CONTROL AND CORRECTION OF HORSE RIDER'S BODY POSTURE

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Abstract. Centre of gravity represents the point where the net force of gravity of all the body parts is applied. Balance is a specific state of the postural control system, being a vertical orientation of human body maintained through balancing the forces and moments of forces that act on the body. Stability is understood to mean the ability to recover the state of balance and typical body position in the space.
The concept of division of the rider's posture into 5 blocks that has been used in the literature seems to be legitimate. However, due to the natural shape of spinal curvature, the division of body into opposing truncated pyramids (a trapezoid in the sagittal plane and a rectangle with longer horizontal sides in the frontal plane) appears to be more accurate. The eight-segment model is dynamic and illustrates all the shallowed or deepened spinal curvatures very well while maintaining alternate sagittal curvatures with regard to the deficits of motion in the joints. It is also correct in anatomical terms since it contains all the sections and joints in the kinematic chain.
Body posture, considered under conditions of the equestrian pair (a rider and a horse) as a motor task, will be adjusted using the continuous control. This control works within the tracking system and consistently adjusts the activity of different muscles to current needs. These needs result from a specific program encoded in the central nervous system and, more specifically, from the difference between the program and current state of the equestrian pair. This program is developed during equestrian training and it represents a demanded situation.

Key words: centre of gravity, balance, stability, feedback

Introduction

Centre of gravity represents the point where the net force of gravity of all the body parts is applied. It should also be emphasized that the centre of gravity and centre of mass are theoretically not identical and might lie in different locations. However, the centre of gravity of the body present in the uniform gravitational field lies in the point which is also the centre of mass. General centre of gravity (COG) in standing position is located at the level of approximately 53% to 60% of body height. Mean values are 56.5% for the population of younger males and 55.5% for younger females. It has often been demonstrated that these differences result from body build, e.g. more developed and stronger muscles of the shoulder girdle in men and more developed pelvic girdle in women.

The above cited differences in percentage levels of COG height did not show statistical significance. In young children, the centre of gravity is located relatively higher than in an adult person due to a relatively higher mass of the head and lower mass of legs. Sports that involve a substantial increase in muscle mass might lead to the change in COG. A gymnast, for example, with well-developed shoulder girdle and upper limbs, might have the COG located higher (with respect to body height) compared to a football player with bigger leg muscles (Bober and Zawadzki 2006). Zagrobelny and Woźniewski (1999), Witt (1999) demonstrated that only insignificant deviations in the upright position can be found between genders, with COG located behind the pubic symphysis, at the distance of 2.5–5 cm before the second sacral vertebra.

Balance is a specific state of the postural system, being a vertical orientation of human body maintained through balancing the forces and moments of forces that act on the body (Bober, Zawadzki 2006). Human body is a complex biomechanism made of five kinematic chains, each of them comprising several segments connected with joints. Forces of gravity must be balanced in each segment. If every segment rests on a similar component located below, joints represent only support surfaces. These surfaces are extremely small and balancing of the segment supported is becoming difficult. Therefore, maintaining its passive balance is impossible since neither centres of gravity in different body parts nor the centres of motion in the joints between them cannot be reduced to the profiles with a common line of gravity. Maintaining the segments in balance necessitates the appropriate muscular tension. Mutual interaction of the moments of forces that originate from gravity and moments of forces released through muscle tension make each segment with respect to the segment below, and the whole body with respect to the support surface, remain in motion.

Using these criteria, one can consider a human body as a highly unstable structure and, bearing in mind irregularity of shapes and unequal bone length, one can conclude that human body, with its philogenesis, “solved” the problem of balance very well. A fundamental factor in maintaining balance is flexibility of vertebral column and physiological curvatures which adapt so that the gravity line falls onto the support surface of the whole structure. If, however, the line of gravity falls outside the support surface, the balance of a highly unstable structure cannot be maintained. The segment-based flexibility of the vertebral column allows only a poor degree of individual rotation of the vertebra, whose ligaments are insufficiently strong to inhibit motion (Zagrobelny and Woźniewski 1999).

In a horse rider, the COG is located in another place, since the support surface is represented by the vertical projection of the rider’s surface whereas position of upper limbs that hold the reins cause a shift of the COG to the front, with its point located most probably ca. 10 cm before the 6th thoracic vertebra.

Despite the substantial search, we found no reports that demonstrated the COG in a horse rider and a pair of a horse and rider. Undoubtedly, this point will not be represented by the location presented by Swift (2004).

Balance is ensured by the nervous system through tension of the postural and anti-gravity muscles. Signals on location and movements of the head are transferred by lateral vestibular nuclei in the medulla oblongata to the spinal cord. The nuclei are the place of integration of signals from otolith organs such as cerebellum and spinal cord. The role of balance control is ensured by information from the four sensory systems: peripheral vestibular organ, visual system, proprioceptive system and mechanical cutaneous mechanoreceptors (Błaszczyk 2004). Balance in the equestrian pair is achieved when the horse body is positioned so that the motion is relaxed and efficient, and, consequently, powerful. This type of sport-specific balance is developed naturally, if the horse is given the chance to be tested. The horses should be trained in varied terrain and different types of surfaces. The less the horse experiences its own balance, the more guidance it requires (Rohlf 2008).

According to Błaszczyk (2004), stability is understood to mean ability to recover the state of balance and typical body position. Two types of stability can be distinguished: functional and structural. There are two factors that affect stability. Firstly, the bigger support surface, the higher forces should be applied in order to disturb the balance and move the line of gravity outside the support surface. Secondly, the lower the centre of gravity, the bigger (longer) the arch that has to be drawn by the disturbing force in order to shift the centre of gravity outside the support surface (Zagrobelny and Woźniewski 1999).

Stability of the standing position is determined by location of the centre of gravity. It is correct if the projection of the centre of gravity is maintained in the centre of the support surface. Its loss results from any human body activity (respiration, blood circulation, cardiac cycle, activity of postural muscles). The direction of sway and its rate is highly chaotic. Stability is corrected through stimulation of the muscles that stabilize joints after exceeding a particular threshold value (soleus muscle and tibialis anterior muscle in the basic position). Edges of the feet represent the stability boundaries for the standing position. Actual stability boundaries are formed by the shape of the feet plus safety margin (5–7 cm) (Błaszczyk 2004). Heuristic model of control of postural stability occurs within the following sequence:

1. Detecting the type, size and direction of balance disturbance by the sequential system.
2. The choice of adequate response that recovers the balance takes from 70 to 100 ms represents the time reserve of postural stability.

Block body structure

Unfavourable structure of the bone system effects in 70% of body mass to locate at 2/3 of body height. Maintaining vertical position typical of the contemporary humans necessitates balancing the moments of external forces, acting on individual passive and active segments. Maintaining body balance is affected by the morphology and function of the bone, muscular and nervous system and the support surface area and height of the centre of gravity. To put it most simply, it can be adopted that human body in standing position is represented by the segments that lie one on another and are a set of reversed pendulums that remain in the state of disturbed balance. Therefore, there is no state of static balance in this position but rather permanent regaining of the lost balance. The reasons for this state include respiratory motion of the thorax (0,3–0,5 Hz), muscular tremor (7–14 Hz), cardiac cycle (0,9–1,3 Hz) and movements that correct maintaining body posture (0,05–0,2 Hz) (Wit 1999).

Analysis of behaviour of the simplest model of standing position, such as the model of reversed pendulum, shows that its stability in vertical position can be ensured in two manners. The first one means a direct monitoring of the angle of pendulum inclination with respect to the support surface. In humans, this angle is controlled first and foremost by the proprioceptive feedback from the area of the ankle joint. Deviation of the posture from the vertical line are signalled as changes in the tension and length of muscles, changes in joint angles and distribution of pressure to the surface of feet. The second type of stability control might utilize the signals on location of the upper tip of the pendulum. In the case of the body posture, this means control of position of human head in the space. Vision and the vestibular apparatus located in the internal ear provide the necessary feedback to maintain proper (the highest) body position in the space. Furthermore, head location controls trunk and limb muscles tension through cervical reflexes. From this standpoint, one can assume that the balance is ensured by integration of the peripheral ascending control (ankle joint – head) and descending control (head – ankle joint) in the nervous system. Both types of control ensure a stable vertical control during free standing and locomotion. The controls supplement each other;

thus, limitation of one of them can be compensated by the activity of the other (Błaszczyk 2004). Maintaining vertical body position necessitates active involvement of anti-gravity muscles (Bober and Zawadzki 2006).

Swift (2004) demonstrated that by arrangement of individual body parts one over another leads to reduction of muscular tension, effort and energy necessary to maintain it in vertical position. Furthermore, Swift also argues that division of the body into blocks is closely related with peripheral vision, respiration and the centre of gravity. Further, this researcher notes that it is essential that the blocks are positioned one over another so that they form a stable wholeness. The effects include following the horse movements and a smooth, unrestricted horse motion.

The concept of the division of the horse rider's body posture into 5 blocks (lower limbs, pelvis, thorax, shoulders, neck and head) seems to be legitimate. However, it might be not entirely true. It is impossible to consider a human body posture as a stable structure composed of "cuboid blocks" and analyse it under conditions of quasi-statics and motion. Due to the natural shape of spinal curvature, the division of body into opposing truncated pyramids (a trapezoid in the sagittal plane and a rectangle with longer horizontal sides in the frontal plane) appears to be more accurate. Similar concept was proposed by Lehnert-Schroth (1973) (the author introduced necessary modifications). Body position represents eight opposing truncated pyramid blocks: the head, with its greater base turned towards the rear, cervical part of the vertebral column turned towards the front, thoracic part turned towards the rear, lumbar part turned towards the front, pelvis turned towards the rear, hips turned towards the front, lower legs turned towards the rear, and feet turned towards the front. The recommended eight-segment model is dynamic and illustrates all the shallowed or deepened spinal curvatures very well while maintaining alternate sagittal curvatures

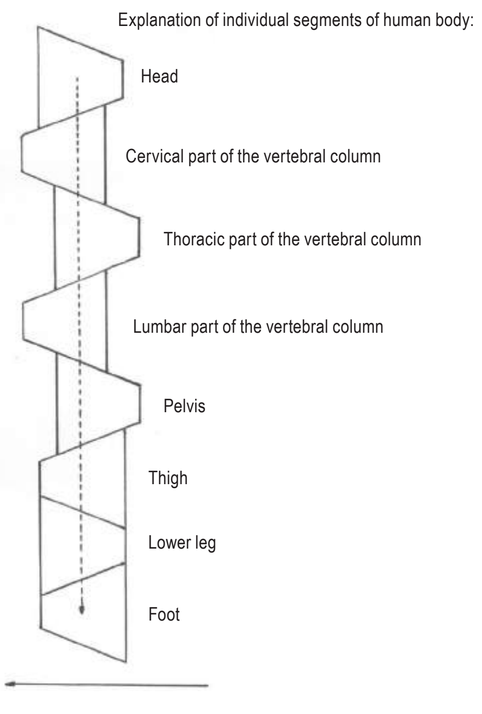

Figure 1. Arrangement of body segments in the basic position

and allowing for deficits of motion in the joints. It is also correct in anatomical terms since it contains all the sections and joints in the kinematic chain.

A precondition for correct analysis that reflects location of individual horse rider's segments in motion or under static conditions in the sagittal plane is to maintain frontal symmetry of the central lines of the pyramids. Under conditions of the balanced and correct body posture, the proposed system of opposing pyramids of the cervical, thoracic and lumbar sections of the vertebral column and pelvis forms a vertical column in the state of balanced joint chain, where the net gravity force vector applied to the head segment covers the component vectors of the hips, lower legs, feet and the COG, oscillating within an individual non-asymptotic statokinesiogram in the central support surface, see Figure 1.

In horse riders, stability is ensured in two manners. The first of them means direct monitoring of the "pendulum" inclination angle with respect to the support surface, but this involves proprioceptive feedback from both ankle joint and hip joint areas. Deviation of body posture from the vertical position is signalled as changes in the tension and length of muscles in the pelvic girdle, changes in the joint angles and distribution of the pressure of hip surface on the saddle and horse sides and the surface of the feet supported in the stirrups. The second type of stability control will be similar in the standing position.

System of postural control

According to Jean Masion, this system uses external and internal referential system. Therefore, there are anticipative and reactive postural corrections. The point of application of the net ground reaction forces generated as a response to muscular action and gravity forces moves within a specific area. With undisturbed standing position, this dislocation in anterior-posterior and lateral directions amounts to 20mm, whereas the frequency of changes ranges from 1 to 5 Hz. A study by Winter (1987) shows that the stimuli received from the centre of foot pressure represent the main signals to control maintaining the stable standing position. As mentioned before, in the case of a horse rider, this means impulses received from hip joints.

A very significant effect on the quality of dynamic postural control, (and, consequently, on stability) is from limited conduction rate of signals and excitation time. This limitations lead to the latency time. Starting an appropriate postural reaction as a response to disturbing stimuli signalled by the vestibular apparatus occurs after 180 ms (visual reaction after 0.5 s). Even longer latency is observed for postural corrections connected with perception of the subjective vertical position: these reactions occur after about 1 to 2 seconds.

In the context of a horse rider, the above presented analysis can be approached in the following manner:

Rider's body posture under conditions of statics

If the structure of truncated pyramids that represent the vertebrae are located one on another and the top position is taken by the head, below the shoulder girdle, the whole structure shifts its gravity into the rear part of the inclined pelvic basin, which sways on the two ischial tuberosities and ramuses supported on the saddle in the area of the vertical projection of the rider's surface and the area of non-asymptotic stabilogram, the stability of this structure depends on whether:

– the line of gravity in each of the pyramids falls in the contact area of the adjacent solids and does not exceed the actual stability limit,

– dimensions of the lower pyramids create sufficient support base on which the whole structure is supported,
– strength of the connections between the pyramids is sufficient.

The muscles that maintain the column of the pyramids one on another are in continuous state of tonic contraction. The horse rider's position always necessitates muscular tension and they are never entirely relaxed. There is an insignificant lateral dislocation of body weight through sacral and pelvic joints and pelvic bones into ischial tuberosities at each side, which might be the location where the gravity line might go through. This causes that pelvis, swaying towards the rear, must be balanced over the tops of the ischial tuberosities. This involves contraction of the iliopsoas and pectineus muscles. Furthermore, in order to ensure the lateral balance in motion, the gluteus maximus and gluteus minimus muscles are also activated. Each deviation from the upright position necessitates higher activity of these muscles and higher work of the extensors.

Under static conditions of the balanced and proper rider's posture, the proposed system of opposite truncated pyramids will be represented by a column of alternately protruding hip and lower leg segments, Figure 2.

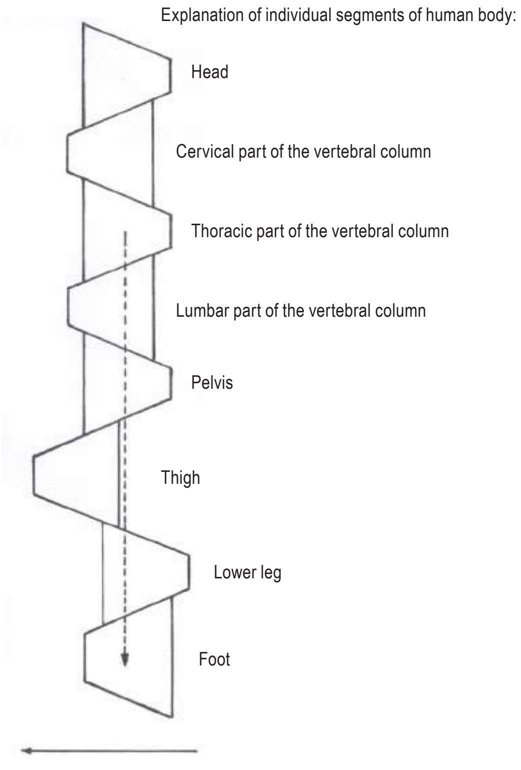

Figure 2. The system of segments in a rider's body posture under conditions of statics

If we adopt the head solid as a reference, the hip segment is shifted to the front, whereas the lower leg is shifted towards the rear. Other solids, i.e. head, cervical, thoracic and lumbar section of the vertebral column, pelvis and feet are oriented similarly to proper body posture. Therefore, the entire system maintains balance, since the projection of the COG, which is most probably located at 10cm before the 6th thoracic vertebra, falls in the area of the external part of the fibula, oscillating within an individual, non-asymptotic statokinesiogram in the centre of the support surface area.

The centre of horse gravity is located between the stirrup leathers and, in vertical line, at 2–3 cm below the flaps. With full riding position, based on three-point support in the saddle (two ischial tuberosities and ramuses) and contact with hips, a horse rider is located very closely to the centre of gravity of the horse and, consequently, in a very good balance, integrated with the horse (Swift 2004). Under these conditions, the general centre of gravity of the horse rider is located over the horse's centre of gravity. This represents one of conditions for optimum riding position, see Figure 2. The combined centre of gravity should not exhibit bigger deviations from the central area in the support surface compared to the rider alone.

Rider's body posture in motion

An additional destabilizing factor is any additional action (rider's posture, upper or lower position) and instability of the support surface that deepens multi-planar and swaying motion of the pelvis. Under dynamic conditions, postural control is reduced to the control of head location in the space. Vision and the vestibular apparatus located in the internal ear provide the necessary feedback to maintain proper (the highest) body position in the space. Furthermore, head location controls trunk and limb muscles tension through cervical reflexes. With this perspective, one can observe that the balance is ensured by integration of the peripheral descending control in the nervous system (head – ankle joint) with a relatively low contribution of the ascending system (ankle joint – head). Both types of control ensure a stable vertical control during free standing and locomotion. The systems supplement each other, which means that the limitation of one of them, e.g. with the horse riding position, might be compensated by the activity of the other. The strategy of the hip joint suits this situation perfectly. Under conditions of the activity of the functional destabilizing stimulus, the loss of the balance is compensated by the sequential muscular activity, started in the hip and trunk muscle, descending downwards to further muscles of lower limbs.

Riding position in balance on the moving horse requires self-awareness, feeling, experience and "listening" to what the horse "says". Being aware that there is nothing like the "proper position", one can use the concept of the position suitable to what we are doing at a particular time. Similar to the case of the horses, it is impossible to achieve a concrete riding position through forcing it and maintaining a specific fixed position. This would most probably result in excessive tension and stiffness. There is no single arbitrary position, but we are attempting to determine which position offers the best balance to a rider, when he or she is sitting on a moving horse. Therefore, this means a position where a rider is able to perform the most of manoeuvres effectively and with easiness. The best position is somewhere in the middle between all the possible riding positions. Searching for the proper body posture is necessary because an individual correct riding position is also the most comfortable. The experience of seeking your own balance represents the point of reference as this process is also experienced by the horse. Furthermore, some characteristics of the basic position necessitate symmetry in the frontal plane, opportunities for placing of the centre of rider's thorax in one line with the horse's thorax and the rider's hip line with the horse's hip line (Rohlf 2008).

The horse's centre of gravity in motion is insignificantly shifted upwards. With full horse riding position, necessary for the equestrian work, the horse rider remains very close to the horse's centre of gravity, and, in a good balance integrated with the horse (Swift 2004). Under these conditions, the general centre of gravity of the horse rider is located over the horse's centre of gravity. In canter and jumping, the rider's weight rests mostly or entirely on the stirrups and, automatically, remains over the horse's centre of gravity. With flexion position and muscular work of the lower limbs and back, the horse rider is close to the saddle, but not sitting on it. Under conditions of the balanced and proper rider's posture during canter, the proposed system of opposite truncated pyramids will be represented by a column with irregular arrangement of the segments. If we adopt the head solid as a reference, the segments of head and neck are moved to the front, whereas lumbar, pelvis and lower leg are shifted to the rear. Furthermore, the head segment is shifted the most to the front, whereas the pelvis is shifted the most to the rear. This causes the whole system to maintain balance. With these conditions, the projection of the COG runs from the point in the thorax and falls next to the external part of the fibula, see Figure 3.

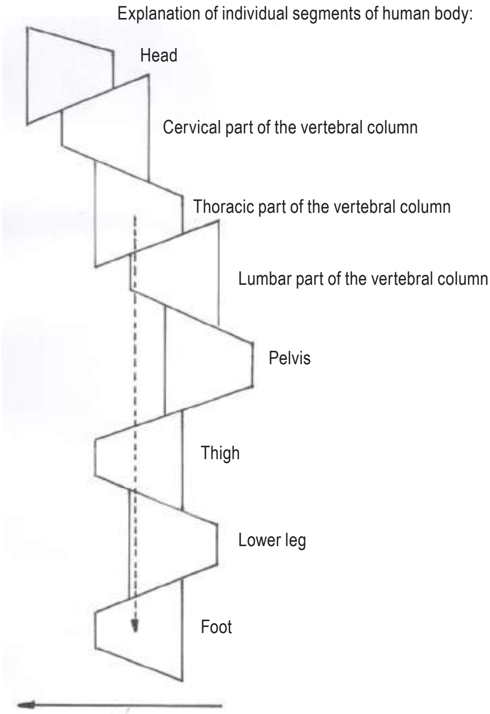

Figure 3. The system of segments in a rider's body posture in canter

The centre of gravity oscillates within individual non-asymptotic statokinesiogram in the centre of the support surface limited by the position of the feet in the stirrups.

The COG must be always in the area of actual border of stability, limited by the shape of the vertical projection of the abducted thighs and lower limbs adjacent to the saddle and feet in the stirrups, forming the support surface with approximate dimensions of: 76–85 cm × 4 cm (vertical distance between the external edges of the stirrup's tread x width of the tread), which also supports the column with often 100 cm in height. Its maximum anterior-posterior dimension amounts to 35 cm, whereas the maximum lateral dimension is 60 cm. This definition of the support surface area reveals substantial problems of the horse riders with postural stability in the sagittal plane and smaller in the frontal plane. The force which effectively throws the rider out of the stability limits in the sagittal plane must be significantly higher in the frontal plane. With regard to theoretical investigations, one should ask the question: Is the support surface in the sagittal surface limited with the stirrup's treads or with the point of fixing the left and right stirrup leathers or the location of the last lower contact with the saddle? The problem requires further research.

The line of gravity of the horse rider's body do not divide the body into two different halves (anterior and posterior) along the theoretical vertical line adopted since flexed trunk position and upper limbs that hold the reins force the shift of the COG slightly further to the front from the lateral ankle, as far as possible towards the actual balance limit.

The adopted and used respiratory pattern during jumping and canter is of substantial importance. The male rider respires more naturally with the abdominal pattern, whereas the horsewomen prefer the costal pattern. With the female rider, this allows for taking the thorax and the COG closer to the horse's centre of gravity. The male rider is forced to adopt a more extensive posture and to use the abdominal respiratory pattern. This leads to the following conclusion: in the case of the male rider, the external destabilizing stimuli might be insufficient for achievement of the same effect in the case of the female rider. Furthermore, the COG of the female rider is located below the rider.

Balance and stability is a complex specific ability of each rider, possible to be trained, and should be trained at the initial phase of the basic training (Mrozkowiak 2009). The above investigations were carried out based on the study by Zagrobelny and Woźniewski (1999).

Correction of body posture of the equestrian pair

Regarding the title of this subchapter, one should adopt the Feldman's hypothesis, which says that body posture can be considered as a motor habit. According to this hypothesis, during learning body postural control i.e. learning a new movement, the nervous system uses initially a strategy of increased stability, which characterizes co-contraction of antagonist muscles in establishment of coordination engrams. However, as the nervous system learns the loads that accompany movements, it gradually switches to a more effective strategy of reciprocal control. This control does not consist in excitation of antagonist muscles for contraction but rather inhibition of these muscles so that they become slack. As a motor habit, body posture is developed within a particular morphological and functional background, whereas the constantly emphasized component of all the programs of corrective procedures or broadly understood "postural re-education" is prevention of the development of a habit of improper posture and development of the proper one. Appropriate structure of bone and joint system and eutonia of the muscular system is essential for adoption and maintaining proper posture.

Body posture, considered under conditions of the equestrian pair (a rider and a horse) as a motor task, will be adjusted using the continuous control. This control works within the tracking system and consistently adjusts the activity of different muscles to current needs. These needs result from a specific program encoded in the central nervous system and, more specifically, from the difference between the program and current situation of the equestrian pair. This program is developed during equestrian training and it represents a demanded situation. The current situation is acquired through the information flowing from proprioceptors (susceptible to shortening and extension of individual muscles, joint receptors, ligament receptors and the internal ear). They provide information on the angles between individual joints, head position and vertical body position. The data from these locations also include those from visual telereceptors and provide information about linear and angular location in the space and, in some cases, the data from other receptors e.g. those susceptible to pressure or pain. The entirety of this information is passed to the central nervous system as current (temporary) result of performance of the motor task (body posture). At any moment, this result can be compared with the value programmed (demanded) and the difference between the result and the program (positive or negative) releases appropriate stimuli that correct erratic performance of the motor task. Performance of the motor task changes during this correction, which releases new information from receptors which, during over-driving, allow for introduction of the correction in the reverse direction. This causes performance of the task to oscillate around the demanded value and does not reach zero difference between the result and the program. This is manifested in the form of sway that occurs in the rider that remains seemingly still. These micro-movements ensure continuous inflow of information necessary to the feedback. The time of information flow from receptors to effectors amounts to 70 to 120 ms, which translates into the frequency of the control cycle of 8 to 14 Hz. The feedback leads to any deviation from the desired value, concerning adoption or maintaining a specific posture, being immediately corrected. This correction occurs through respective activation of all the muscles which are regulated at a particular instant i.e. muscles responsible for the correction that allows for performance of a motor task. Therefore, muscles follow specific muscular patterns of contraction and loosening, while the degree and order of activities of different muscles are changing within very short time sections.

In order to realize the complexity of the regulatory system for correction of the posture of a horse rider, one should consider that the system has a considerable number of degrees of freedom and performs its role under conditions of disturbed balance on the unstable and narrowed ground such as a horse. This does not only mean a high number of joints that require a total stabilization or elimination of the motion in a concrete plane and automated choice of specific parameters of the micromovements: direction, force and rate. This complexity also results from a great number of muscles, being the object of regulation at the same time, which are active in all the planes at the level of an individual body segment and in the inter-segmental system.

The previously mentioned program is first developed during the supplementary training and then during the equestrian training. It consists in students' learning new motor skills and remembering movements during training. This also concerns the rider's posture which is an integral part of each movement activity. To put it more simply, acquisition of new motor abilities occurs initially on the pathway of unconditioned reflex – conditioned reflex – dynamic stereotypes. Therefore, development of the rider's posture is based on the postural reflexes, which include: static reactions, corrective reactions and balance reactions.

Development of the appropriate temporal and spatial relations necessitates, however, a substantial number of repetitions. Firstly, different types of posture are adopted and maintained through trial and error. The significant role at this stage is played by visual control, coach's assistance and the state of emotional tension. It is essential for this process to continuously correct mistakes because the many-time repetition of specific motor patterns helps establish these patterns in the form of what is termed coordination engrams. Therefore, it is essential that the engrams are correct from the very beginning, because, according to the Vel's law, incorrect movement is worse than the absolute lack of movement. The justification can be found in the "law of priority" that has been used in developmental neurophysiology. This law suggests that temporal relations which were formed in the first place are established the most firmly and are the hardest to re-establish. On the other hand, the correct coordination engrams formed using this pathway, through repetition of the pattern, are transformed and established as habits and automated neuromuscular activity that represents the highest level of motor activity. This "coordination peak" necessitates huge number of repetitions, whereas it is reached only at the age of an adult athlete. All of this affects the program encoded in the central nervous system, which is the basis for automated regulation of the rider's posture. The motor activities performed in this manner occur subconsciously. They can be voluntarily initiated, maintained or switched off and, to some extent, corrected. The conditional reflexes acquired during the process of learning are not permanent. They can be inhibited and replaced by others, which somehow imposes the necessity of a specific "reminder" action.

Establishing the habit of incorrect rider posture is connected with development of a "new program", which also means a kind of "acceptance of this new incorrect posture". From this moment, any incorrect and correct state is compared to this new but incorrect coordination engram. If the difference occurs, the motor activity is created and performed, making the system use improper patterns. This state is the manifestation of pathological motor activity. The new program encoded in the central nervous system also represents a new "standard" of the rider's posture, which is used for sending false signals of the defects and results from erratic compensation. Therefore, if the beginner rider is taught how to adopt proper posture, this will undoubtedly cause that the system of his own body is determined by the established habit and, in more general terms, the new program which is sensed by the rider as an incorrect posture. These phenomena occur most probably in the system of the vicious circle, with the improper posture disturbing proprioception, proprioception impairing postural control, and postural control affecting the quality of the rider's posture. With this approach, analogically to other pathological processes, stopping the vicious circle might represent the basic condition for successful learning proper riding position and posture. Therefore, training in a riding school should start, among other things, from establishment of the habit of proper rider posture.

If one follows the Molier's principle, which says that the whole dynamic and static human system represent one functional wholeness, the re-educational procedure must involve the whole rider's body. Therefore, according to Kutzner-Kozińska (1981), postural re-education includes: improvement in the ability to correct body posture, development of the abilities to maintain the corrected posture for a longer time and, consequently, development of the ability of automated maintaining the corrected posture. These elements are considered to be the stages in postural re-education, although they actually represent consecutive aims of procedure, with the procedure not having the remarkably stage-based character as the consecutive periods of equestrian training involves all the goals, with the accents distributed differently. The in-depth analysis reveals that they have many facets while the wholeness of the procedure has to be comprehensive, which does not make it easy for performance. These goals include other tasks prior to re-education activities, i.e., making a rider realize the defects. As emphasized by Grochmal (1985), any effect should be multifaceted and the wholeness of procedure should contain, among other things, a number of components that remind about the necessity of adopting a particular posture. However, the recalling process might be insufficient, because a rider with already established incorrect riding posture remembers about correct position of the feet, calves and thighs, corrected physiological spinal curvatures and the symmetry of body trunk in the frontal plane, but the information about performance of these attempts are false. The faultless performance of the motor activity, which consists in correction of the mistakes at a particular time is impossible as long as the control system uses a particular program and until it obtains the reliable information from the circuit about performance of this task.

This problem has been previously investigated with respect to the broadly understood nervous and muscular re-education, using the procedure based on the equivalent (biopsychical) feedback. This procedure eliminates substitution and prevents incoordination. Therefore, it eliminates the negative phenomenon, which is the manifestation of the self-compensation, thus creating the basis for proper re-education. Similar needs and abilities are also present with respect to re-education of the rider's posture. Additional equivalent information is provided to the rider through exteroceptive pathways (visual, auditory or tactile). However, this procedure is insufficient in many cases, especially due to limited technological opportunities of the coach, group classes and use of only subjective observations. All of this leads to insufficient presentation of the posture and riding position, both as a side or rear view. It prevents riders from realization of the type of incorrectness, chances for correction and proper performance of the motor task. Therefore the opportunities for elimination of improper habits and development of good ones are limited. Development of technology and the related development of the methodologies of re-education with the biopsychical feedback offer new opportunities for re-education of the established errors and incorrectness. Overview of current opportunities in these terms helps separate two directions of this type of corrective procedure.

– it consists in continuous monitoring of the rider whose posture is being corrected, which offers chances for constant correction of the deviations. This direction, however, generates some problems that result in particular from the lack of necessary equipment for all the people who require such procedures,
– another direction is performing such exercises during individual equestrian trainings. The weakness of this approach is limited time of this type of classes.

Apart from the opportunities offered by both cases, it should be concluded that it consists in the exercises aimed at changes of the established motor habit. However, they are enriched with equivalent inflow of information about the correctness of the motor task, thus about the correctness of the posture, riding position, assistance, elongation, symmetry etc. This information is usually passed by means of the auditory receptor or, less frequently, visual receptor, although exteroceptors can also be used. A more effective method of re-education is offered by the means based on contemporary technological achievements that utilize biopsychical feedback. The exercises performed under these conditions are of essential importance to correction of any mistakes made by a rider. They allow for the application of the rule of gradation of difficulties through avoiding those going beyond the abilities of the rider. This method ensures correctly performed exercises and prevents from formation and establishment of improper patterns of coordination. With respect to the aims of re-education of the equestrian posture, it is sufficient to say that e.g. exercises performed in front of the television screen help develop the ability of local and global correction. Compared to ordinary exercises, the value of those monitored lies in the opportunity of simultaneous controlling of global correction, force developed during these activities, dosing and changing this force during exercising and opportunities for establishment of the sense of this force in the rider.

Most problems are generated by the last aim of the rider's re-education since establishment of the habit of correct equestrian posture, position of the limbs and assistance with different aids necessitates the continuous monitoring. Obviously, this is not the necessary but optimum condition. The experience shows that the sum of partial effects obtained through other exercises of this type is often sufficient. These exercises suit best to the cases where no morphological obstacles for full correction occur. The justification is the necessity of formation of the correct habit i.e. under conditions of full correction. This does not exclude the purposefulness of using this type of exercises for the already established incorrectness. In this case, the exercises are used only for extending the scope of re-education.

The question remains whether the disturbances in proprioception that in particular occur with disturbances of sensation of body position are the cause or rather a result of this incorrectness and whether they are actual disturbances or "normal" functional proprioception in the system based on the new program of postural control i.e. the program that accepts presence of incorrectness.

All these problems also concern other areas of rider's body, which makes the problems discussed even more complex. The investigations were based on a publication by Janusz Nowotny (1988).

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