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## **Deep stabilization muscles training in patients with polyarticular hypermobility**

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## **Abstract**

Hypermobility syndrome is an inherited dysfunction in the structure of connective tissues. It is manifested by disturbances in the proportion of collagen. The main symptoms of this syndrome are: laxity joint capsules and ligaments, range Increasing the mobility of joints, pain and many disorders and Functioning of organs and systems containing connective tissue. Improperly selected and dosed physical effort in patients with hypermobility syndrome can lead a frequent injuries and overload the musculoskeletal system. The consequence will be early degenerative changes and disability.

## **Introduction**

The most important function of the musculoskeletal system in terms of biomechanical human is the ability to move in the most economical and safe. To achieve these objectives it is necessary adequate stability and mobility of a particular type of created the musculoskeletal system. The most popular model kinematic stability of cells in the organ of human movement model is proposed by Panjabi<sup>1</sup>. It consists of a combination of actions of the 3 systems: nervous, myofascial and bone-joints and ligaments. The efficiency of these systems determines the correct operation of the system stabilizing. This model assumes that each system has an impact on the other two, and malfunctionone element affects the entire mechanism leading to compensatory overload on the other. The consequence is reduced mobility [2,3,4].

Another element for the stability is defined by the concept Panjabi neutral zone. It is a small range of motion in the vicinity of the zero position (resting) the joint, during which there is no agitation yet proprioceptors (sensory receptors deep) around the pond, and thus there is no central stimulation of muscle tone. Resistance bone-ligament is minimal. Larger range of motion of the neutral zone is a dangerous situation for the pond. Delayed proprioceptors information from the central system to the current joint position, gives the answer in the form of a separable muscle tension in that area, but it may be inadequate for an external force

acting on the joint and lead to injury [5].

The factors which disturb the neutral zone may include eg. trauma, degenerative diseases of joints and connective tissue disorders - one of the key building blocks of the compounds (muscle, fascia) and passive (bones, joints, ligaments) structures of the musculoskeletal system.

According to some authors hypermobility of arthritis (hypermobility) should not be treated as a separate disease entity but rather as a symptom of many diseases accompanying abnormalities eg. Team Down's syndrome Marfan, Ehler-Danlos syndrome, hypermobility syndrome mild arthritis [6].

Constitutional hypermobility (abbreviated HK) is a generalized, congenital and idiopathic renal tissue of the body. The main symptoms of HS include: increased relative to normal mobility of joints, and ligaments laxity bags, ease joint dislocations and sprains, muscle and joint pain, stretchy skin, blurred vision, disturbances of visceral disorders, stabilize the body. HK observed mainly in people aged development, as well as in young adults (women three times more often than men). With age, decreased range of motion of joints, however, is related to the aging of the organism, and no relief from connective tissue abnormalities [7,8].

In order to determine the occurrence of hypermobility polyarticular symptoms should be performed (interview), physical examination (monitoring the patient, the standardized scales) and additional tests (eg. Genetic testing). The basic scale for the assessment of HK International Beighton Scale. It consists of five steps, respectively scoring. These include: passive dorsiflexion V-phalangeal MCP joint  $90^{\circ}$  above, passive pull the thumb to the forearm, elbow joint hyperextension than  $10^{\circ}$ , a hyperextension of the knee than  $10^{\circ}$ , a hand position flat on the floor while the slope in front of the upright knee joints. The joint provided by hypermobility retrieving at least 4 out of 9 [7,9,10].

Prevention and treatment of patients with joint hypermobility is based on properly conducted physiotherapy, through the use of appropriate locomotor training [11].

You should remember that the treatment of people with HK is only symptomatic. With suitably adapted exercises to strengthen the weakened muscles may be increased over the stabilization of the movable joints, thereby reducing the pain [12]. In order to improve stability, in the process of improving the patient exercises to be implemented mainly in closed chains biokinematic (ang. Biokinematic closed chain). These exercises are safe because it minimizes the formation of shear forces, which often cause damage or overload of joint structures. An important advantage of practice in closed kinematic chains is that by the

action of polyarthritis, and involve more muscle groups greatly improve proprioception (deep sensation), and a central stabilization. The idea of a central stabilization exercises (ang. Core Stability) is allowed to maintain stable body (core) when moving in the space and the movements of the limbs (mobility stability) [13].

A key element of stability is the central work of muscles deep ie.: m. multifidus (lat. musculus multifidus), m. section of the abdomen (lat. musculus transversus abdominis), the diaphragm (lat. diaphragma), m. oblique view of the abdomen (lat. musculus obliquus externus abdominis), m. internal oblique abdominal (lat. musculus obliquus internus abdominis) m. quadrate lumbar (musculus quadratus lumborum), m. lumbar większy (lat. musculus psoas major), mm. pelvic floor.

Stabilize the disorder within the central organ of the movement leads to the production of negative compensation. Disturbance of the pattern of the locomotive, muscle balance, overload occurs within the structures of the musculoskeletal system manifested by chest pains.

The next step in the process of rehabilitation of patients with HK incorporate strength training, endurance, balance and coordination. Stretching (stretching) is reduced to a minimum.

Currently, there are many utensils that can be used for training patients with HK. One of them is the ball rehabilitation [14].

The beginnings of its existence dates back to 1960 years. It was used by the Swiss physical therapists as an aid in the wider rehabilitation. It was not until 20 years later, the ball went to the United States. There, its application, extended beyond rehabilitation exercises skills balance, stability, enhance muscle strength and flexibility of the ligament structures - capsular. It has been observed that it is very useful in the prevention of musculoskeletal pain disorders [15,16,17].

In working with patients diagnosed with hypermobility constitutional Swiss ball can serve as a preventive and rehabilitacyjną<sup>18</sup>. The only limitation is the weight limit. Depending on the manufacturer are found maximum values of 200-250 kg.

The main benefits of using the Swiss ball in the rehabilitation of people with hypermobility may include constitutional [19,20]:

a) Improved posture - trying to maintain balance in a sitting position on the ball activates the muscles of the abdomen, back, upper and lower extremities. This not only shaping them but we also care about the correct posture. Popular chair or chair used when working at the computer or watching television can be replaced by a ball rehabilitation. The benefits that

entails changing the classic seat on the ball are widely documented in the medical literature.

b) Strengthening the structures of the musculoskeletal system by:

- improving the deep sensation (proprioception); due to the instability of the ball the user is forced to self-conscious and body positioning in space so that they are involved stabilizing muscles of our body;
- improve the stability of central (Core Stability) which provides functional stability in the episode lumbosacral spine and pelvic girdle.
- improving flexibility and strength of muscles, ligaments and tendons, which translates to better stabilize joints and lower the number of injuries;
- They work by improving the balance in an unstable equilibrium point, and search;
- - improving muscle strength superficial and deep through the use of isometric exercises that are characterized by small amplitude of movement and are safe for joints.

Rehabilitation ball can be used to carry out the exercise m.in: strengthening, stabilization, shaping, equivalent strength, breathing, relaxation. Her versatility shows that gymnastics is an interesting utensil which might be interested in closer wanting to improve the function of the musculoskeletal system of the HK [18].

Below, the authors show examples of exercises using balls rehabilitation for people with hypermobility constitutional.

Before the training, the patient should receive instructions on how to properly sit on the ball and how to get up from the exercise to be effective and safe.

Proper sitting position on the ball:

1. We sit on the ball and easily put your feet on the ground.
2. Knee evenly arrange the feet in a straight line.
3. between the thighs and lower legs angle should be at least  $90^{\circ}$ .
4. The angle between the thighs and the upper part of the body should be  $90^{\circ}$ .
5. The pelvis slightly forward.
6. The body erect, protruding from the front of the chest and a slight bend the lumbar spine.
7. The head slightly withdrawn (beard affects the bridge)
8. The sight directed forward, parallel to the ground.
9. The rim shoulder situated freely and loosely.
10. Arms slightly tilted back, her hands quietly resting on the thighs. Sitting down, we should evenly distribute body weight so that the pelvis is not moved back and did not cause bad

posture while sitting.

Figure 1 instruction on how to properly sit on the ball rehabilitation.



Figure 1

When waking up the center of gravity of the body must move forward, torso erect and leans forward. The upper part of the body ceases to move forward, and are lifted buttocks. You can lay your hands on your thighs to help himself get up.

The following is an exemplary set of training exercises for people with HK. The number of repetitions of a given exercise and the number of series should be dependent on the functional status of the person exercising. For beginners it is recommended to perform a

particular exercise in 2 series of 10 repetitions. Before training to be a warm-up general labor whose aim will be to prepare the body for further exercise.

### Exercise 2

Starting position (PM): Attitude straddle. Arms bent based on the ball.

Movement: Pressure forearms ball. The abdominal muscles tense, the head of the extension of the trunk. We maintain muscle tone 5 seconds.

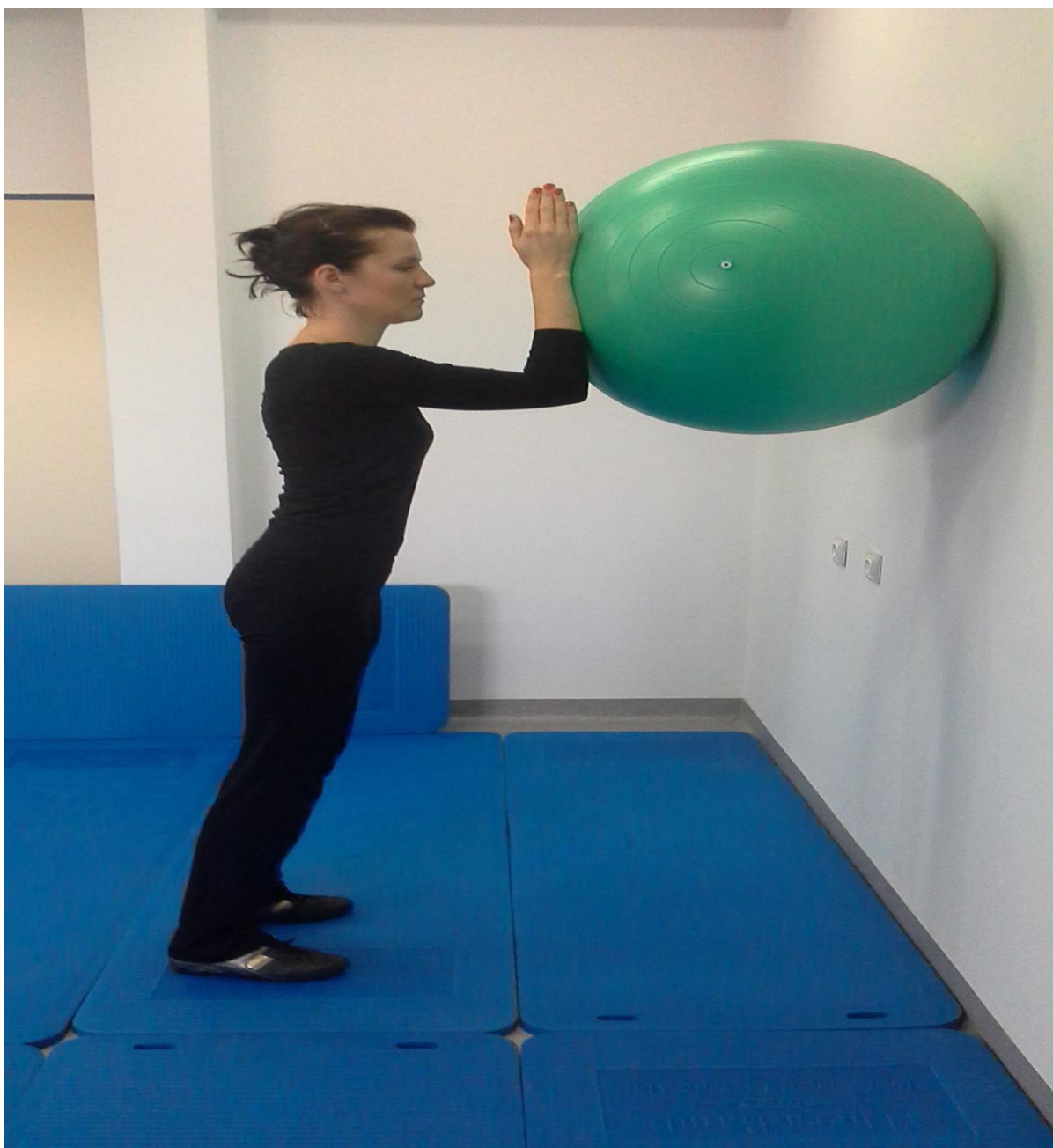


Figure 2

### Exercise 3

PM: Attitude straddle. Arms straight forward, based on the ball.

Movement: Pressing the upper limbs of the ball. The abdominal muscles tense, the head of the extension of the trunk. We maintain muscle tone 5 seconds. Back to the PM.

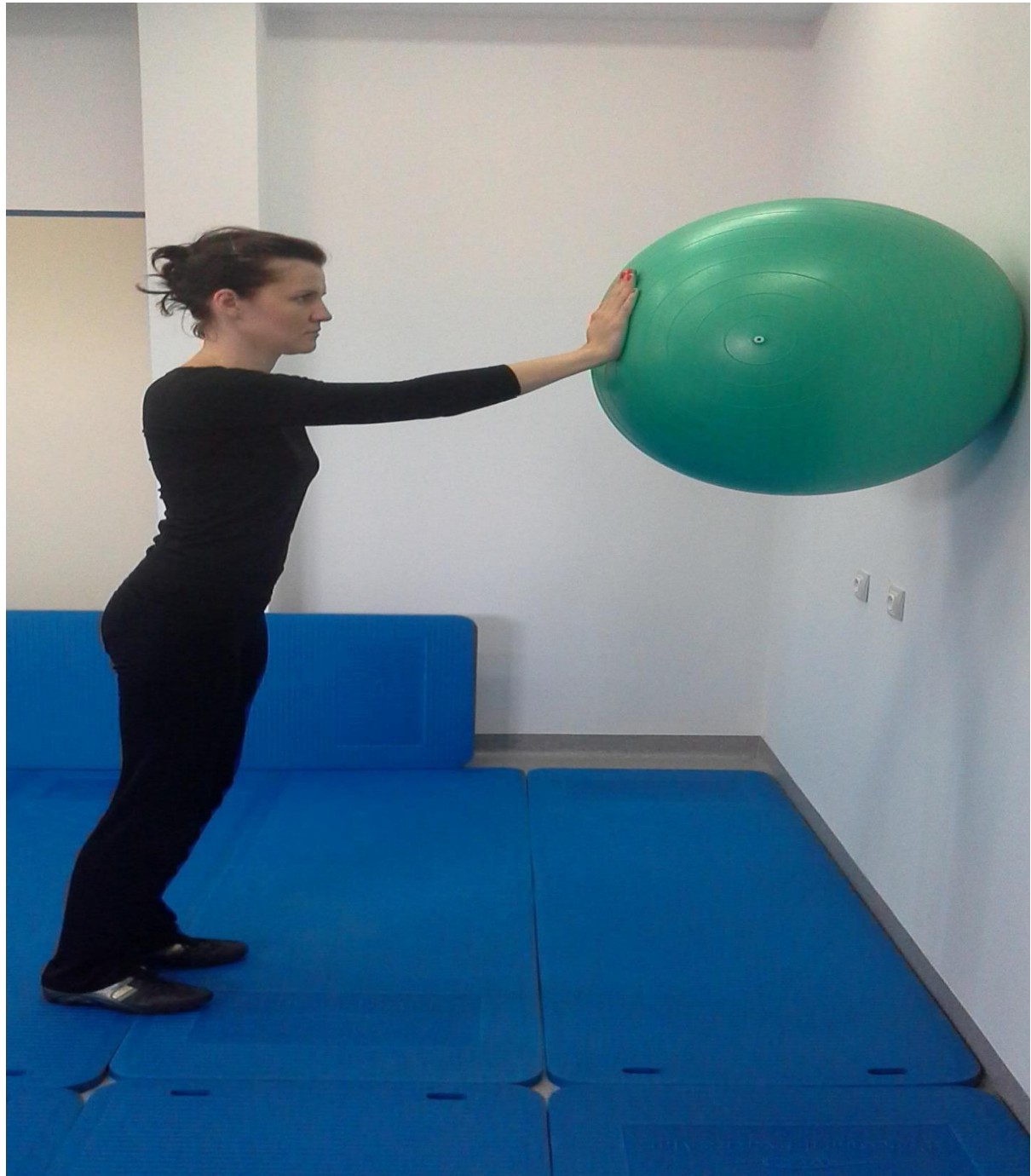


Figure 3



Exercise 4

PM: Ball set between the back and the wall at the height of the lumbar spine. Back straight, head back to the extension. Based hands on his hips, feet hip width extended to (A).

Movement: Squat. Knees do not exceed the feet. We maintain muscle tone five seconds (B).  
Back to the PM.



Figure 4A



Figure 4B

Exercise 5

PM: Attitude straddle. Arms straight forward. Palms disposed between the ball (A).

Movement: Squat while retaining hands on the ball. We maintain muscle tone five seconds (B). Back to the PM.



Figure 5A



Figure 5B

Exercise 6

PM: Attitude straddle with arms up. In her hands the ball (A).

Movement: Squat with simultaneous precipitation arms down in front of the ball. Holding 5



sec. (B) and back to the HP.

Figure 6A



Figure 6B

Exercise 7 Rolling forward and backward

PM: Sit on the ball. Back straight, head in the extension of the spine. Hands-based thighs. Legs and abdominal muscles tight.

Movement: Tilting the pelvis forward (B) and backward (A), his buttocks from the ball.

Purpose of the exercise: to improve the balance of the body, strengthening the muscles of the lower extremities, spine and abdomen.



Figure 7A



Figure 7B



Exercise 8 Snap legs will sit on the ball

PM: Sit on the ball, hands on hips based. Legs and abdominal muscles tight.

Movement: Raising the lower limb (left) bent at the knee joint (90) above the substrate retention for 5 sec. (A). The straightness of the lower limb (left) knee Hold for 5 seconds. (B). Changing the lower end.

Purpose of the exercise: to improve the balance of the body, strengthening the muscles of the lower extremities, spine and abdomen.



Figure 8A



Figure 8B

Exercise 9 Sit on the ball with your hands while oppression ball and elevation of the lower limb.

PM: Sit on the ball. Arms straight forward. Hands holding a small ball. Straight trunk, the foot adjacent to the substrate (A).

Movement: In the seated position, the deflected lift the leg in the knee joint while the ball compression palms (B). After 5 seconds, change legs.



Figure 9A



Figure 9B

Exercise 10

PM: Lying on the ball in the kneeling propped. Arms shoulder width apart, hands based on the substrate. Lower limbs hip width apart, bent at the knee and hip joints. The head of a trunk line (A).

Movement: Alternate sides elevation upright upper limb while the upright elevation of the lower limb (B) . Tension maintain muscle five seconds. Changing the limbs.



Figure 10A



Figure 10B

Exercise 11

PM: Lying on the ball in the kneeling propped. Arms shoulder width apart, hands based on the substrate. Lower limbs hip width apart. Right leg bent at the knee and hip joints, straight left leg rests against the wall. The head of a trunk line (A).

Movement: Extension of the right hand forward while pressing the left leg in an upright wall (B). We maintain muscle tone 5 seconds. Changing the limbs.

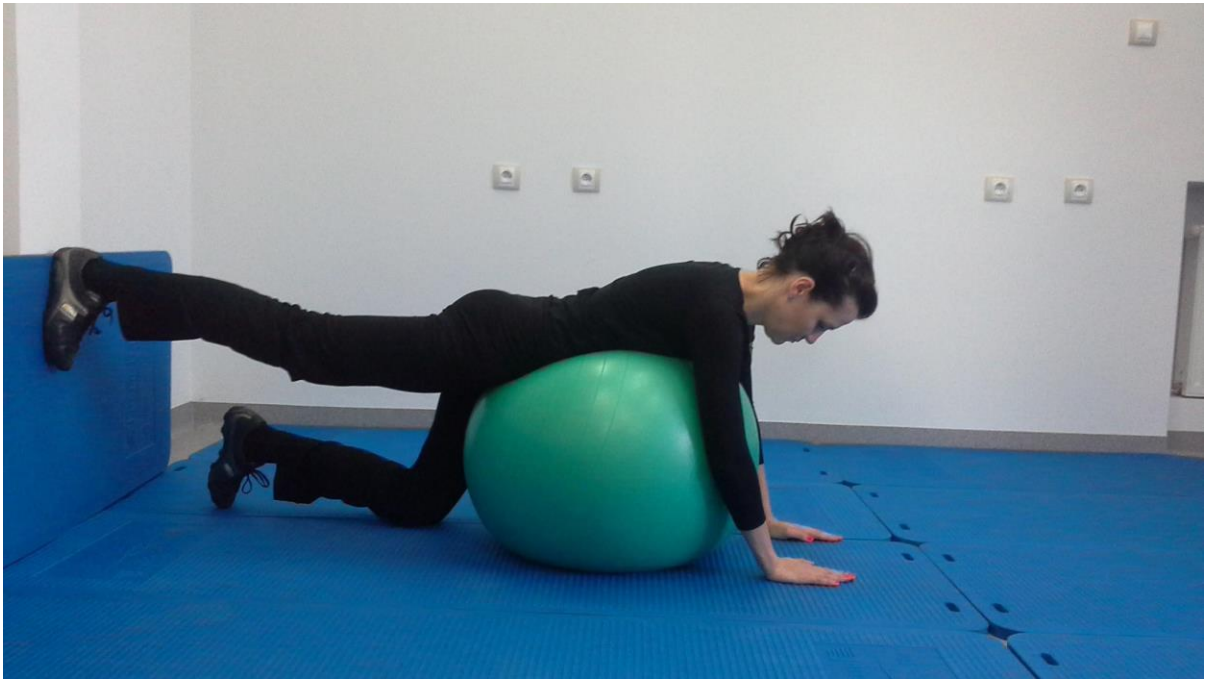


Figure 11A



Figure 11B

Exercise 12

PM: Lying on the ball first. Arms shoulder width apart, hands based on the substrate. Lower limbs hip width apart, knees straight in. Head to the body in a straight line.

Movement: Alternate sides elevation upright upper limb while the upright elevation of the lower limb. We maintain muscle tone 5 seconds. Changing the limbs.



Figure 12

Exercise 13

PM: Squat supported forearms resting on the ball. The head of a trunk line (A).

Movement: Move the ball to the front of the abdominal muscles at the same time short-circuit (B). Stop 5 sec., Return to the starting position.



Figure 13A



Figure 13B



#### Exercise 14

PM: Lying back. Arms at your sides. In the lumbar spine adheres to the substrate. Lower limbs bent at the knee and hip joints (90°), are based on the lower legs on the ball.

Movement: Pressing head and shoulders into the ground at the same time focus on the ball of the lower limbs. We maintain muscle tone 5 seconds.



Figure 14

Exercise 15

PM: Lying back. Arms at your sides. In the lumbar spine adheres to the substrate. Right leg straight knee lower leg rests for the ball, left leg bent at the knee and hip joint (angle 90°) rests on the ground.

Movement: Pressing the lower limb on the ball with his hand simultaneous emphasis on the substrate. Time circuit 5 seconds. Change legs.



Figure15

Exercise 16

PM: Lying back. Contraction of the arms, hands joined at the chest. In the lumbar spine adheres to the substrate. Lower limbs bent at the hip, knee straight based on a lower leg of the ball (A).

Movement: Pressing hand while pressure on the ball of the lower limbs of raising the hips up (B). We maintain muscle tone 5 seconds. Back to the PM.



Figure 16A



Figure 16B

Exercise 17

PM: Lying back. The arms along the trunk, spine in the lumbar region adjacent to the substrate. Lower limbs bent at the hip, lower thigh based on the ball. Right leg straight, left leg bent at the knee joint (90 degrees).

Movement: The pressure on the ball of the lower limbs. We maintain muscle tone 5 seconds. Change legs.



Figure 17

Exercise 18

PM: Lying back. The arms along the trunk, spine in the lumbar region adjacent to the substrate. Lower limbs bent at the hip joint are based on the lower thigh of the ball (A).

Movement: Pressing the arms of the substrate while the pressure of lower limbs on the ball of the hip raising (B). We maintain muscle tone 5 seconds. Back to the PM.



Figure 18A



Figure 18B

### Exercise 19

PM: Lying back, arms along the body, the spine in the lumbar region adjacent to the substrate. Lower limbs bent at the knee joints and the hip (90 degrees), the foot glued to the substrate. Placed the ball between his knees.

Movement: Pressing the lower limbs on the ball. We maintain muscle tone 5 seconds.



Figure 19

Exercise 20

PM: Lying back. Arms to the side, feet based on the ball, hips lifted (A).

Movement: bring the heel to the buttocks of the raised hips connection keep five seconds (B).

Return to the starting position.



Figure 20A



Figure 20B

### Exercise 21

PM: Lying back. Hands along the trunk, lower limbs bent at the knee joint (angle  $90^{\circ}$ ), lumbar adheres to the substrate. Set between the ball and the wall of the bent feet of the lower limbs.

Movement: Pressing the balls in the wall at the same time focus your hand on the ground. We maintain muscle tone for five seconds. Back to the PM.



Figure 21



## Summary

Deep muscle stabilization exercises are an essential part of the training in patients with polyarticular hypermobility. With the increasing availability of rehabilitation equipment performed exercises become more efficient and safe. Below are rules that must be followed by joining the physical training:

8 principles of 30 minutes of exercise rehabilitation with the ball:

1. Each workout should consist of: warm-up (exercise generally improving), the main exercises (exercises with ball rehabilitation), the final exercise (relaxation exercises).
2. Remember regularity. To see results, you need to exercise regularly. Better results will give a 30-minute workout 4 times a week than hour workout once a week.
3. We run down to train moderately. It is dangerous exercises when the body is tired.
4. While exercising, take into account your age and the limitations that puts your body.
5. During the exercise you should not feel pain.
6. When you exercise, remember the correct and regular breathing ie. Inhalation nose - exhale through the mouth, the exhalation is two times longer than inhalation.
7. At the end of training, be sure to execute the relaxation exercises.
8. Before starting any exercise program, consult your physician and / or physiotherapist. Prior to the exercise of a person must be carried HK medical diagnostics and musculoskeletal physiotherapy.

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