Lower Extremities

Lower extremities are adjusted to provide locomotion but, at the same time, carry the full body weight. The lower limb movement is transferred through the hip joint and pelvis onto the spine. Every disruption of muscle balance and overload with no suitable compensation affects the basic function of lower limbs, i.e. the locomotion, and thus affects the body posture. Lower extremities often display abnormalities in the development of hip joints, such as knock-knees, bow legs, flat feet, etc. Considering the regular movement effort, sport training effort, random recreational movement activities (jogging) regardless of the musculoskeletal system's condition, carried out on inconvenient terrain and with inconvenient footwear, we can be certain some health problems will occur, sooner or later.

Posterior Compartment of Thighs – Knee Flexors

Relaxing and stretching of muscles in the posterior compartment of thighs are very important compensation exercises. It is largely because these muscles are part of tonic muscles that tend to shorten and become tight. Since they are attached to pelvis, it is important to note they are therefore connected with lumbar muscle groups. In order to prevent these muscles from harm it is important they are all stretched equally. This implies that the low back should be focused on before we start stretching the posterior compartment of the thigh. This are is often overloaded and without its prior relaxation and stretching it is not possible to guarantee successful stretching of lower limbs, especially the knee flexors. Many of the exercises mentioned in the chapter on lumbar spine can be therefore used prior to the actual posterior thigh muscle stretching. Stretching that is usually done when standing or with one's trunk bent forward, cannot be valuable unless lumbar region has been stretched. That is because the more dominant muscle tonus of the lumbar area works as an anti-gravity force and hindering force at the same time. This could cause harm to the tightened muscles in the posterior thigh compartment (they are not in the ideal stretching position; see the rules of stretching and relaxing above). From the methodical point of view we should start stretching and relaxing muscles in the back-lying position..

T*op-performance sport involved*

- *Soccer, Ice hockey*
- *Athletics: all kinds of running, jumping and walking*
- *Handball, Tennis*
- *Water sports (canoeing, rowing, etc.)*
- *Weight-lifting, Cycling*
- *Figure skating*
- *Rock climbing*
- *Hiking, condition jogging*

Muscle	**Origin**	**Insertion**	**Action**
Biceps femoris	*Ischial tuberosity, medial compartment of thigh bone (femur)*	*Head of fibula (calf bone)*	*Flexes the knee joint, extends the hip joint*
Semimembranosus	*Ischial tuberosity*	*Shin bone (tibia)*	*Flexes the knee joint, extends the hip joint*
Semitendinosus	*Ischial tuberosity*	*Shin bone (tibia)*	*Flexes the knee joint, extends the hip joint*
Gracilis	*Pubis*	*Shin bone (tibia)*	*Adducts thigh, flexes the knee joint*
Gastrocnemius	*Femur, posterior lower part*	*Calcaneus (bone of the heel)*	*Plantar flexion, flexes the knee joint*

Our goal is to compensate the muscle imbalance and strain in this area by using the appropriate exercises. The attention must be paid to the pelvis position when exercising. Pelvis must be stabilized and fixed.

SP: (basic position): lie on your back with arms alongside your body
– as you breathe out, tilt your pelvis forward, draw the tip of your left foot up towards your body
– do the same with your right leg and then with both legs at the same time.
Mistakes: sagging the lumbar spine, bending knees, lifting shoulders, leaning your head backwards.

SP: lie on your back with your left leg bent, foot on the floor; the right leg is raised with the knee bent, hands holding the knee,

- breathe out and pull the knee towards your chest
- breathe out, stretch your right leg and grasp your shin
- breathe out and pull your right leg to your chest (You can make the exercise more difficult by pulling the tip of your right foot towards your body)
- repeat the same with your left leg

Mistakes: sagging the lumbar spine, lifting shoulders, head leaning backward, and insufficient stretching of the exercised leg.

SP: sit on the floor with your legs slightly apart and your right leg bent, lean forward over your left leg and grasp your ankle (if you are dexterous enough grasp your foot),
- breathe out, bend your elbows and then breathe freely,
- repeat it on the other side.

Mistakes: bending the leg you are exercising with and making round back.

SP: Sit on the floor with your legs apart; bend forward slightly, arms rising forward with your palms on the floor,
- breathe out and bend your elbows but do not move your hands on the floor; breathe regularly.

Mistakes: bending your knees, knees not pointed upwards, lifting your shoulders.

Note: during this exercise you also stretch anterior thigh muscles, which is not totally useless since these muscles assist with knee flexion.

SP: stand with your right leg raised, facing a bench, your right foot is placed on the bench,
- breathe out and lean slightly forward, keep your back straight, put your hands on your right thigh (above your knee)- until you feel slight pull,
- repeat it with your other leg.

Mistakes: bending your knees, sagging the lumbar spine, rounded your back, knee not pointed upwards.

SP: stand up with your legs slightly apart, facing the wall ribs, lean forward with your back straight, the hands are placed on the rib at the hip level,

- breathe out and pull your pelvis away from the ribs until you stand up on your heels and feel a slight pull.
Mistakes: bending your knees, sagging the lumbar spine, rounded back, head leaning backward, lifting your shoulders.

SP: squat, put your palms on the floor,
- as you breathe out stretch both legs until standing; your palms (fingers) are touching the ground.
Mistakes: bending your knees, feet and knees not heading forward, bending your trunk rather than bending at the hips to lean forward

Valgus and Varus Deformities of the Lower Extremities (Knee Joint)

This chapter deals with the knee joint deviations from the lower limb axis. Knees can either be deviated outward (like the letter O) or inward (like the letter X). The axis of lower limbs is mainly influenced by the knee joint. Insufficient function of the lower extremity joints may result in (or deteriorate) deviations from the axis. As mentioned above, the hip joint condition affects the overall lower extremity alignment. The muscles of this area are dealt with in the chapter on knee joint muscles. There is also a connection between postural function of lower extremities – hip joint, knee and ankle joint position - and sacroiliac joint in the low back area.

Genua vara or bow legs is a deviation of the knees from a vertical axis which goes through the hip joint, knee joint and ankle joint on the anterior side. This alignment is caused by tight hip and weak abductors. Active exercise to balance muscle imbalance between hyper and hypoactive muscles is important.

Genua valga or knock-knees is a deviation from the vertical axis which goes through the hip joint, knee joint and ankle joint toward the central axis. This deformity is often associated with the in-toeing position of the foot and heel.
In both cases, it is important to strengthen the case of joint and increase the static muscle tonus. Exercises strenghtening the weak muscles and stretching the tight muscles of the lower extremities, without exerting the extremities, are also recommended.

Sport disciplines enhancing the lower limb deformities:

- *soccer*
- *ice hockey, floor hockey, handball*
- *horse riding*
- *wrestling*

For better illustration and application of strenghtening exercises listed here or in other sources, it is necessary to recollect the relevant groups of muscles. Check the following list of muscle areas.

Muscles of the hip joint area (See "Hip Joint Area" chapter)

Muscles increasing the varus defomity:
- posterior thigh muscles- their contraction decreases the inclination angle of the hip joint

Muscles increasing the valgus deformity:
- anterior thigh muscles- contraction increases the inclination angle of the hip joint
Before we start exercising it is important to relax the lumbar area end the hip joint. During the exercise itself we observe the instructions mentioned in the initial part of thebook and follow the rules for stretching and strengthening. We also focus on the optimal number of repetitions (6-8 times).

Varus deformity (O)	SP: lie on you back, bend your knees, put your hands behind your knees, - as you breathe out, bring your legs to your chest, as you breathe in bring them away. Mistakes: head leaning backward, holding breath. SP: lie on your back with your right knee bent, both hands are placed behind the knee, - as you breathe out, pull the right leg towards your chest and stretch the left legs reaching as far as you can on the floor; as you breathe in, pull the right knee away, repeat on the other side. Mistakes: head leaning backward, lifting your legs from the floor, holding breath

SP: lie on your back, the knees are bent, legs apart, arms rest along your body,
- as you breathe out, try to touch the floor with your right knee (heading inward), next time try to get 1 cm (0.4 inch) closer to the floor , draw back as you breathe in , do the same with your left knee.
Mistakes: the other leg assist with the movement, your shoulders and pelvis are lifted and pelvis from the floor, breathing out of the movement rhythm.

SP: lie on your back with the ball held between your ankles,
- as you breathe out press the ball with both ankles and then relax.
Mistakes: bending your knees, sagging the lumbar spine.

SP: Back-support sitting position, put a chair between your legs,
- as you breathe out, try to push your legs inside against the resistance of the chair.
Mistakes: bending your trunk, holding breath.

Valgus deformity (X):

SP: lie down with your back on the floor, part your legs, let your arms rest along your body, palms turned upward
- as you breathe out slightly lift up your pelvis from the floor and stretch both your legs, feet turned outward
Mistakes: pelvis insufficiently fixed, curving lumbar spine, movement of legs not coming from the hip joint, head bending backward, lifting up shoulders

SP: sit on the floor with your legs apart, lean forward, arms are in between your legs, hand on the floor between the knees,
- as you breathe out, bend your elbows while leaning the trunk slightly forward, hands still on the same spot.
Mistakes: bending your legs, swinging movement of the trunk, irregular

breathing, head leaning backward, rounded back.

SP: take the back-support sitting position with your legs apart,
- as you breathe out, pull your shoulder blades towards each other and bend slightly forward keeping your back straight, arms resting on the floor.
Mistakes: bending your legs, rounded back, holding breath, head leaning backward, legs turning outward.

SP: lie on your back with your feet together, arms stretched sideways,
- as you breathe out, slide your heels on the floor to the straddle position, tighten your abdominals, flatten your low back on the floor, as you breathe in slide the heel to the starting position.
Mistakes: sagging the lumbar spine, head leaning backward.

SP: lie on your right side, hold an overball between your ankles, your right arm is stretched upward, flat on the floor, your right arm is flexed with the hand placed in front of your chest for better balance, the pelvis is tilted forward,
- as you breathe out, raise both feet app. 20 cm (app.8 inches) above the floor, breathe in and draw them back, do the same on the other side.
Mistakes: body deviating from its vertical axis, hip joint flexion, trunk moving simultaneously, holding breath.

SP: Take the straddle seat, knees are bent, feet places with their soles together, grasp your ankles,
- as you breathe out, press your knees to the floor (make it easier by leaning elbows on your knees).
Mistakes: rounded back, head leaning backward, swinging motion of the legs.

SP: take the back-support sitting position with your legs apart, put your legs inside, between two legs of a chair,

- as you breathe out, press your feet outward against the chair's resistance
Mistakes: head leaning backward, rounded back, holding breath

SP: sit on a big ball with your legs slightly apart, arms stretched sideways, pull shoulders back, chin up, both feet flat on the floor,
- cross one leg over the other one, switch legs and repeat,
Mistakes: pelvis and shoulders insufficiently fixed, head pushed forward, rounded back.

SP: stand with your feet together,
- as you breathe out, try turning your knees actively outward.
Mistakes: bending your knees, toes not pointed forward.

Flat Feet

Congenital flat foot is a very rare deformity. It is more common to develop this deformity than to be born with it. A complex of outer and inner factors may result in developing muscle imbalance and muscle weakness, ligament overload and subsequent fixation of the flat foot. Normal foot arch is one of the important postural and movement mechanisms and helps to maintain the body balance. The foot sole condition is connected to the knee position, which subsequently affects the pelvis and spine alignment. The foot arch collapse results in a flat foot. The foot has two functions – carrying the body weight and enabling transfer of the body weight (movement).

In order for a body to be stabilized it must supported on three pivot points. The foot also has three support points – calcaneal tuberosity, head of the first metatarsal bone, and the head of the tarsal bone. We can distinguish two systems of arches of the foot – transverse and longitudinal. The transverse arch lowering, between the heel and the head of the first metatarsal bone causes transversely flat foot. Lowering of the longitudinal arch, between the heads of the first and the fifth metatarsals causes a longitudinally flat foot. Arches are protected by elastic tissues of foot and enable flexible tread. The most effective prevention from flat feet and improving their state is everyday, regular and sufficiently long exercising.

Sport disciplines overloading the lower extremities and foot sole leading to worsening the negative deformities of muscle balance are the following:

- *Soccer, ice hockey, basketball, handball*
- *Figure skating, sport and modern gymnastics*
- *Hiking*
- *Tennis*
- *Athletics: running, jumping, throwing*
- *Downhill skiing*
- *Jogging*

Transverse arch of the foot – intercepted and supported by the tendon formed by tibalis anterior and fibularis longus:

Muscle	**Origin**	**Insertion**	**Action**
Tibialis anterior	*External part of tibia (shin bone)*	*Navicular bone (internal), proximal phalanx of the great toe*	*supports the arch, dorsiflexion at the ankle joint*
Fibularis longus (Peronaeus longus)	*Head of fibula (calf bone)*	*Navicular bone (internal), proximal phalanx of the great toe*	*Supports the arch, flexes foot*

In general, the transverse arch is supported by all the traversing structures.

Longitudinal arch of the foot – intercepted and supported by tibialis anterior (see above).

In general, the longitudinal arch of the foot is supported by structures that are lengthwise and crossways oriented on the sole (corresponding to the long foot axis).

SP: lie down on your back with your feet together, arms resting alongside your body,
- as you breathe out, stretch your toes (plantar flexion), press your lumbar spine against the floor, relax when breathing in.

Mistakes: sagging the lumbar spine, head leaning backward.

SP: take the back-support sitting position,
- by curling and stretching the toes of both feet, slide both legs forward on the floor

(bending and stretching legs), so-called earthworm crawl.
Mistakes: head leaning backward, round shoulders, relaxed abdominals.

SP: sit on the bench, legs vertically down, put a rolling pin under your feet,
- roll back and forth from your heel to your toes.
Mistakes: round shoulders, insufficient pressure on the rolling pin.

SP: sit on the bench, legs down, feet flat on the floor,
- try to pull 3 imaginary points on your sole (heel, head of the tarsal bone of the great toe, head of the tarsal bone of the little toe) together – by which you form so-called small foot (foot-curling),
- alternate your feet.
Mistakes: insufficient approaching of the 3 points, curling the toes

SP: stand with a tennis ball under your right foot,
- massage your sole by rolling the ball on the floor, repeat with your left foot.
Mistakes: faulty posture – bending your trunk, crouching, bending the leg you are not exercising.

BP: stand with your feet together,
- walk forward alternately on heels and tiptoes.
Mistakes: bending knees, sagging lumbar spine, crouching.

SP: stand with your legs slightly apart,
- walk forward with your feet alternately turned outward and inward (walking on the outer and inner edge of the feet).
Mistakes: bending knees, sagging the lumbar spine, rounded back.

SP: stand with your feet together,
- walk on uneven terrain,
- walk on a pole or rope, etc. placed on the floor (walk forward, backward, to sides; try to use different parts of the sole).

Mistakes: rounded back, bending trunk forward