

Review article

## KINESIOLOGICAL ANALYSIS OF EXERCISES FOR THE PREVENTION AND CORRECTION OF LORDOSIS

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**Abstract:** The paper deals with a high-quality kinesiological analysis which can serve as a base for therapists and persons involved with the prevention and correction of body deformities to make a choice and administer exercises which are the most efficient for preventing and correcting the existing body deformity, in this case, lordosis. The paper describes the basic starting positions in which the exercises are carried out, as well as the contents and analysis of the presented exercises and their aim. Stated for every administered exercise are the muscles and muscle groups which carry out a movement, the types of muscle contractions and the way of their engaging in the existing movement (exercises).

**Key words:** *Lordosis, kinesiology, starting position, exercise, muscles, analysis.*

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### INTRODUCTION

Kinesiology is a science which studies the movements of the human movement apparatus of both healthy and ailing persons, that is, persons with damage locomotion.

In order to understand it, it is necessary to also understand functional anatomy, physiology, biomechanics, motor education, re-education, etc.

It is necessary to knowing and master the high-quality kinesiological analyses of exercise which a therapist determines for the purpose of physical and functional enabling of patients, as only a well chosen and adequately applied

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exercise can lead to positive transformational effects, and thereby also to a total healing after illness or injury. Such an approach is especially necessary in the area of prevention and correction (healing) of postural disruptions and body deformities.

By using high-quality kinesiological analysis, there is feedback on how to carry out the most comprehensive, that is, the most efficient movement (exercise) on the treated segment or the organism on the whole.

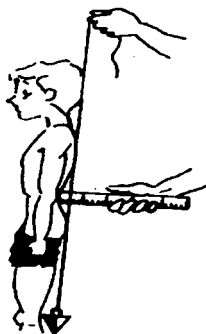
For the kinesiological analysis to be as complete as possible, the exercise which is analyzed should be carried out from a certain starting position, in order to view the muscles and muscle groups which take part in carrying out the movement, the type of muscle contractions, the way of engaging muscles in the movement and other.

## LORDOSIS

One of the most frequent postural disorders in pre-school and younger school children is lordosis. It is the inward curvature of the lumbar region of the spine, but with a forward pelvic tilt, when the pelvis tips forward from 15 to 30 degrees when resting on top of the thighs, measured according to the *Cobb* angle measuring method. An increase of over 30 degrees of the curvature indicates the existing of lordosis.

The status of a lumbar curvature can also be determined with the help of a plumb line and a ruler (Figure 1). The increase of a lumbar curvature over 5 cm, measured from the base of the curvature to the plumb line along the spine indicates the presence of lordosis.

Figure 1.



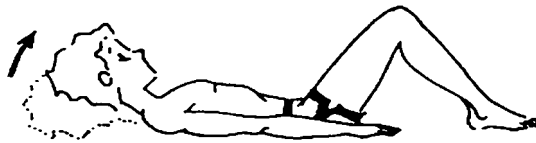
The basic cause for the occurring of lordosis is the disruption of the balance between the flexors and the extensors of the hip joint, as well as an insufficiency of the stomach muscles.

## KINESIOLOGICAL ANALYSIS OF EXERCISES

### Lying starting position

This position (Figure 2) is very stable as the brunt of the body is over the ground with an exceptionally large support area. It can be said that the lying position is very economical from the standpoint of energy expenditure. It can be applied in the elderly as well as very young children as a starting position for carrying out exercises due to its efficient nature and stability. It can also be applied as a lying position on the back (supine), while lying on the stomach (prone) and lying on the side (lateral position). All the mentioned positions are applied often in the preventive and correctional work as numerous exercises can be carried out with a greater or lesser torque.

Figure 2.



**Starting position:** Lying on the back (supine). The legs are flexed in the joint of the hip and knee, and the hands are next to the body.

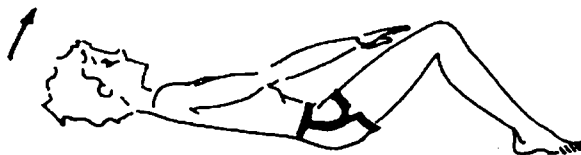
**Contents and analysis of exercises:** The patient should flex his head to the moment of contact of the chin with the *fosom jugulum*. The movement is carried out in the atlanto-occipital joint and the neck part of the spinal column and the flexors of the head and neck (*m. sternocleido mastoideus*, *m. rectuscapitis anterior*, *m. longuscapitis*, *m. longuscolli*, *mm. scaleni*, *mm. suprahyoidei et mm. infrahyoidei*). The mentioned movement is carried out by a concentric contraction. The isometric contraction of the stomach muscles fixates the sternum, and the fixating of the sternum and clavicle is also helped by *m. pectoralis mayor (pars clavicularis)* and *m. subclavius*. In this movement, both the neck and upper body spine extensors participate as the stabilizers, via an isometric muscle contraction. They fixate a part of the spine in order for the prevertebral and scalene muscles to have the necessary support for carrying out a movement.

Returning the head to its starting position is carried out under the influence of gravity, and the mentioned muscles are directed by an eccentric muscle contraction, or in other words, they control the movement.

**The aim of the exercise:** The exercise is chosen in the aim of strengthening the flexors of the head and neck, and it very efficiently engages the stomach muscles. The very starting position is optimal as it is very stable

and does not exert a large expenditure of energy. The flexed legs direct a retroversion of the pelvis and the strengthening of the lumbar curve. The exercise is appropriate for the young as well as barely mobile patients. It is recommended in the prevention and correction of lordosis.

Figure 3.



**Starting position:** Lying on the back with flexed knees and the arms next to the body (Figure 3).

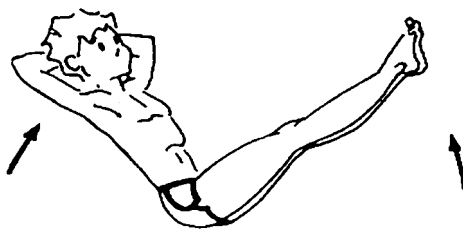
**Contents and exercise analysis:** The patient raised the upper body (cranial) together with the hands extended in front of the body. Elevating the body from the ground is carried out to the moment of separating the shoulder blades from the floor, at most 45 degrees from the floor. The movement is started by the flexors of the head and neck, and then the flexors of the torso by concentric muscle contractions. Thus, the torso flexors (*m. rectus abdominis*, *m. obliquus externus et internus abdominis*, *m. psoas mayor*) carry out the movement up to 45 degrees when the torso tilts the mentioned angle with the base.

The flexors of the thigh with an isometric contraction “act” as the fixators of the pelvis, securing its stability. The position of the arms additionally increases the torque which makes the exercise even more efficient.

Returning to the starting position is carried out by the muscle flexors of the torso by an eccentric contraction, and in the final part of the movement also by the flexors of the head and neck via an eccentric muscle contraction.

The aim of the exercise: Strengthening primarily the muscle of the abdominal wall, which is carried out by correcting the increased lumbar curve.

Figure 4.



**Starting position:** The lying position on the back with legs stretched out, with fingers interlaced at the back of the head (Figure 4).

**Contents and exercise analysis:** A simultaneous elevating of the lower (caudal) and the upper part of the body are to be carried out from the mentioned position. The position of the arms increases the torque so that the torso flexors, that is, the front even kinetic muscle chain will be exceptionally engaged by concentric contractions. Thus, along with the abdominal flexors, also participating in the movement are the flexors of the thigh (*m. iliopsoas*, *m. tensor fasciae latae*, *m. sartorius*, *m. pectineus*, *m. rectus femoris*, *m. adductor brevis et longus*, *m. gracilis*, *m. obturatorius externus*), as well as *m. quadriceps femoris* which by an isometric contraction maintains an extended calf.

Considering there is a simultaneous elevating of the upper and lower parts of the body, the mentioned musculature is engaged in total, and the position and the movement additionally impact the correcting of the lumbar curve.

The return to the starting position is carried out under the influence of gravity, and the same muscles are directed and controlled by an eccentric contraction.

**The aim of the exercise:** Strengthening the stomach muscles, which impacts the prevention and correction of lordosis.

Figure 5.



**Starting position:** Lying on the back with extended legs, with the arms next to the body (Figure 5).

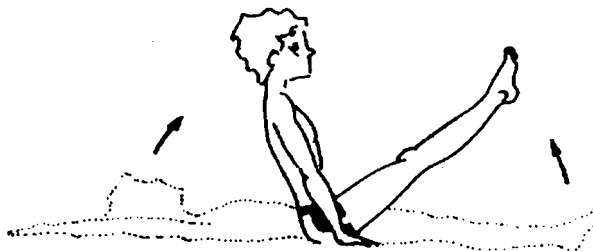
**Contents and analysis of exercises:** The patient elevates the upper part of the body together with outstretched arms, and then he carried out a torso rotation to one side and returns to the starting position. The movement is repeated with the rotation to the other side and alternatively. The torso rotation is carried out to the moment of separating one shoulder blade from the floor. At the same time with elevating the upper body from the floor the movement of torso rotation is also carried out, and the extended hand follows the mentioned movement, in such a way that the hand of one touches the upper arm of the other hand.

The movement starts with a concentric contraction of the flexor muscles of the head and neck. In that part of the movement, the stomach muscles fix the sternum with an isometric contraction, and then the muscles

of the abdominal wall contract. The stomach muscles carry out an elevating of the torso from the floor by a concentric contraction. In the first part of the movement, the most active is the even stomach muscle, and then the traverse inner one on that side and the traverse external muscle from the other side, carrying out a movement of torso rotation to one side. Also participating in this movement are the muscles of the dorsal spine (*m. transversospinalis*, *mm. levatores costarum*, *m. iliocostalis*). Along with the mentioned, also engaged are the muscles of the thigh flexors which by an isometric muscle contraction carry out a pelvis stabilization.

**The aim of the exercise:** Strengthening the muscles of the longitudinal front even and the transverse kinetic muscle chain.

Figure 6.

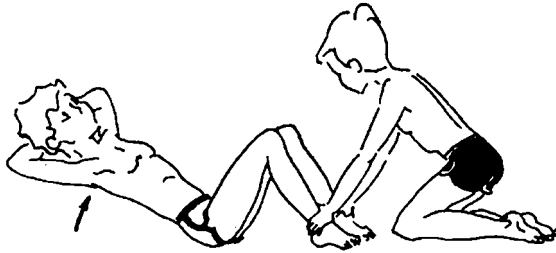


**Starting position:** Lying on the back with the arms elevated – outstretched (Figure 6).

**Contents and analysis of exercise:** From the mentioned starting position, carry out the raising of the upper (cranial) and lower (caudal) body part to the sitting position. In the finishing part of the movement, the hands are along the pelvis, leaning on the floor. The elevated hands increase the torque in relation with the previously described exercise. The exercise is carried out by a simultaneous action of the torso and thigh flexor muscles. Along with the mentioned muscles in the first part of the movement, also active are the muscles of the shoulder area, that is, the anteflexors of the hands (*m. deltoideus*, *m. clavicularis*, *m. pectoralis mayor*, *m. corac brachialis*) as well as the flexors of the head and neck. The outstretched calves are upheld by *m. quadriceps femoris* by an isometric muscle contraction. Returning to the starting position is carried out under the influence of gravity, and the movement is directed and controlled by the same muscles, but by an eccentric contraction.

**The aim of the exercise:** The strengthening of the complete stomach wall in an open kinetic chain. In the finishing stage of the exercise, a sitting position with outstretched legs carries out an optimal effect on the lumbar curve in the sense of its retracting.

Figure 7.



**Starting position:** Lying on the back with legs held by the therapist and with the fingers interlaced at the back of the head (Figure 7).

**Contents and analysis of exercise:** The patient carries out the elevating of the upper body up to 45 degrees. The closed kinetic chain downwards will cause a strong effect of the complete front longitudinal chain. The hands behind the head and the elbows extended along the shoulder axis will increase the torque, which makes the exercise more efficient. The movement is carried out by even and transverse stomach muscles by a concentric contraction. The hip flexors, in the very beginning of the movement, and the lower parts of the stomach wall by an isometric contraction appear as pelvis fixators. Already after the separating of the shoulder blades from the floor, the entire stomach musculature and *m. psoas mayor* as a synergy movement are engaged. The mentioned muscles carry out a 45 degree movement. If the movement should go over 45 degrees, the same would occur within the hip joint. In that case, the stomach musculature transforms into a static contraction and behaves as a stabilizer of the pelvis, while the flexors in the joint would by a concentric contraction continue to carry out the movement. Returning to the starting position is carried out under the influence of gravity, and the movement is directed at the beginning by an eccentric contraction of the flexors in the hip joint, and then the muscles of the abdominal wall, to the starting position.

**The aim of the exercise:** Strengthening the stomach muscles. The exercise is very efficient and used in the final stage of the treatment of lordosis. If it were applied in the beginning stage with an insufficient stomach musculature, it would even be counter-indicated. An insufficient stomach musculature in a closed kinetic chain downwards could not carry out the elevating of the cranial part of the body from the floor. In that case, there would occur a hypertension of the lumbar spine. Such a hyperlordosis-affected spine would be fixed by the stomach muscles via an isometric muscle contraction, and the flexors in the hip joint would carry out the movement, which would totally minimize the effect of the exercise and render it harmful.

Many therapists err when they opt for this and similar exercises in the early stage of the treatment with a still insufficient stomach musculature. Thus they can cause more damage than benefit.

### The sitting starting position

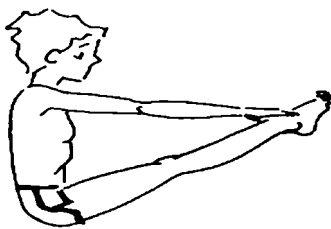
The sitting position can be very good for carrying out exercises to strengthen the stomach muscles (Figure 8). The brunt of the body is retained in the borders of the support polygon. The level of energy expenditure depends on whether the position of the legs crossed or a basic sitting position is used.

The exercises for strengthening the stomach muscles are mostly carried out from the starting position with bent and outstretched legs. The sitting position with legs crossed is most often used for stretching the lumbar extensors and for achieving a retraction of of lumbar curve.

The starting position is relatively stable, and at the same time demanding as well, especially if the legs are outstretched, and the spinal column is strengthened and elongated. For maintaining such a position, it is necessary to increase the activity of the torso extensors (*m. erector spinae*, *m. iliocostalis*, *m. transverso spinalis*, *m. spinalis*, *mm. levatore scostarum*, *mm. intertransversarii*, *mm. interspinales*, *m. quadratus lumborum*) and the activity of the thigh flexors (*m. quadriceps femoris*), which should maintain a passive insufficiency of the muscles of the back side of the buttocks.

During carrying out the exercises in this starting position, the stomach muscles are mainly engaged via a static muscle contraction.

Figure 8.



**Starting position:** Sitting with outstretched legs and hands on the floor.

**Contents and analysis of exercise:** At the same time, carry out the flexing of the outstretched legs in the hip joint and an anteflex of the outstretched arms towards the feet dorsum. The movement in an open kinetic chain is carried out by a concentric muscle contraction of the thigh flexors, while the stomach muscles via an isometric contraction stabilize the pelvis. The stomach muscles as stabilizers are especially active in the first part of the movement. If the movement continues to the total separating from the back of the thigh from the floor, that is, to the collapsing of the pelvis upwards, the stomach muscles would additionally be engaged even via a concentric contraction.

An anteflexing of the outstretched hands, along with the anteflexors in the first part of the movement, engages the upper parts of the stomach muscles

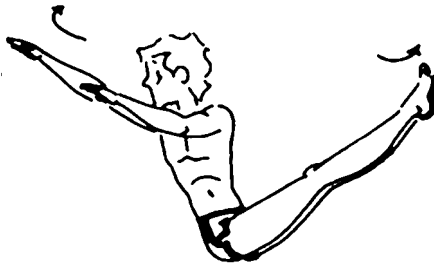


via a concentric contraction. Thus, this exercise engages the entire front part of the real kinetic muscle chain. At the same time, through all the stages of the movement, from the start to the final one and returning to the starting position, the lumbar spine constantly retains a good, i.e. improved position.

It is carried out by the same muscles only via an eccentric muscle contraction.

**The aim of the exercise:** Strengthening primarily the muscles of the abdominal wall which impacts the decreasing of the lumbar curvature.

Figure 9.



**Starting position:** Sitting with outstretched legs and the hands on the floor (Figure 9).

**Contents and analysis of the exercise:** Unlike the previous exercise, this one is far more complex in a motor as well as kinesiological sense. The exercise is started by the muscles flexors of the thigh via a concentric contraction along with a simultaneous concentric contraction of the arm elevators. Throughout this, the stomach and muscles of the extensors of the lumbar spine fix the pelvis via an isometric muscle contraction. Raising the outstretched leg and turning them to one side, and the arms and torso to the other side, demands a complex engaging of the muscles from the front, side and back side of the torso. The turning of the legs to one side is followed by moving the pelvis to that side. Along with carrying out of this movement and with the thigh flexors, the muscles of the abductors of the thigh from the same side also take part (*mm. gluteus medius minimus et maximus, m. tensor fasciae latae, m. sartorius, m. rectus femoris, m. piriformis, m. obturatorius internus*) and the muscles of the abductors of the thighs from the opposite side (*m. iliopsoas, m. aductor longus et brevis, m. gracilis, m. gluteus maximus, m. obturatorius externus, m. quadriceps femoris, m. pectineus, m. biceps femoris, m. semitendinosus et semimembranosus*). The torso rotation is carried out in the same direction by the *m. iliocostalis* and *m. obliquus internus abdominis*, and in the opposite direction by *m. obliquus externus abdominis, m. transversus spinalis et mm. levatores scolarum*.

The harmful movements which follow torso rotation exceptionally engage the upper parts of the even and transverse stomach muscles. Their

engaging, depending on the movement stage, goes from isometric, concentric to eccentric muscle contractions.

The aim of the exercise: Primarily strengthening the complete stomach wall, as well as the influence of all the mentioned muscles which are engaged in the mentioned exercise.

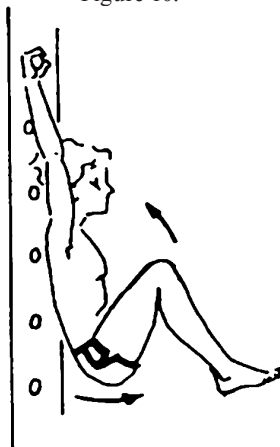
### Starting hanging position

This position represents a stable type of balance, and it can be applied as an active and passive hanging. In our case, it is an active hanging (Figure 10).

It is desirable to be carried out on a climbing frame with the back facing the apparatus. The starting position does not allow for the moving of the pelvis, that is, the entire dorsal side backwards. With an active hanging, along with isometric muscle contractions of the flexor muscles in the finger joints, it is necessary to increase the isometric engaging of the muscles which should maintain a good position of the shoulder area and the area of the lumbar spine.

The shoulder muscles (*m. levator scapulae*, *m. trapezius*, *m. serratus anterior*, *m. pectoralis mayor et minor*, *m. latissimus dorsi*) prevent via an isometric contraction the failure of the head-torso-pelvis-legs system through the shoulder area. Also, the isometric contraction of the stomach muscle wall prevents the turning of the pelvis around the transversal axis straight and downwards, which reduces the lumbar curvature. The starting position is quite demanding and strenuous and should be applied only in the later stage of the correctional treatment of lordosis.

Figure 10.



**Starting position:** Hanging position.

**Contents and analysis of exercise:** From this position, carry out a simultaneous flexing of the legs in the knee joint as well as their elevating

towards the torso. The movement is carried out by a concentric contraction of the flexors in the hip joint in the first stage of the movement of the stomach muscles engaged by an isometric contraction as pelvis stabilizers. When the knees of the flexed legs are in a right angle which inclines the thigh and torso, and when there is a separating of the pelvis, that is, the gluteus region, the stomach muscles changes from an isometric to a concentric contraction bending the pelvis towards the torso. In the finishing part of the movement, along with an exceptional engaging of the muscles of the stomach wall, there is a retracting of the lumbar curve. Returning to the starting position is carried out under the influence of gravity, and in the very start the stomach muscles, and then the hip flexors and the thigh extensors via an eccentric contraction take the lower extremities to the starting position.

**Contents and exercise analysis:** Primarily strengthening the stomach muscles via a static, concentric and eccentric muscle contraction. Along with this, the very starting position leads to an axial extension of the spinal column.

## CONCLUSION

The paper shows a high-quality kinesiological analysis of exercises for the prevention and correction of lordosis. A limited space dictated the choice and number of exercises. The description of the mentioned starting positions from which the exercises are carried out and the kinesiological analysis of the exercises shown should show the specialized community how to approach the creating of certain exercises. This implies that therapists, P.E. teachers and coaches should in such a way view and carry out a choice of complex exercises. While creating exercises, attention should be paid to the choice of the starting position, as well as the type of muscles and muscle groups included in the exercises as well as the way of their inclusion. There should also be a clear aim what needs to be attained by applying the chosen exercises.

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