physical creations, but the foundation often goes unnoticed. To accomplish a jump on ice successfully requires support on the tiniest surface under difficult circumstances since the ice acts as a smooth plane, which offers minimal friction even for normal walking. Moreover, the sole of the skater is not resting on the ice directly because he is standing on a sharp skate blade. This requires the finest, absolutely flawless utilization of the coordinated posture of the musculature to provide balance in such a labile occasion because only then might the jump be performed. For an uninformed observer, it is hard to see the background of regulation of the posture of the body and the necessary muscular functions.

On the other hand, the observer will find the movements of an individual, who deviates from the common ideal of normal motion and whose autonomic regulation of the body's posture does not work properly, especially conspicuous. This makes certain forms of cerebral kinetic disorder, like spasticity or dystonia, so visible. Spasticity exhibits a cramped and stiff posture that inhibits continuous movements. Dystonia is the opposite; it lacks the posture that secures and guides motion. This is evident in the shooting, exaggerated and spasmodic movements of a sufferer.

The ability to regulate posture connects both examples. In the aforementioned kinetic disorders, the deficiency in posture management is manifested through significantly deviant motion. Thus, the quality of motion is based on the corresponding ability of autonomic regulation of posture.

The role of most muscles is not derived from their anatomical description, but from their function, which has been centrally assigned within the autonomic regulation of posture, righting and balancing reflexes and basic stereotypical movements (gait, grip, respiration, etc.)

Concurrently, the muscle roles vary depending on the changes of physical positions and movements performed. The same muscle can provide the postural balance of the body (e.g. when leaning and righting) and in the next moment, its role changes to active movement within the gait mechanism. This functional variability is a necessary precondition for the functionality of the musculoskeletal apparatus as a whole. It is hard to imagine the luxury of having a body that has the muscles intended for gait and balance maintenance separated from each other. The single muscular functional purpose is evolved only in highly specialized muscles, i.e. the muscles of the larynx, swallowing muscles or facial muscles.

Those muscular groups are rather small and energetically economic. They occur to a greater extent only in humans.

A more detailed analysis of the musculoskeletal apparatus shows that both sides of the body perform the righting, leaning, weight-bearing and kinetic roles in functional steps that follow each other. This is caused by both sides of the body complementing each other in purposeful movement, righting and gait through central coordination.

Permanent transfer of the centre of gravity is provided by the exchange of weight-bearing and movement elements. Permanent regulation of balance is connected with this exchange. It can be noted that performing the above mentioned movements is nothing special. The individual with the normal sequence of posture and movement does not think at all about all the preconditions that must be accomplished to perform such movement. Nevertheless, this sequence may represent insurmountable obstacles for the individual with impaired utilization of kinetic patterns (i.e. an individual suffering from kinetic disorder). Continuous changing of the body's positions is normal in healthy individuals and usually causes no problems. However it requires permanent adjustment of the autonomic regulation of the posture that takes place in the CNS through basic operational system of motor skills.

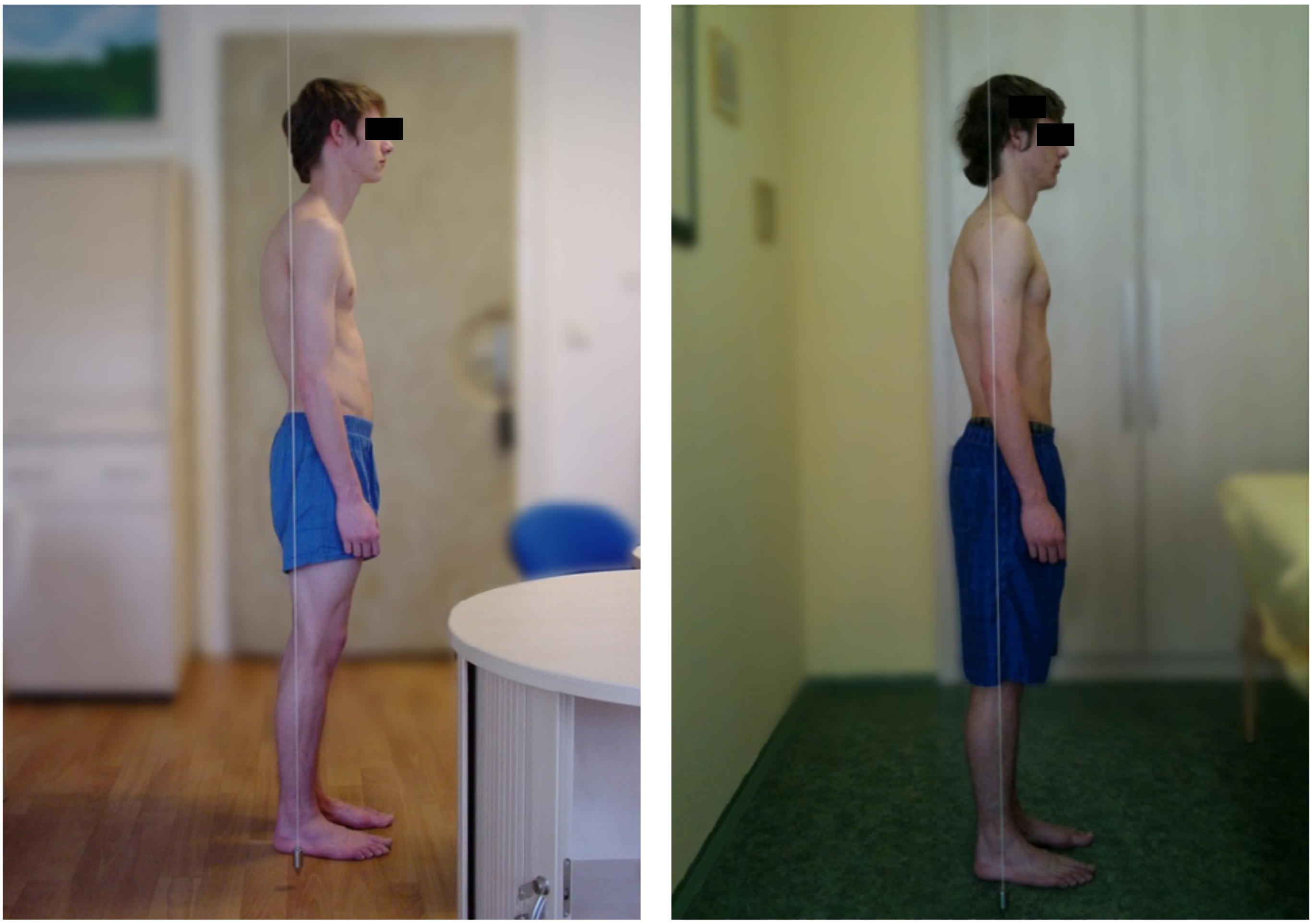
Habitual processes and the central nervous system's plasticity

To apply the Vojta method in children within the 1st year of life with a kinetic disorder of differing aetiology requires the competent therapist to know these kinetic developmental patterns.

Their knowledge is essential for the assessment of initial values of the two types of evaluation of the autonomic regulation of posture, righting and postural reflexes as well as the phasic motion of the examined child, namely the quantitative (i.e. What does the child do?) and qualitative (i.e. How does the child do it?) evaluation.

Neurons in the CNS, all of which are connected via synapses, possess many habituation mechanisms within information processing. Adaptive processes that pass through certain changes in the presynaptic and postsynaptic region (i.e. before and beyond the synapsis) up to improvement, i.e. an increase in synaptic efficiency, are usually called primary activation. There is a type of memory at the unconscious level, which affects and orientates the individual. This specific phenomenon is the repeated stimulation of certain neural tracts, which strengthens the level of effect of the stimulation of the same strength or enables stimulation of the neural tracts with the weaker stimulus as well. This phenomenon describes the mechanisms, by which the synapses increase the efficacy of the transfer relations through more frequent specific activation. This condition may last for minutes, hours or several days depending on the sort of special habituation processes of facilitation reactions that created this condition.

Creation of new synaptic bridges or reactivation of inactive synapses constitutes other possibilities of habituation. The findings from in vitro experiments in neurons of rats have proved that the facilitation of the neuronal synaptic activity is significant for



Result of the therapy after one year

the formation of new connections between neurons. It can be assumed that the state of the synapses, their strength, density and activity significantly depend on the mode and the number of afferent patterns of irritation. If the adequate stimuli do not arrive, the synaptic connections will decrease and the respective circuits will cease.

To achieve the required CNS activity and utilize the developmental area (CNS plasticity), it is necessary to repeat the activation of the neuronal network that will subsequently respond to the habituation process in the best (i.e most personalized) way possible. The information contained within repetitive stimuli coming to the CNS is probably not identical during their processing, but they are similar. Formation of optimal movement as a response to a stimulus requires processing within the same kinetic patterns based on the innate and activated program.

Integration of different sensory impressions shows another dimension of the complex network of the CNS. The individual sensory organs are needed for specific stimuli. Vision requires light stimuli. Hearing requires sonic stimuli. Smell requires aromatic stimuli. Touch requires pressure stimuli. Specific stimuli are received by the receptor of the respective sensory organ, and they are transmitted to the CNS. It is not only the respective cellular bundles of the corresponding CNS regions, which are active. Cellular bundles from adjacent regions also participate on the classification and processing of the sensory impressions, for example stimulation with light and associated regulation of oculomotor muscles and eventually the posture of the body. The network does not contain only motor areas and their cellular bundles because the ocular fixation is possible through the coordinated activity of the oculomotor muscles and the corresponding posture of the head and body.

These complex processes can also be noticed during therapy – activation of the motor patterns of the torso not only influences and changes (remaining with the example of eyes) the ability of adequate coordination of the oculomotor muscles (different types of strabismus can be generated with incorrect coordination), but it also normalizes accommodation of the eyes. This happens again due to the normalization of the muscle coordination of the ciliary muscles of the lens.

Clinical practice has showed that the body has to be placed into a predefined position to start the repair program. Subsequently, any of the several “trigger reflex zones” of the body has to be stimulated.

This evokes reflexive, i.e. involuntary, movement. We can distinguish two types of these movements – reflexive belly-crawling and reflexive turning, which have branched out into several modifications over time. The utilization of the technique of reflexive belly-crawling is just in its early days. It is an isometric movement, as though a real movement has been “frozen” in a certain phase. Far higher efficiency could be achieved this way thanks to temporal and spatial summation of the stimuli that return back to the brain.

Stimulation of neuronal structures of the CNS is also achieved from the defined starting positions through stimulation of so called trigger zones. There are many trigger zones and trigger points in the body. Predominantly, they stimulate the tensile receptors in muscles and tendons, pressure receptors in the skin and periosteum and the receptors of internal organs (interoreceptors). Balance receptors (the membranous labyrinth) and balance and righting reflexes belong among the other receptors that participate on the start of the repair program.

CNS plasticity

It seems probable that gradual involutional changes in the body result from the interplay of decreasing efficiency of the “hardware” of the musculoskeletal apparatus and “software” processes in the CNS. The degree of gradual deterioration is proportional to the necessary mutual adjustment of both parts – i.e. the hardware to the software and the software to the hardware.

Changes in the autonomic regulation of the posture of the body and the stereotypical movements are not just the result of changes of the musculoskeletal apparatus. Changes in other tissues and biological systems are involved as well. These include changes in elasticity of bone tissue, decrease of the tone of the smooth muscles of the digestive apparatus, limitation of the ability to ventilate the apices of pulmonary lobes and common decrease of vital lung capacity, among others. The aging body as a whole cannot be "forced" to change through exercise in an analytical manner (strengthening, stretching) because these voluntary interventions do not take into account the aforementioned aspects. If the head was pushed from an excessively forward position back to its physiological position by voluntary exercise, it would cause unpleasant sensations in swallowing and phonation. This is caused by the fact that those autonomic structures are not subjected to our voluntary effort. Thus, it is practically impossible to change their posture and tone.

On the other hand, the plasticity of the CNS is able to perform adjustments to a newly generated posture of the musculoskeletal apparatus. This applies to both musculoskeletal and internal organ systems or their tone and function, assuming that it would happen with the help of reflexive locomotion unconsciously in accordance with the genetically predefined program.

Figuratively speaking, the above mentioned possibilities of stimulation and positioning constitute the system of keys and locks to kinetic programs.

The quality and intensity of activated kinetic program patterns of locomotion directly corresponds to the level of reliability, availability and stability of the newly generated circuit connection and the density of the neuronal network of the CNS. Thus, it is necessary to repeat the doses of the therapy daily. Due to repeated stimulation, the autonomic posture of the body and the righting and balance reflexes normalize. This also enables and stabilizes the involvement of the spontaneous motor skills.

The significant effect of stimulation is also manifested in the normalization of perception of the body scheme. In children with central motor disorder, who cannot undergo normal development of the musculoskeletal apparatus, the sensorimotor perception of the body is significantly impaired and inhibited. To a certain extent, the body scheme is also disrupted in adults with a different aetiology of motor disorder. For example, it is manifested in the disorder of autonomic regulation of the posture of the body or in disturbed stereotypical gait. Reflexive locomotion also enables the normalization of the ability of differentiated awareness of the body, which helps both children and adult patients to create a foundation for learning new functions or enables the start of new application programs. Newly acquired confidence in one's body cannot be underestimated as it develops during the therapy.

Utilization of the plasticity of the neuronal network and its ability to grow is also important because, fundamentally, the respective functional loss should

The illustration of the immediate influence of the reflexive stimulation on the normalization of the autonomic regulation of the posture of the lower extremities.

not be assumed by the extent of anatomical damage to the CNS. It is known that in severe anatomical damage, only small functional deficiencies may occur. On the other hand, small anatomical defects are often connected with great functional loss. The extent of the anatomical defect does not provide any reliable information on the relevant unused developmental possibilities within the CNS, consequently posing challenges for rehabilitative therapy.

The CNS is extensively stimulated during therapy. The stimulation can be intensified by modifying the starting positions and by combining the trigger zones with varying trigger pressure. The CNS also has to readjust to new requirements after each practice of reflective locomotion, even if only by changing the posture of the body. CNS activity significantly increases this way.

Exploring the plasticity with the help of reflexive locomotion within the phase of the body during repair attempts shows particular promise. In this phase, CNS tries to organize and substitute the damaged tissues with its new structuring.

This phase of new structuring is particularly important in children as it inhibits the faulty regulation of motor skills as much as possible and prevents its derailment. This is because the incorrect substitutional kinetic patterns have not been fully “loaded”. The CNS offers “a patch” (repair) on the basic operational program through the reflexive locomotion and its kinetic patterns.

For example, there are great opportunities in early treatment of the central coordination disorder, particularly within the first months after birth.

There is this case of a child with perinatal traumatic brachial plexus palsy. Why is the early onset of the treatment so important? From the beginning, the child is aware of her body and needs both sides of it. Due to brachial plexus palsy, the affected arm is restricted for long periods or it is incapable of spontaneous movement.

Demonstrations of classical stimuli of reflexive locomotion

Reflexive turning 1

Reflexive turning 2

Reflexive belly-crawling

Variation of the reflexive belly-crawling

Variation of the reflexive belly-crawling

If the therapy did not start within 10 days, the restricted motion possibilities would consolidate. The child does not perceive its arm or it is only partly aware of it. Thus, it does not turn to that side. Defective sensorimotor sensation is not the only consequence. There is also a physical asymmetry that may lead to further worsening of the subsequent damages.

A defective optic nerve, which has not been continuously activated, is restricted to only limited myelination. This also applies to the disorders of peripheral nerves.

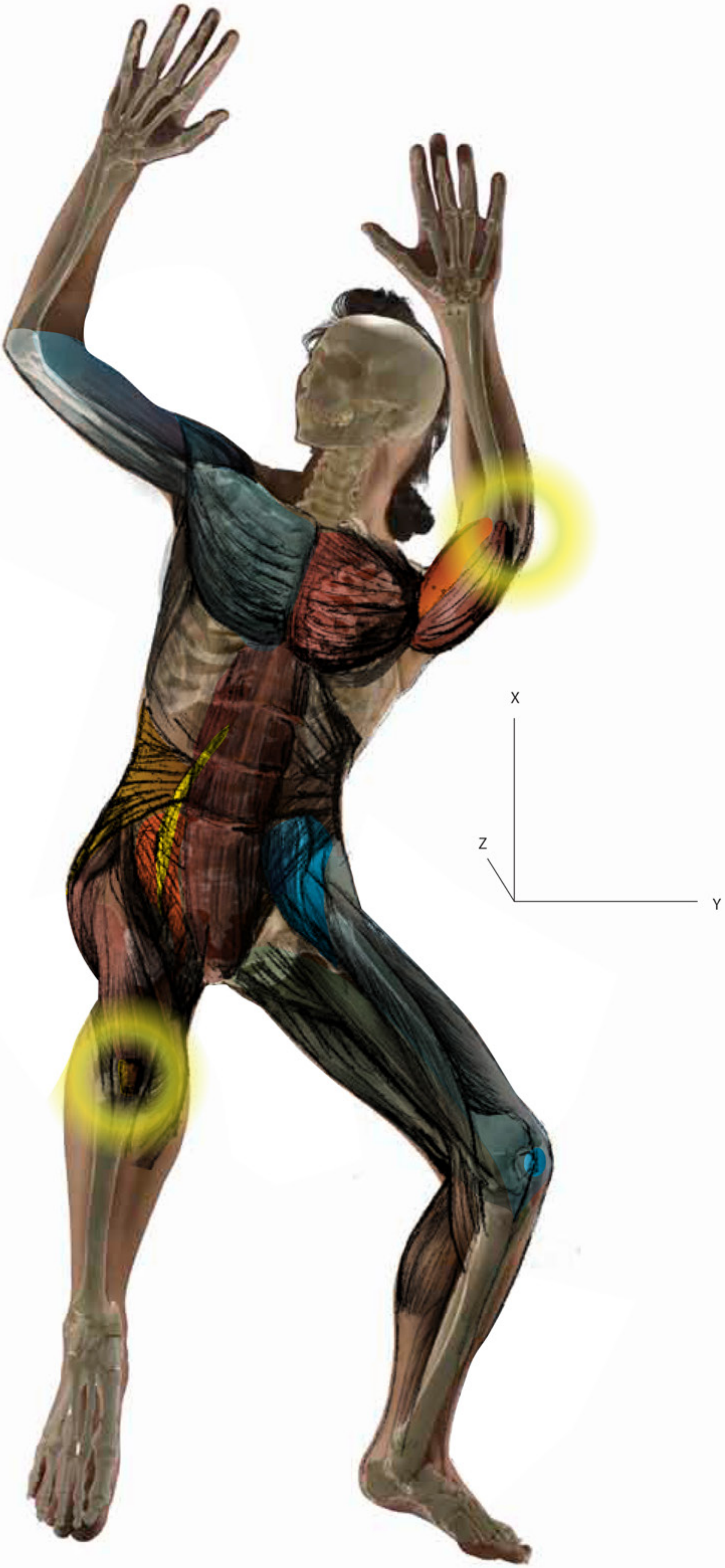
Programs of reflexive locomotion – the Vojta method

Body scheme perception

So far, most agree that the perception of the body scheme is a matter of continuous learning. The ideal of one's body should be based on experience with the body and the perception within. This should lead to storing the sensorimotor information at different levels of the CNS, e.g. to the dedicated cerebral cortex areas. The possibility to be aware of one's body and its position within the environment is facilitated this way.

To reach the normal and maximal possible sensorimotor development of the child, it is necessary for the arrangement within the CNS to create one single integrated self-image. The question is whether the information that forms this body scheme is created by external and intrinsic stimuli in the form of incremental learning.

I think that it is only the gradual "unzipping and saving" of the innate programs of sensorimotor creation of the body scheme. Or, the program for sensorimotor perception is a part of the basic operational program for motor skills. It is a part that provides feedback for regulation of the musculoskeletal apparatus. Feedback is a component of every regulation. Thus, the regulation of motor skills also depends on the permanent correction of movement deviations. We certainly cannot talk about a learning process, which is not a suitable instrument for the complex and mostly automated motor skills. As the other even more primitive regulatory programs contain a feedback component of regulation, the extremely complicated programs of the musculoskeletal apparatus possess the biofeedback component as well, i.e. the sensorimotor skills. Subsequently, the ability to perceive the body scheme is proof of properly activated and operated sensory function. We can talk about this truly conscious perception only in children, whose mental level of individualization and separation has begun to mature. (Refer to Piaget – The Development of Mental Functions in Children.) The generation of the body scheme is significantly delayed in children, who have not undergone physiological (normal) development of the musculoskeletal apparatus. It is impaired in proportion to the damage of the regulation of motion.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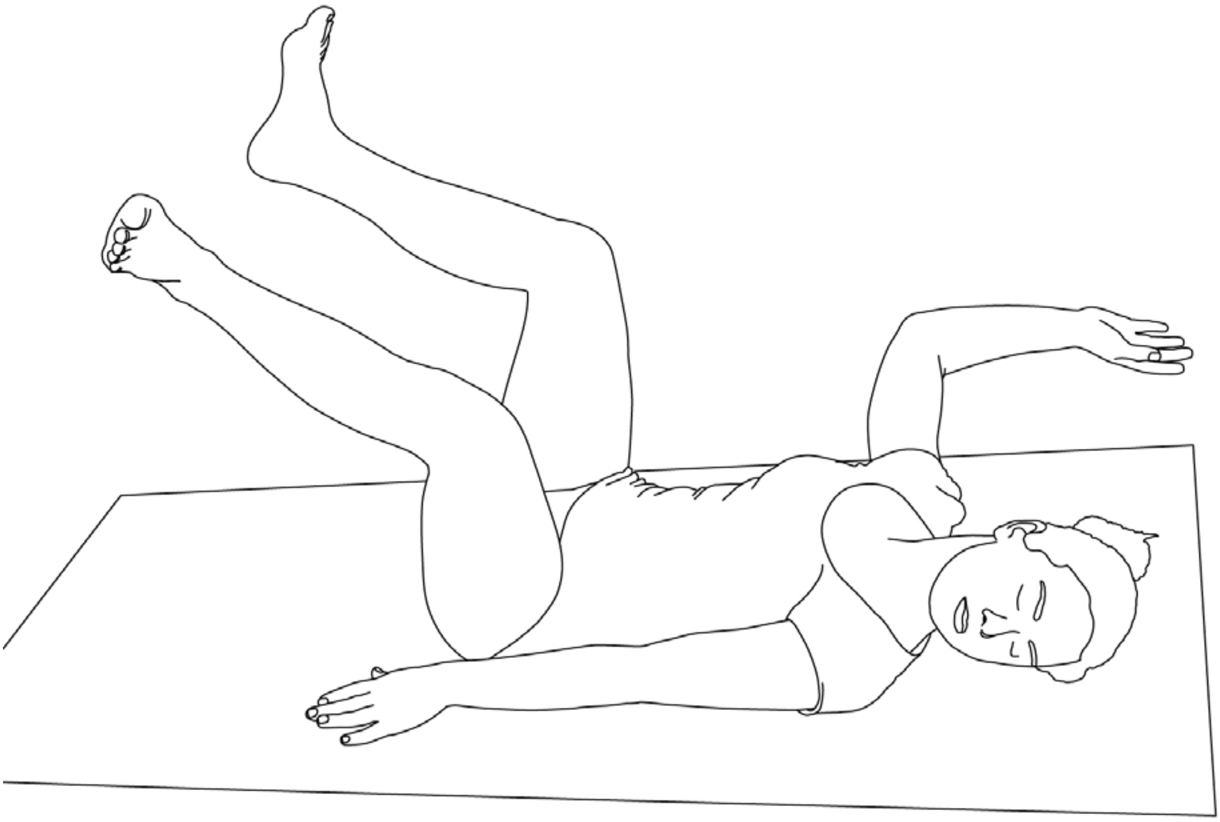
The Function Is Developed By Its Organ



The Vojta Method – An Overview

Basic Prerequisites for Implementation of the Method

- Basic knowledge of developmental kinesiology
  - Physiological
  - And pathological
- Basic positions of reflexive stimulation
  - Reflexive turning 1
  - Reflexive turning 2
  - Reflexive belly-crawling
  - Reflexive crawling on all fours
- Movement coordination enabling the transition from one position of the body to another
- Basic straightening reflexes
- System of stimulation zones and their utilization
- Combinations of stimulation zones (spatial summation)
- System of induced directions of movement of the extremities and torso (temporal summation)

Possibilities for extension of VM

- System of inhibition of induced movements
  - Counter-movement with rubber straps
  - Restraints
- Stimulation by balance technique, Aktiva Disc, inflatable balls
- Stimulation by changing the position of the body by tilting the bed, along the longitudinal and transversal axis
- Stimulation by shifting the centre of gravity of the extremities with weights
- Auxiliary techniques, support of the extremities, antalgic positions

Actual performance of the therapy

- Basic starting conditions and positions for induction of the reflexes
  - On the back – reflexive turning 1
  - On the side – reflexive turning 2
  - On the stomach – reflexive belly-crawling
  - On all fours – reflexive crawling on all fours
  - Basic stimulation of reflex zones, position and direction of the stimulation
  - Basic inhibition of the induced movement

Reflexive tuning on the tilted table, large pad on the Aktiva Disc which is also tilted.

Exercise on the tilted table, large pad, tilted transversally, tilted Aktiva Disc, children's weights on the lower legs.

- Extension positions and therapeutic accessories forcing the sequences of reflexes
  - Gradual multiple stimulation of reflexive zones
  - Partial labilization of pelvis by Aktiva Disc (wedging an Aktiva Disc under the pelvis)
  - Gradual longitudinal tilt of the bed, body lays on the adhesive mat (head goes higher than feet)
  - Complete labilization of pelvis by Activa Disc under the chest

- Tilting of the pelvic axis in the transversal direction with a wedge
  - Tilting of the axis of the body in transversal direction
  - Labilization of other weight-bearing points with inflatable balls
  - Inhibition of the direction of the movement with rubber straps
  - Inhibition of the direction of the movement of the extremities with restraints
  - Shift of the centre of gravity of the extremities with weights

- Support positions and the equipment for facilitation of reflex induction
  - Tilt of the bed in longitudinal axis, with head slightly down
  - Supporting the feet
  - Supporting the hands
  - Supporting the pelvis with solid wedge

- External conditions of stimulation
  - Quiet and peaceful environment that would not disturb the patient
  - Technical equipment, appropriate accessories
  - The ability to track the time of individual stimulation and the overall stimulation
  - Reflexive belly-crawling on a tilted surface, labile support of inflatable balls and an inflatable disc
  - Reflexive turning on a tilted table, large pad and Aktiva Disc that is also tilted

Reflexive turning 2 on the side, tilted surface, restraint with adhesive pads, inflatable ball. To increase the stimulation, vibrating exercise garment is used.

- Education of the patient
  - To bring the patient into a relaxed state
  - To explain to him/her that in a while, the reflex itself is going to “hold” his/her extremities in set positions against gravity
  - To explain that his/her perception of their body scheme is going to be “switched off” gradually, and he/she will stop to sensing where his limbs are located
  - To explain, that he/she will experience the gradual manifestations of “autonomic joint centration”, i.e. the shiver, tremor and involuntary movement of the extremities and pelvis
  - To explain to the children not to “play” with the ongoing reflex and interfere with it; distract them with singing, music, audio books, etc.
  - Encourage the patient to report any incipient discomfort (pain, tension in muscles, fatigue)

- Observing the induced reactions of the reflex in the patients
  - Autonomy of the posture of the extremities against gravity
  - Setting the angles of axes of the extremities and their changes
  - Intensity of the reflexive movements
  - The speed of the onset of fatigue
  - Whether the stimulation does not cause pathological substitute posture of the extremities
  - Duration of the uninterrupted stimulation, breaks, overall duration of the therapy

- Repeating the therapy in one day
  - In children preferably 2 to 3 times a day
  - In adults with respect to their possibilities at least once a day

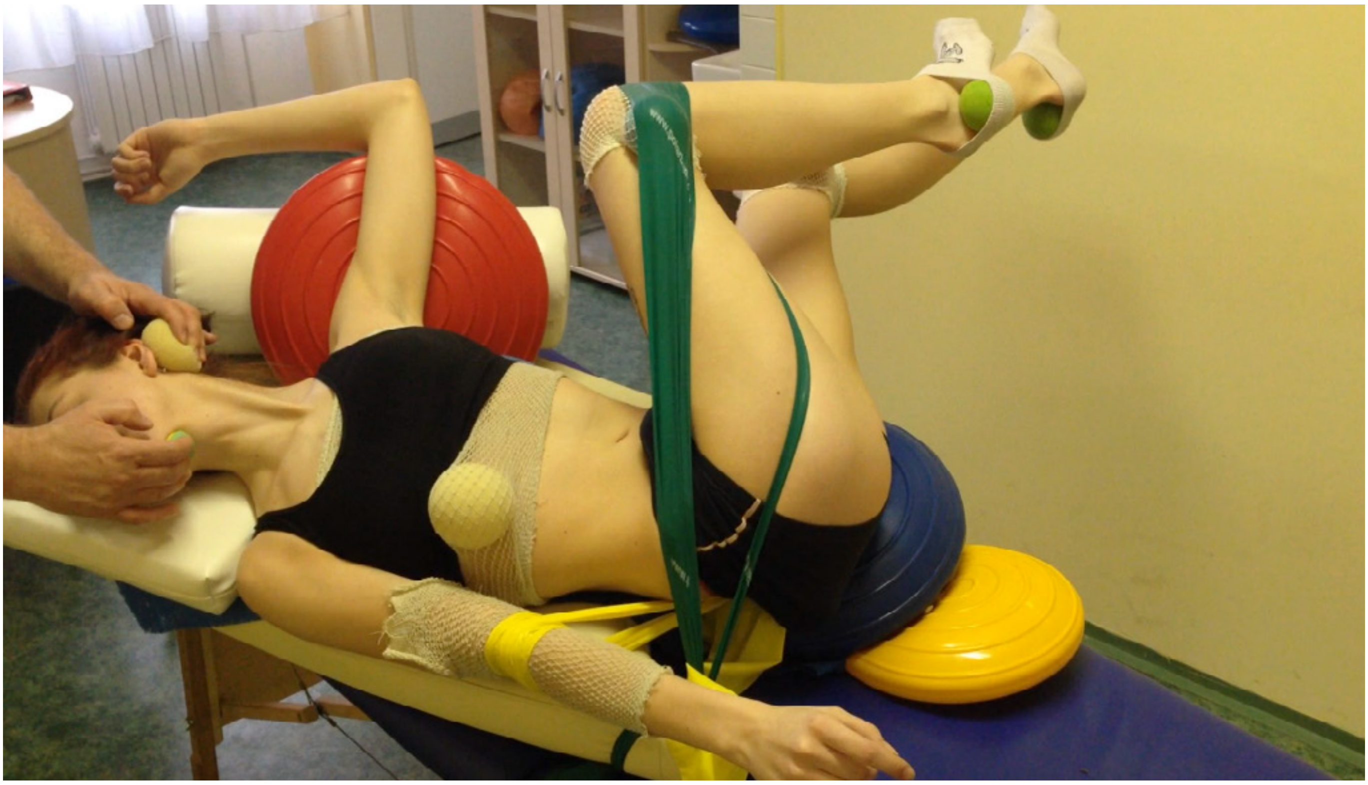


Illustration of very difficult position for reflexive turning on the tilted table, oblique large pads, labilization of points of support with Aktiva Discs, forcing the external resistance with rubber straps.

- Management of the therapy
  - According to actual intensity of the "system" (tremor, size of movements…)
  - According to the patient's individual response (speed of onset of fatigue, pain, discomfort)
  - According to changes in autonomy of body's posture
  - According to changes in autonomy of joint centration
  - According to changes in basic stereotypical movements
  - According to changes in "extension" programs of soft and gross motor skills
  - According to changes in regulation of superior nervous functions, improvement of phatic functions, abatement of dyspraxia, onset of fatigue, irritability

Reflexive response of "the system" of the patient

- The autonomic posture of the body and extremities against gravity with no voluntary effort
- Gradual "switching off" of perception of the body scheme up to the level preceding falling asleep, the feeling of loss of the body
- Autonomic joint centration manifested with tremor, shiver and movement automatisms, particularly in hands, feet, whole extremities and pelvis.
- Gradual prolonging of the time of the patient's tolerance of the stimulation without discomfort
- Increasing ability to tolerate the increase of load by multiple stimulation, balance discs, tilted and longitudinal

Exercise of pregnant women is beneficial for back pain and also as physiological preparation for labour

position of the bed, tension of rubber straps, weights on the extremities

- Involvement of all muscles of the body in specific “MODE” without fatigue during the performance of the therapy and afterwards
- There is no exhaustion within all stimulation zones; there is no adaptation to the stimulation
- The work of muscles reveals specific fatigue, usually localizes due to muscle incoordination, which subsides immediately after cessation of the stimulation

Results of the therapy occur at several levels

- Normalizing the autonomic posture of the body at all levels from toes to posture of the head
- Normalizing the setting of angles, axes and physiological extents in all joints of the body (influence of autonomic centration)
- Normalizing the muscle tone
- Normalizing the autonomic straightening reactions
- Normalizing the autonomic balance reactions
- Normalizing the autonomic regulation of joint centration in physical activity without a risk of recurrent decentrations, subluxations or blockage
- Normalizing the basic stereotypical movements (gait, grip, respiration, swallowing…)
- Normalizing the physical configuration of the body
- Posture of the arches of the feet, posture of calcanei
- Axes of the lower extremities, particularly the posture of the knees and hip joints
- Posture of the pelvis
- Posture of the axes of the spine in sagittal and frontal planes

Reflexive belly-crawling on a tilted surface, labile underlays with inflatable balls and inflatable disc

- Configuration of the ribcage
- Posture of the shoulder girdles, particularly of the scapulae
- Axes of the upper extremities, particularly of the hand
- Posture of the head
- Posture of mandible
- Position of the eyes
- The therapy has a demonstrable positive influence on superior neural functions, including the cognitive functions
- Normalizing the stereognosis
- Normalizing the disorders of fine motor skills, writing, painting, playing musical instruments
- Normalizing the reading, vocal presentation, singing
- Normalizing the manifestations of hyperactivity in children with ADHD
- Normalizing practical disorders

It appears out to me that pathological progression and most common manifestations of senile frailty could be hindered or prevented with the Vojta method. They include particularly the following:

- Tiredness during common daily activities
- Decreased mobility and restriction of physical activities
- Psychomotor slowing
- Deterioration of physical condition
- Loss of muscle mass and power
- Decreasing tolerance of physical exertion
- Instability with falls ensuing
- Uncoordinated movement
- Change in autonomic posture of the body, senile kyphosis of the spine and flexed posture of the extremities
- Sensory and especially sensorimotor deficits
- Chronic pain

Secondary positive influences on elderly

- Improvement in the venous return from the lower extremities (improvement of stereotypical gait, longer duration of walks, improvement of muscle tone, improved mechanics of diaphragm drawing the blood from lower extremities)
- Improvement in the respiratory mechanics and thus oxygen saturation (improved posture of the ribcage and the mechanics of the diaphragm)
- Improved ability to tolerate mental stress
- Reversal of appetite loss and hypobulia
- Reversal of weight loss and concurrent malnutrition
- Deceleration of memory disorders and cognitive deficits
- Decrease in mental apathy

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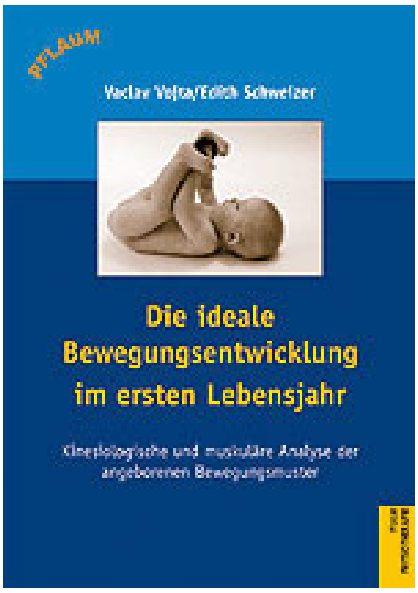

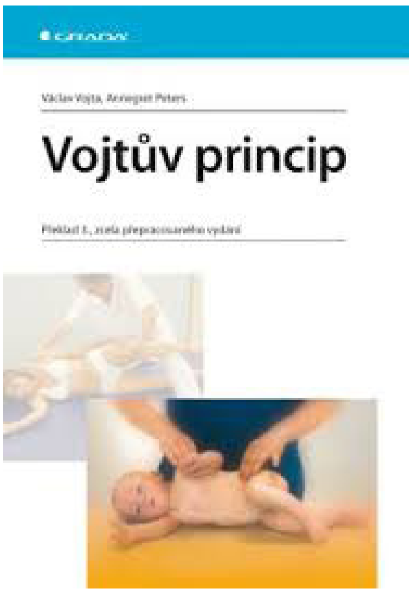

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