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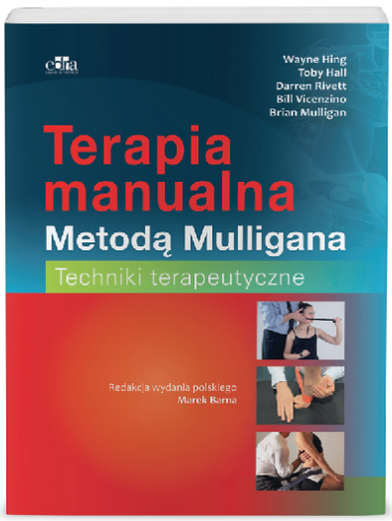

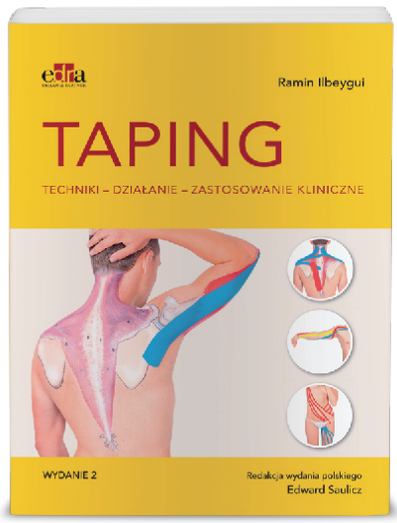

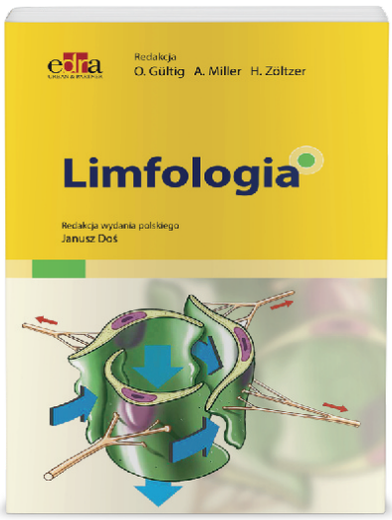

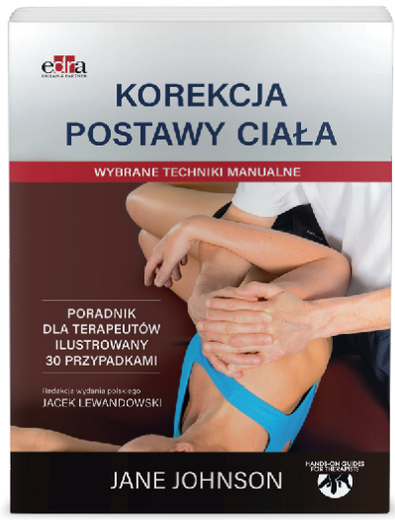

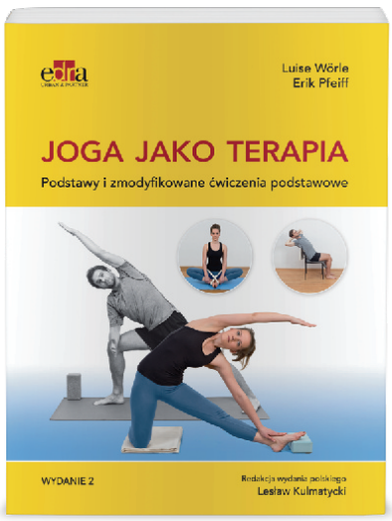

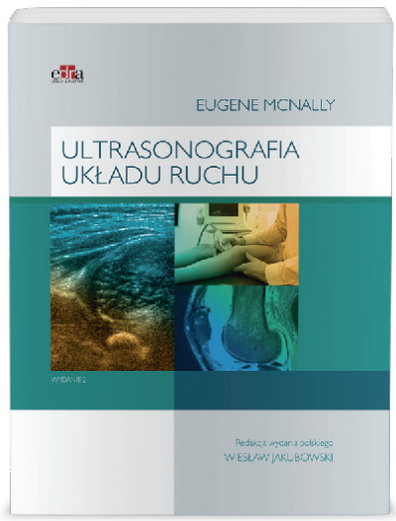

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Przykłady ćwiczeń funkcjonalnych zalecanych w profilaktyce zaburzeń posturalnych w płaszczyźnie strzałkowej u dzieci w wieku przedszkolnym i wczesnoszkolnym. Praca nad nawykami

Examples of functional exercises recommended in the prevention of prostural disorders in the sagittal plane in children of pre-school and early-school age. Work on habits

推荐用于学龄前儿童及学龄早期儿童的矢状面姿势障碍预防的机能性练习实例。习惯研究。

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Streszczenie

Niedoskonałość postawy obserwowana u dzieci wieku przedszkolnym i wczesnoszkolnym jest stanem fizjologicznym i wynika z braku umiejętności stabilizacji odcinka lędźwiowego oraz sąsiednich segmentów ciała, a także z niedoskonałego jeszcze na tym etapie rozwoju czucia głębokiego. W efekcie dzieci w tym wieku mają problemy z zachowaniem stabilnego układu ciała podczas pozostawania w bezruchu oraz w trakcie wykonywania różnych czynności, a dla zachowania zrównoważonego układu ciała często przyjmują charakterystyczną postawę – z miednicą pochyloną w przód i barkami wysuniętymi do przodu. By stan ten z czasem nie przerodził się w nawyk nieprawidłowej postawy, należy zadbać o jak najwcześniejsze wyeliminowanie niekorzystnych sytuacji posturalnych, czemu służą proponowane w opracowaniu ćwiczenia funkcjonalne.

Słowa kluczowe:

niedoskonałość postawy, dysbalans mięśniowy, stabilizacja przestrzenna miednicy, pozycja aktywna, ćwiczenia funkcjonalne

Abstract

The imperfection of posture observed in children of pre-school and early-school age is a physiological condition and results from the lack of ability to stabilize the lumbar spine and adjacent body segments, as well as the imperfect deep feeling at this stage of development. As a result, children of this age have problems with maintaining a stable body system while remaining still and during various activities. To keep the body balanced, they often take a characteristic posture – with both the pelvis and shoulders inclined forward. In order for this condition to not change into the habit of an incorrect posture, it is necessary to ensure that adverse postural situations are eliminated as early as possible, which is supported by the functional exercises proposed in the study.

Key words:

imperfection of body posture, muscular dysbalance, spacial pelvis stabilization, active body position, functional exercises

摘要

在学龄前儿童及学龄早期儿童中所观察到的姿势不良是一种生理状态，为腰椎及临近的身体部分缺乏稳定性所造成，也是在此发育阶段感觉纤维还不完善的结果，使此年纪的儿童在不动或进行各种活动时不容易保持身体的稳定，他们通常会采用特殊姿势以维持身体平衡，也就是将骨盆前倾和肩膀向前伸。应当尽早消除姿势不良的状况，通过所建议的机能性练习使该状况不致演变成惯性姿势不良。

关键词：

姿势不良、肌肉失衡、骨盆的空间稳定、活动位置、机能性练习

Introduction

The human body is one functional whole. This dependence translates into mutual connections between static and dynamic systems, which is reflected in the adoption and maintenance of various positions, remaining in them and performing different movements. Therefore, for a smooth human functioning, a specific compromise between stability and mobility is needed. It is ensured by proper skeleton construction and proper alignment of adjacent anatomical elements that help counteract different forces and efficient mechanisms keeping the whole body in balance. In short, balancing the body in the frontal plane is determined by the symmetrical arrangement of individual body segments, eliminating automatically the necessity of engaging additional forces ensuring the alignment of this system. In the sagittal plane, however, such a favorable situation occurs only in normal conditions – thanks to the fact that the projections of forces associated with gravity run quite close to the axis of rotation of large joints, which in turn makes them balanced by relatively small forces of antigravity muscles. The situation becomes unfavorable when the system changes – e.g. increasing one of the curvatures of the spine – excessive kyphotic or lordotic position. Moreover, it must be remembered that the human body is not a rigid mass, and the positions during various activities accompanied by movements of the trunk and / or limbs cause the center of gravity of the body moving constantly, which necessitates constant balancing of the body system [1].

The spatial position of the pelvis is very important for statics. Because the sacrum bone together with both ilium bones move together as one unit of movement, the spatial position of the pelvis significantly influences the shape of the spine (the so-called pelvic-lumbar rhythm). An important element determining the quality of posture in the sagittal plane are also the physiological spine curvature ensuring its proper balance. They determine the proper placement of body mass, and the displacement of any segment (forward or backward) entails a specific chain reaction, causing compensatory displacement of neighboring sections in opposite directions [1, 2].

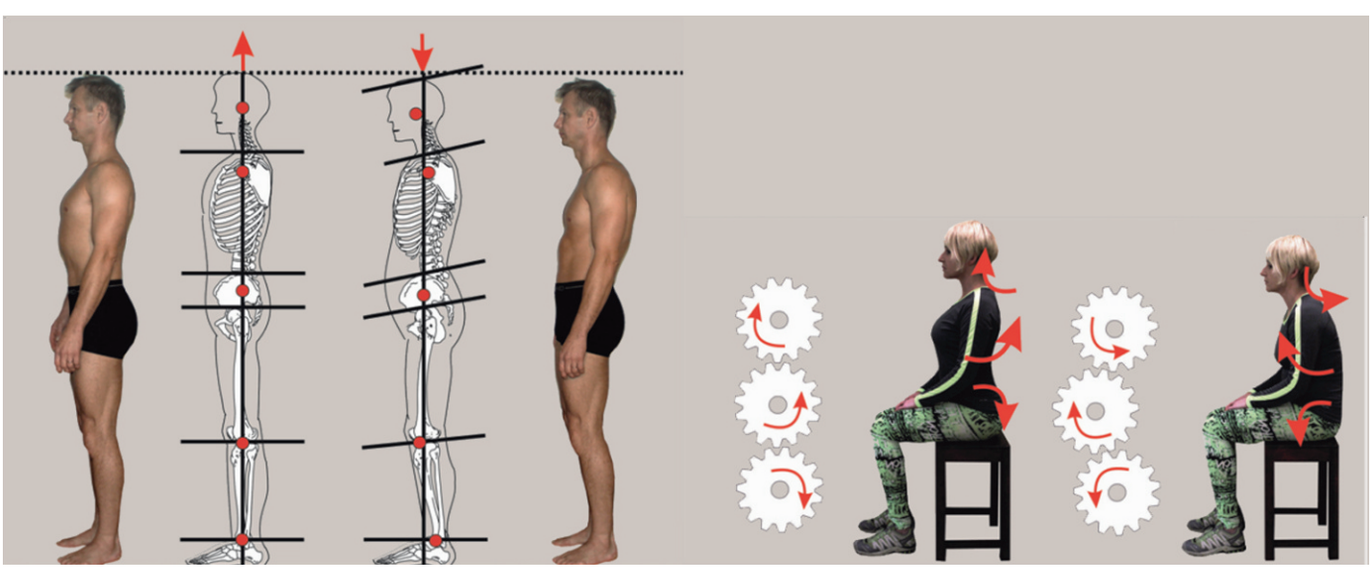

Fig. 1. Changes in the spine curvature vs. the quality of posture

In order to adopt and maintain any position higher than flat lying, it is necessary to have efficient, coordinated activity of all antigravity muscles (conditioned by the nervous system controlling their work) and proper bone and joint system structure. It ensures appropriate conditions for muscle activity, mainly through the placement of insertions, the course of the muscles and their tendons, the length of the lever, bone and ligament stabilization, etc. It is also known that the muscles do not work selectively, but the activity of one involves the activity of the other, which in turn results from the construction of the so-called myofascial system [1].

And finally, the functioning of a person should also be seen through the prism of working in a specific kinematic chain. The kinematic chain involved in opposing the power of gravity and maintaining balance in the statics is a system with a large number of degrees of freedom. It consists of the following joints: the feet (metatarsus and tarsus), ankles, knees, hip and sacroiliacs, and 23 pairs of joints between vertebrae and 23 connections between vertebrae and discs, as well as 2 joints connecting the head with the spine. All this means that displacements even within a small range require balancing, and in the absence of opportunities/skills, they become the "perfect" ground for the development of irregularities [1].

In pre-school and early- school children, these mechanisms are just developing, so their postures are often imperfect at this stage of development. Therefore, this imperfection is in a sense a physiological state resulting from the characteristics for this period of muscular lack of balance, i.e. inappropriate cooperation of agonist muscles with antagonistic pelvic-lumbar regions. This causes an imbalance between the needs in this respect and the possibilities of a developing body, which results

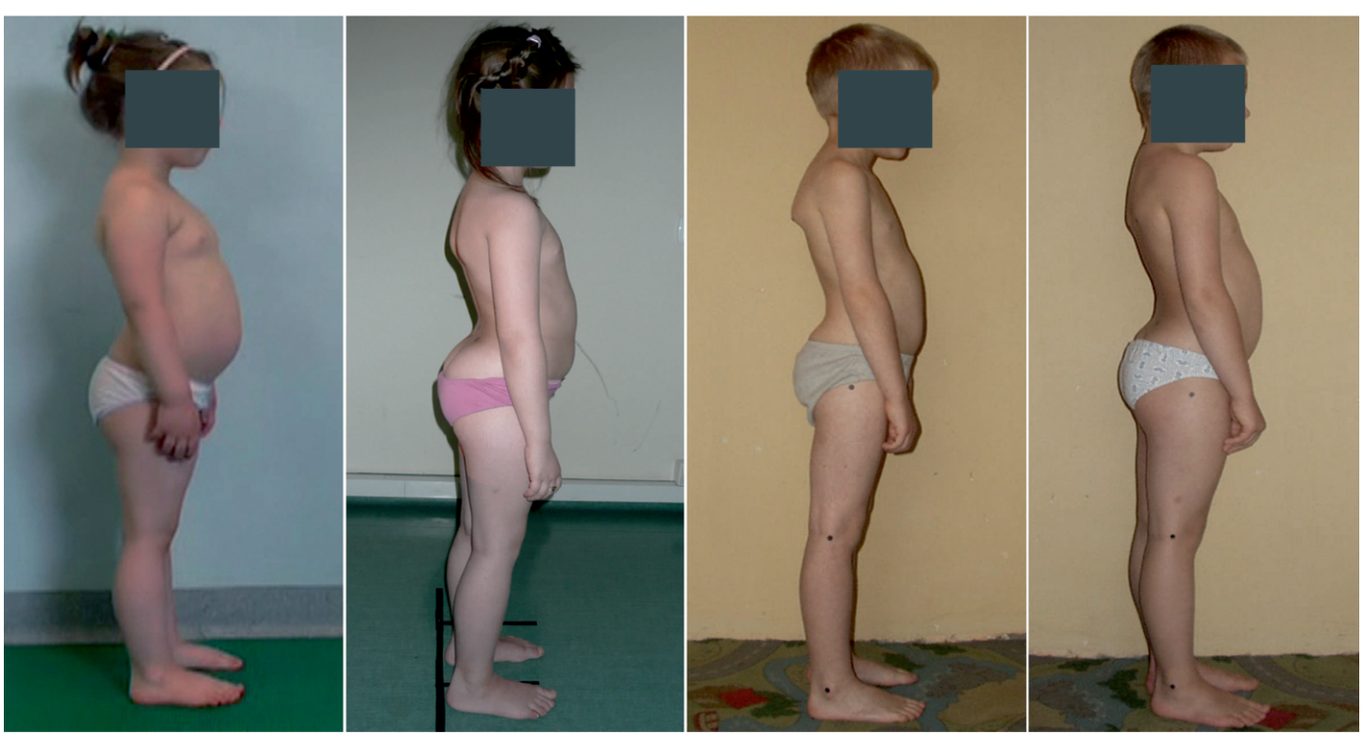

Fig. 2. Imperfection of the posture in the sagittal plane characteristic for children in pre-school and school age

in the lack of the ability to stabilize the lumbar region and neighboring segments of the body. Therefore, the static-dynamic conditions change, making it difficult to control the course of the center of gravity projection on the support plane. An additional problem is imperfect and still developing deep feeling, as evidenced by problems with maintaining the balance in both static positions (when the attention of the child is focused on performing an additional task) and during the performance of various motor activities. As a consequence, the child, wanting to maintain the most stable body system, often adopts a characteristic posture - with the pelvis and shoulders inclined forward, which together results in round or round-concave backs [3-10]. In order to prevent this incorrect posture from becoming a habit, which is known to be possible due to second-order stereotypes, special care should be taken as early as possible [1].

Aim

The aim of the work is to present exemplary functional exercises intended to improve the stabilization of the pelvic-lumbar region and proprioception in pre-school and early-school children.

Prophylactic treatment in relation to postural disorders with a functional basis in the sagittal plane in pre-school and early school children

Treatment is based on the elimination of unfavorable postural behaviors observed during spontaneous activities of a child, both in the home environment (during play, learning, hygiene and all other household activities) as well as outside of it (in kindergarten/school, during extra activities, in the cinema, during activities on the playground, etc.) [11]. This is mainly about avoiding being in kyphotic positions with the pelvis forward tilted. However, to achieve this goal, there is the need to actively stabilize the lumbar spine in the optimal position - by activating and maintaining the tension of the deep abdominal muscles.

For pre-school children this is not an easy task, hence learning (exercises) should be in the form of pleasant games and should be facilitated by the use of feedback. Both of these conditions are met in the preparatory exercise, or rather a fun play of "crushing" a paper ball or sponge placed under the lumbar spine. The child's task is to tighten the lower back to the ground, which is possible primarily through the tension of the abdominal transverse muscle, and with it the synergistic tension of the multiform muscles. This play can be named freely – it is important to create a kind of password in response to which the child will react accordingly.

An additional stimulation may be tapping, that is pressing the abdominal area with fingers, paying attention to the child how much they can stretch the abdominal muscles (hard stomach, concave navel). The paper ball / sponge can be replaced by any soft element susceptible to crushing. It can also be a string or rolled up towels, which the child will try to stop pressing the lumbar region to the ground while the therapist will try to pull them out.

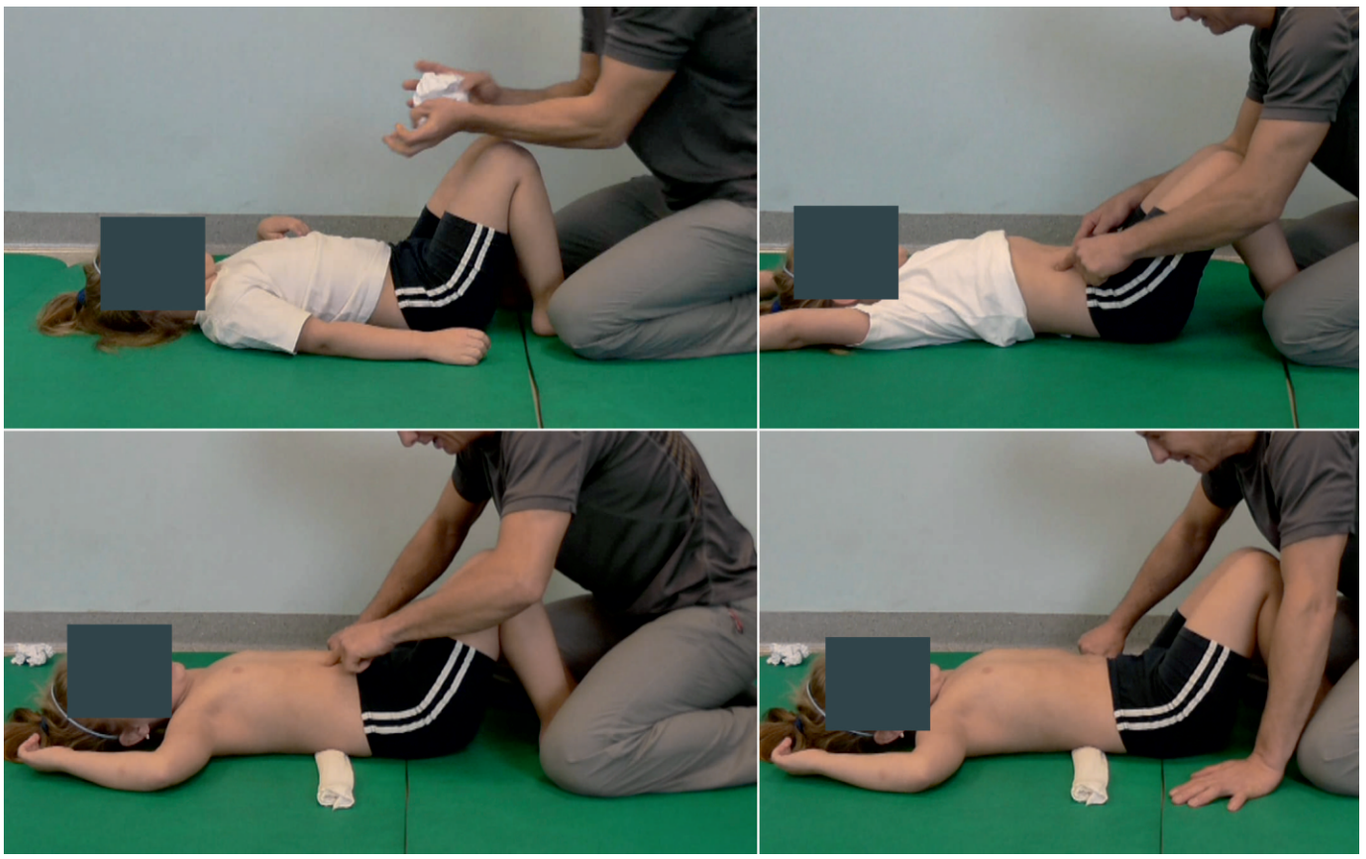

Fig. 3. Activation of the abdominal transverse muscle - exercise with feedback element

Increasing the difficulty of the exercise consists in introducing additional diversified activity of other muscles and performing tasks (exercises) in another biomechanical system (position) requiring greater control. Exercises can therefore be performed in the recumbent position with both lower extremities flexed (in the symmetrical flexor system of the hip joint, in the attachment position of the insertions) or with only one limb flexed (in the asymmetrical system) and – in the more difficult version – with alternating bending and straightening of the lower limbs or lifting and lowering (but only to the safe limit) of both lower limbs. The range of lowering movement should be determined by the therapist's hands, and conditioned by the child's training – that is, their real ability to maintain adequate control of the lumbar region (pressure to the ground). An important element to pay attention to is the need to coordinate the work of the deep muscles with normal breathing (with the work of the diaphragm). Therefore, the child should not hold their breath. To prevent this from happening, the children should be encouraged to converse or count during the exercise.

Regardless of whether these will be exercises controlled from the top (the movement is performed by the shoulder and the upper torso) or the bottom (the movement is performed by the lower limbs) in the first phase of the exercise (before any movement is performed) the lumbar section should be clearly pressed against the ground. Otherwise, especially in children with excessive lumbar lordosis, there may be an overload of this area and/or greater strengthening of the hip flexors (which are already much stronger in relation to the abdominal muscles).

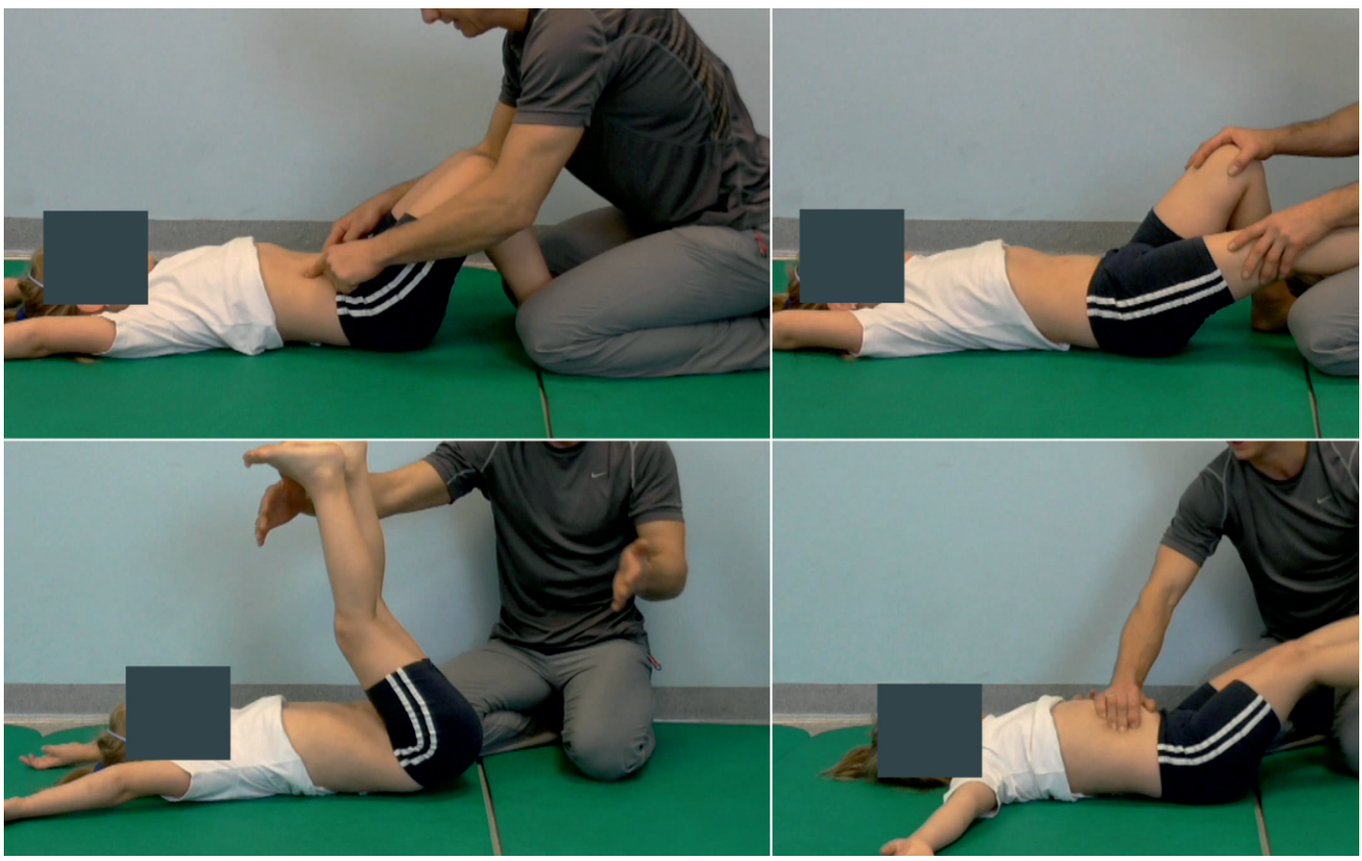

Fig. 4. Activation of the abdominal transverse muscle - grading the difficulty of exercising

More challenging than those described above are the exercises improving the stabilization of the pelvic-lumbar complex in the vertical arrangement of the spine. Initially, the exercises

Fig. 5. Improving the control of the lumbar spine during antigravity work in a sitting and standing position with the use of feedback

should be performed in a sitting position (with a stabilized pelvis) and backs resting against a wall (feedback). For example, a child can be instructed to press the lumbar section to the wall in this position, while performing symmetrical slow movements of the flexed, abducted and rotated out upper limbs along the wall. The next step is to include a spinal elongation test. In each of the described versions, the child may be able to control the activity of the abdominal transverse muscle by placing a crushing object under the lumbar section and/or checking the tension of the abdominal muscles through the touch of the therapist. Yet another variant of the exercise described above is to perform it in a standing position, back against the wall, and facing the mirror (double feedback). The introduction of visual control (the child sees their reflection) facilitates the correct performance of the exercise.

The next stage of improving antigravity activity in a standing position (and thus a greater difficulty of the exercise) is the ability to maintain an adjusted posture while improving co-contraction. The exercise consists in maintaining the optimal (corrected) body system in a free standing position (without backrest) during the impact on the child's body of multidirectional forces precipitating them out of balance. The exercise can be performed both under eye control and without (with eye lids closed).

It is important to note that the generated interference forces should not be too high during the exercise – the child should be able to maintain the corrected position without compensating movements with the upper limbs, and the feet should remain in the same position at all times. Co-contraction can be triggered within the trunk (at different levels – at the height of the lumbar, thoracic and shoulder sections) and the head and from different sides – by applying the hands alternately at the front, back and both sides. The most difficult version of this exercise is the introduction of an unstable ground (e.g. standing on a thick mat or sensory pads).

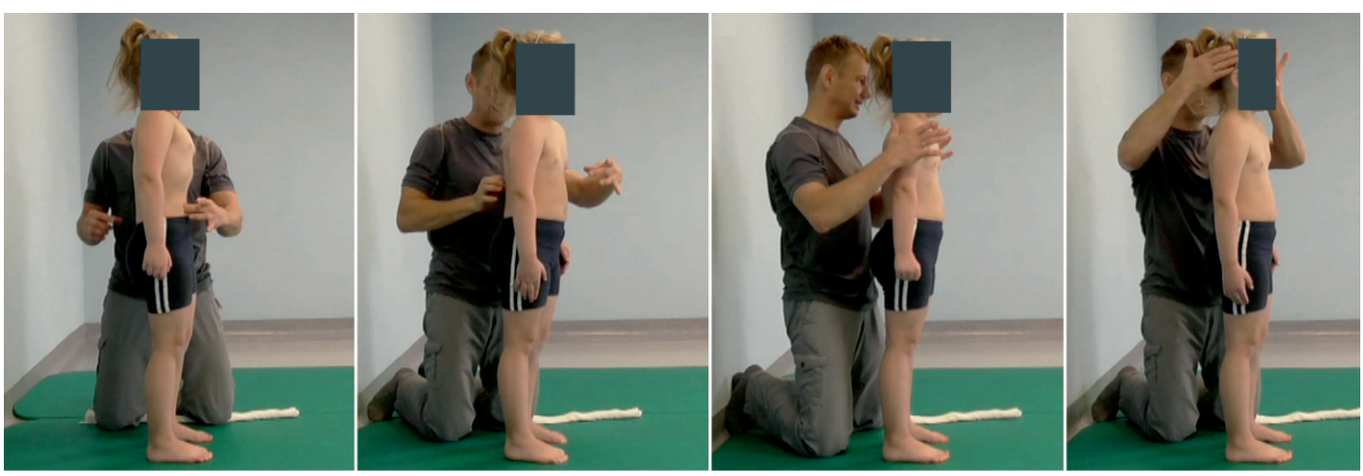

Fig. 6. Improving proximal stabilization in the corrected body system by provoking co-contractions

The next stage are exercises that improve the control of the trunk setting by activating the antigravity muscles in the so-called active, corrected sitting position. Ideally, they should be under the control of the eye (feedback), that is in front of a monitor or mirror. The aim of these exercises is to improve

the proprioceptive sensation and contraction of the muscles stabilizing the trunk, and the degree of their difficulty is determined by the type of ground on which they are performed – stable/unstable, as well as the use of resistance or its lack. It should be noted that the active, corrected sitting position adopted by the child is maintained during the whole exercise – both at the beginning of the exercise (starting position), during movement (e.g. when moving the upper limbs in a specific direction), final position (after reaching the maximum elongation of the torso), and even at an additional time (about 10 seconds) after stopping the resistance (e.g. after releasing the tape).

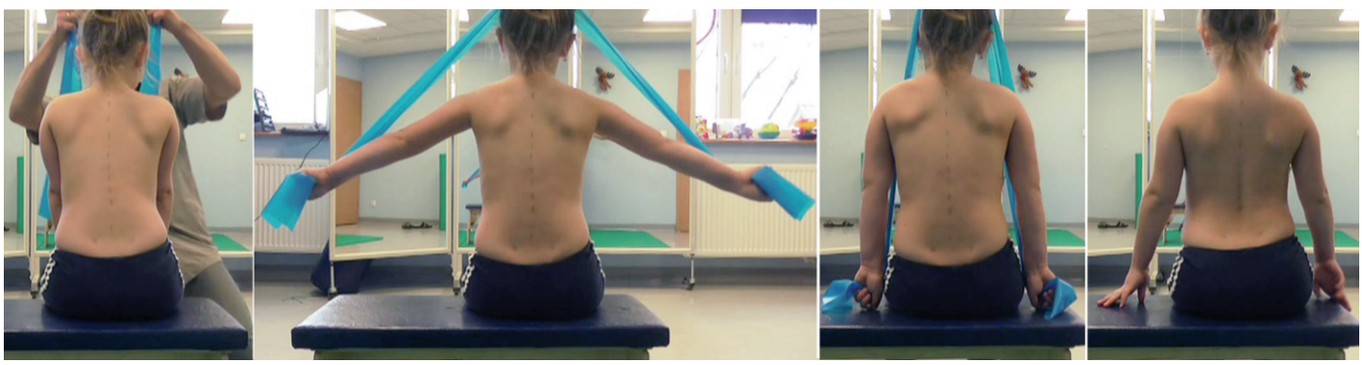

Fig. 7. Exercises in an active, corrected sitting position

A more difficult version of the above exercise is the introduction of a mobile ground – improving the stabilization of the trunk sitting on a ball. The child's task is to maintain a stable position during changing conditions – both when the therapist tightens the tape, pulls it in his directions and after releasing the resistance (release of the tape from his hands) for at least 5 seconds without additional movements – e.g. moving feet from the ground. During the exercise, special attention should be paid that the child does not tilt the trunk backwards, and that the child does not lordize the lumbar spine.

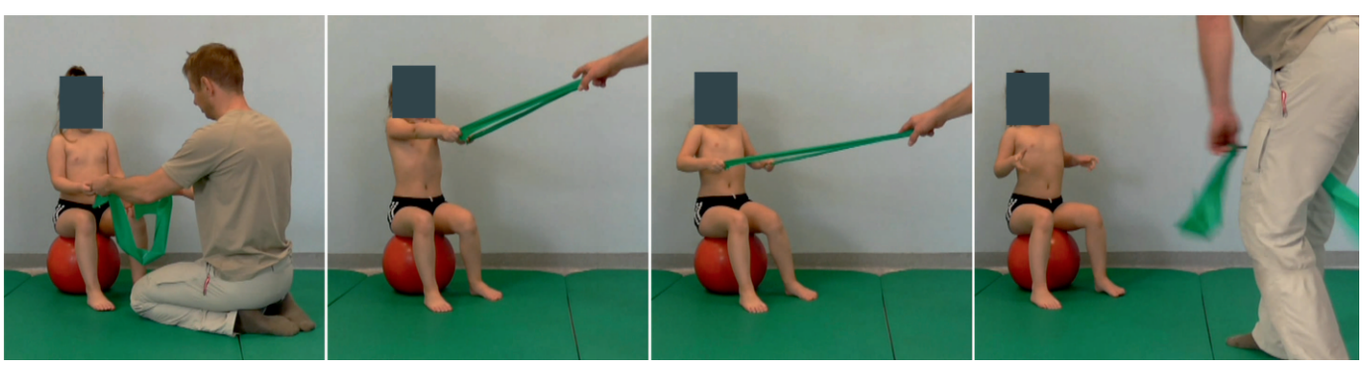

Fig. 8. An example of an exercise improving trunk stabilization sitting on a ball

Instead of the tape to create the resistance, the child can be encouraged to jump while sitting on the ball (vertical movements of low amplitude), with upper limbs in various positions. It is important, however, that during the whole exercise the child consciously controls the system of his body and recognize its quality (correct/incorrect). The exercise can

also be completed by accepting a standing position – free and active, corrected.

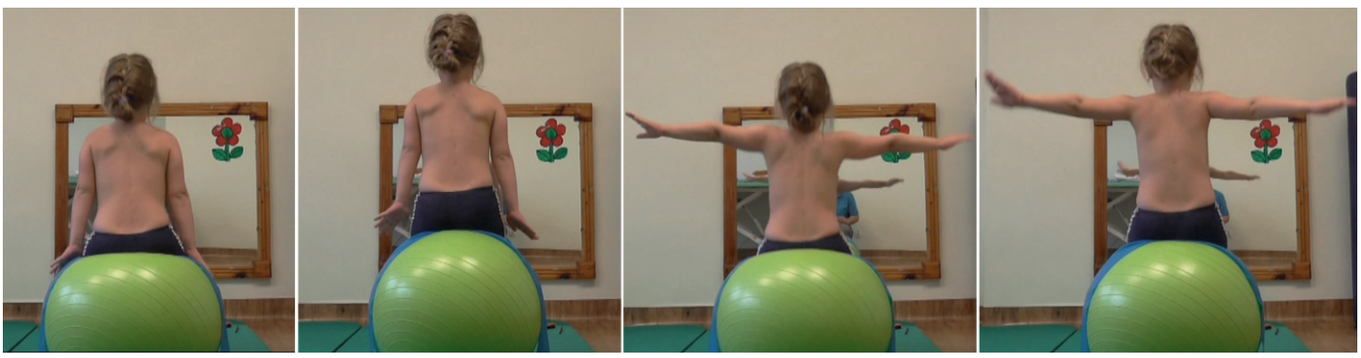

Fig. 9. An example of an exercise improving trunk stabilization sitting on a ball (continued)

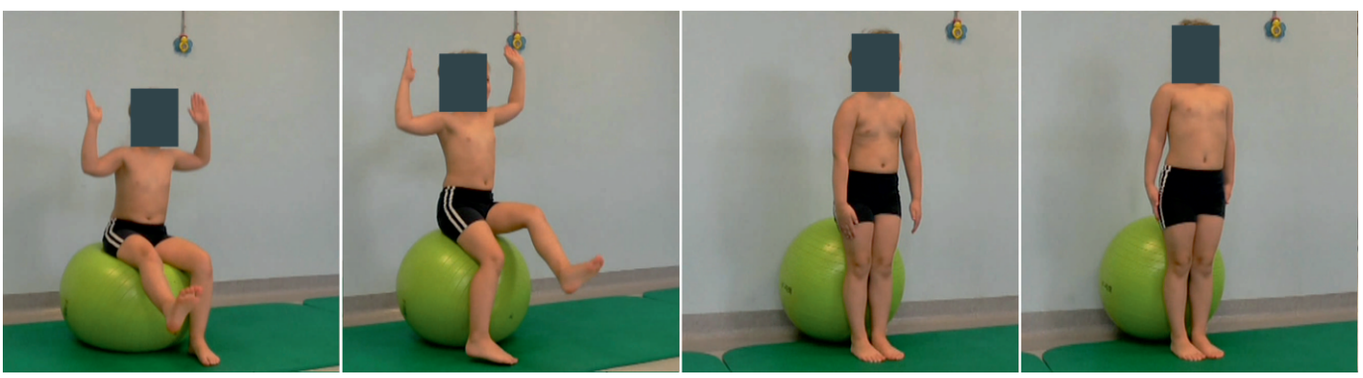

Fig. 10. An example of an exercise improving trunk stabilization sitting on a ball (continued)

Active stabilization of the lumbar spine with a closed and open kinematic chain

The improvement of the spatial control of the pelvic lumbar complex (and the improvement of proprioception) can also be seen through the prism of work in kinematic chains. Assuming this division criterion, it should be noted that the exercises described above were performed in a closed, partly open and open kinematic chain depending on the degree of their difficulty, and thus the position in which they were performed. For such exercises to have a functional value, they should contain not only a static but also a dynamic component - the so-called mobility on stability. An example of an exercise in a closed kinematic chain can be lifting the hips in the recumbent position with the feet resting on the wall. The child should lift the hips so that the pelvis is in line with the trunk and lower limbs, and hold the position for a few seconds, then slowly place the hips back on the ground. Before moving the hips, the child activates the deep abdominal muscles (by pressing the lumbar spine to the ground), and during movement attention should be paid that excessive lordotic arrangement of the lumbar region does not occur. To make the exercise more difficult, the child can be instructed to put the feet on the wall closer to the floor (below). Additionally, the position of the upper limbs can be changed (e.g. along the trunk, stretched forward) or the number of support points can be reduced by taking off one foot away from the wall, partially opening the kinematic chain.

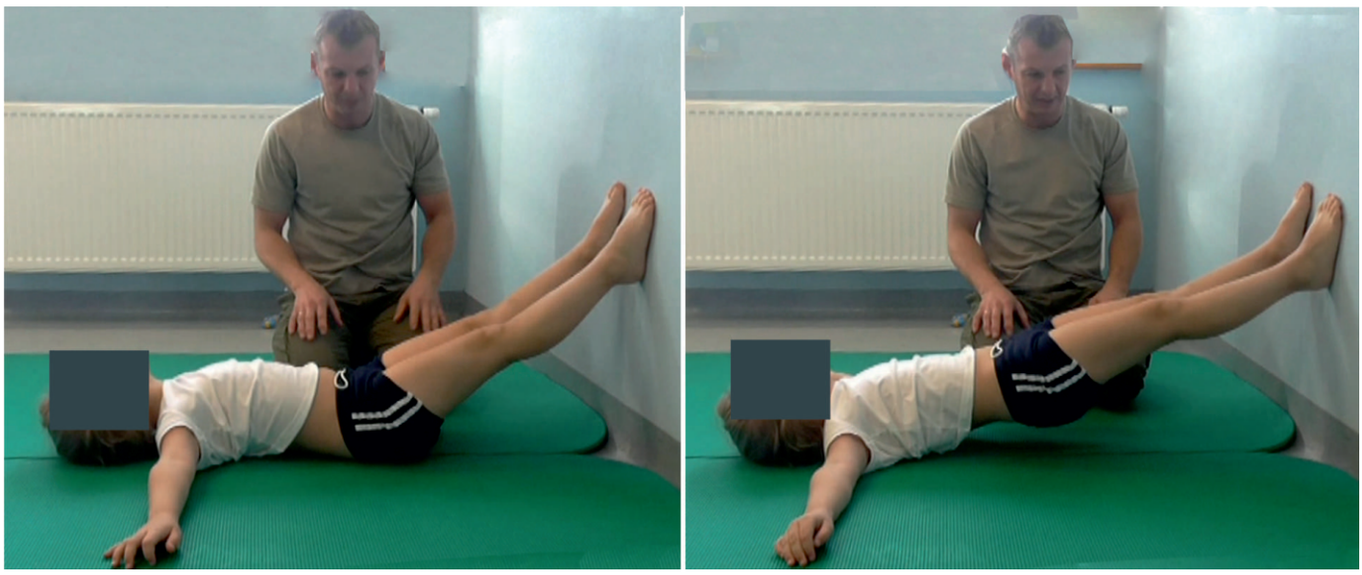

Fig. 11. An example of an exercise to improve trunk stabilization in a supine position

Improvement of stabilization within the trunk in a closed kinematic chain can also be performed in the vertical body system. It is the training of antigravity muscles in their natural working conditions. The child's task is to maintain tense abdominal muscles (without deepening lumbar lordosis) during changes in the system of lower limbs (moving to simple one-legged kneeling) while holding the roller over the head on the wall (with the help of a therapist). The next step may be moving from one-legged kneeling to a standing position. Another variation of this exercise can be moving from a sitting position on a chair (facing the wall) to a standing position – with hands moving up the wall, and in the final stage – moving to a free standing position (open chain).

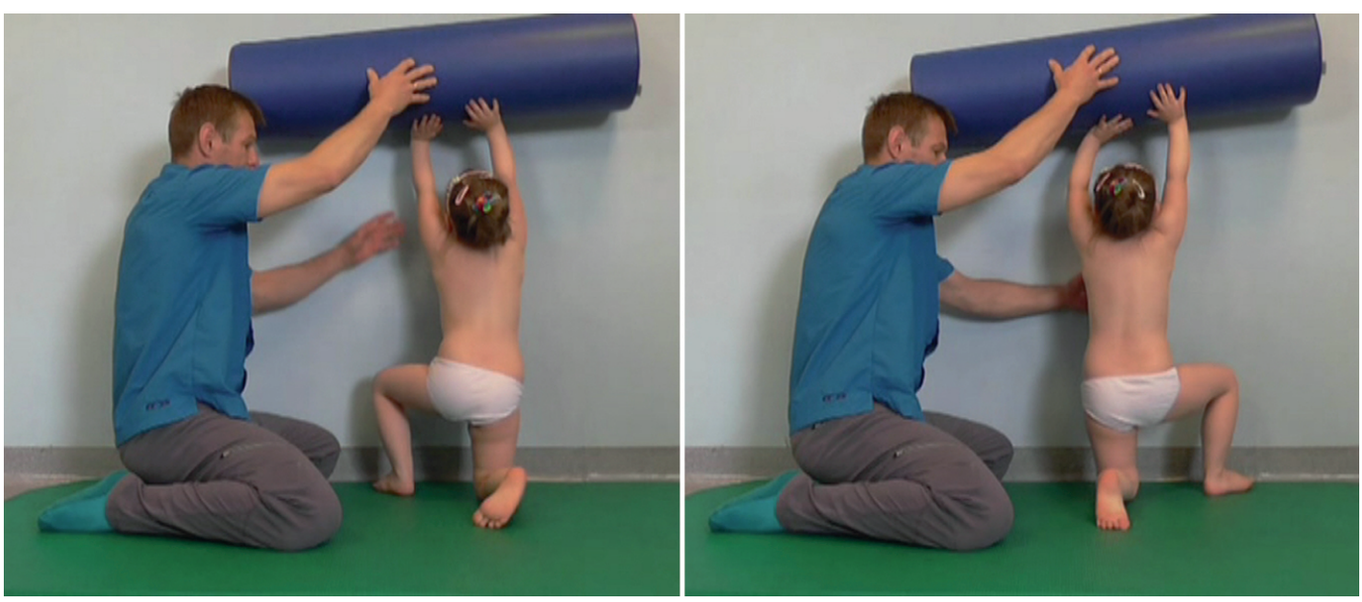

Fig. 12. An example of an exercise to improve trunk stabilization in the vertical body system

Yet another exercise to improve the trunk stability in the open chain performed on unstable ground, is to exercise in the back lying position on the half-roller (easier version) or roller (more challenging version). The child's task is first to activate the deep abdominal muscles while remaining motionless, then to maintain a stable position during a slight unbalancing by triggering co-contraction or roller movement, and then during movements of the upper and lower limbs. For this purpose, the child can be given a toy and their task is to capture it, move it and give it to the therapist. If necessary, the therapist may slightly stabilize the child's pelvis.
Exercises on an unstable ground in the vertical body system can be carried out analogously to the previously described exercises on a stable ground (with co-contraction, without eyes control).

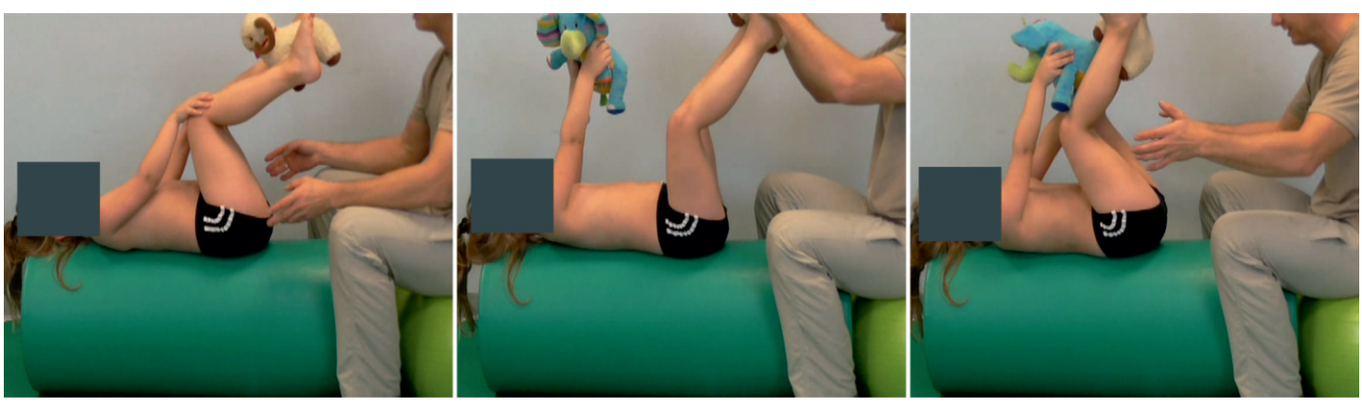

Fig. 13. An example of an exercise to improve trunk stabilization on unstable ground

Summary

The exercises presented here do not conclude the subject. They are only examples of tasks developing the ability to maintain an active corrected sitting and standing positions, work in a closed and open kinematic chain and the ability to efficiently resist external forces in various postural conditions. All of them are very useful in maintaining correct positions/postures during everyday activities. Thus, they prevent the formation of the habit of an incorrect posture in the sagittal plane. In order to actually serve this purpose, the tasks (exercises) must be constructed in such a way that in the final stages they transfer skills acquired by the child to stabilize the pelvic-lumbar region to activities performed by them every day – maintaining an actively corrected body system, e.g. during drawing, learning to read, as well as various forms of plays. It is also recommended to include simulations of "self-service" activities (dressing/undressing) and hygiene (e.g. washing hands/teeth) in the set of exercises. This stage carries the elements of the so-called training of behaviors used in children's programmes of " healthy back schools " [12].

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