PHYSICAL THERAPY FOR NORMALIZING THE STATO-KINETIC FUNCTION

KINETOTERAPIA PENTRU NORMALIZAREA FUNCŢIEI STATO-KINETICE

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Key words: stato-kinetic function, muscular stretching technique, functional parameters, proportionality indexes

Abstract: The study assessed the efficiency of physical therapy, in order to normalize the stato-kinetic function:

- the efficiency of the prophylaxis and the treatment through movement;
- assuring the muscular agonist-antagonist balance of the stato-kinetic function

Metods The study has been performed on 5 grups of children 6 to 10 years old (n=76), that were examined and tested for this research. During the research we applied different programmes using the modern approaches of physical therapy, hydro-stretching, respiratory techniques, specific methods for increasing the functional parameters.

Results The comparisons between the groups in relations to diagnoses >**following index p-p:** significant level of p <0,002, the value t = -1,63 The correlations in relation to the comparison to the entire experimental groups have an average of the **minimal values** of -3,51 mV with **a standard deviation** of 0,723, a maxim of 3,47 mV with a standard deviation of 0,760, the variable p-p has an average of 6,99 mV with a standard deviation of 1,48 and a median of -0,014 with a standard deviation of 0,008.

Conclusions The muscular force of the quadriceps shows an increase to all experimental groups which is confirmed by the left/right knee mobility test, the combined box test, and EMG registrations for left and right limbs. As a consequence the studied aspects can be dealt with in a future research, (modul and model Bernstein and the functional comportament development).

Cuvinte cheie: funcţie stato-kinetică, stretching, parametri funcţionali, index de proporţionalitate

Rezumat: Studiul a evaluat eficienţa kinetoterapiei în normalizarea funcţiei stato-kinetice:

- eficienţa profilaxiei şi a tratamentului prin mişcare
- asigurarea echilibrului muscular agonist-antagonist a funcţiei stato-kinetice

Metode. Studiul s-a realizat pe 5 grupuri de copii între 6 – 10 ani, care au fost examinaţi şi testaţi pentru acest studiu. Pe perioada studiului s-au aplicat diferite programe ce folosesc o abordare modern a kinetoterapiei, hidro-stretching, tehnici de respiraţie, metode specific creşterii parametrilor funcţionali. **Resultate.** Comparaţia între grupuri în relaţie cu diagnosticul > după **index p-p:** semnificaţie de p <0,002, valoarea t = -1,63. Corelaţia în raport cu compararea întregului grup experimental are o medie a valorilor minime de -3,51 mV cu o deviaşie standard de 0,723, un maxim de 3,47 mV cu o deviaţie standard de 0,760, variabila p-p are o medie de 6,99 mV cu o deviaţie standard de 1,48 şi mediana de -0,014 cu deviaţia standard de 0,008.

Concluzii. Forţa muscular a cvadricepsului cunoaşte o creştere la toate grupele experimentale, lucru confirmat de testul de mobilitate a genunchilor drept-stâng, testul EMG pentru membrele inferioare. CA o consecinţă a, aspectul studiat poate fi aprofundat într-o cercetare ulterioară, (modulul şi modelul Bernstein şi dezvoltarea comportamentului funcţional).

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Introduction

Neuromotric development - psychomotor development, regulating, correcting the stato-kinetic functions of children happen once in a life time, between the age of 0-12.

The main goal of the postural control in human beings is to maintain a stabile antigravitational position with the protection of the mobile weight center on the support surface of different sizes and distances from the weight centre.

There were a lot studies regarding the very existence of the strategy of head stabilization in space. The head plays an essential role in the:

- *geocentric* process (orientation on the vertical)(5);
- *egocentric* process (head orientation in regards to body);
- *exocentric* process (orientation towards an object from the environment).

A difficult problem to explain (within the automatic postural responses that take place until the neuromotric maturization and gait can be obtained as "a final product") is the appearance of an activity of muscle shortage and stiffness within the muscles that are not active in the moment of recovery from a disequilibrium – a sort of agonist-antagonist disequilibrium. This can be observed in the medical checkups of the first months of life (see Figure 1.1).

Hypothesis

Applying the physical therapeutic methods, especially the Proprioceptive Neuromuscular Facilitation techniques, the stretching techniques, is beneficial to obtaining the statokinetic function and the independent gait as a "final product", as well as the ability to run for children of 6-9 with dysfunctions in the locomotor system or other disabilities.

Tasks

The kinetic treatment and using the stretching techniques on the spiral dynamic (see 2 and 5), and model , modul Bernstein concept, helps the child and motivate our preoccupations to take into consideration each of the function, until the development or maturization is over (age 12).

The evolution of the function underlines the sequences and the alternatives of the stability and mobility, of the symmetry and asymmetry, as well as *the independence of the stato-kinetic function, obtaining as a final result the independent gait and running. We can notice the following phases of the motor control: prefiguration, discovery, specialization*.

<u>The strategy of the central axis</u>, in my opinion (5), has to go through the following stages in regards to the motor control of the segmental area and of elaborated and controlled movements.

These stages are:

1. The strategy of head and neck control;
2. The strategy of movement and control of scapular-humeral belt and upper limbs;
3. The strategy of recovery and control of dorsal –lumbar spine;
4. The strategy of lumbar-sacral-buttock area within the spine-pelvis-hip connection;
5. The strategy pf lower limbs (knee and ankle);
6. The strategy of the trunk and basin for standing up from quadruped position, from kneeling to orthostatic and obtaining the orthostatic unipodal control ;
7. The gait with all its implications and forms (with and without aiding devices).

Figure 1.1 Examining the muscular tone in children (5)

Age	Baling	Extensibility of the popliteus angle	Extensibility of the adductors angles
New born	absent	90°	30°
2-4 months	minimal	100°	60°-
4-6 months	medium	120°- 130°	90°- 100°-
8-10 months	almost normal	140°-160°	120°-
12 months	normal	180°	140°-

The voluntary movement is taking place according to a preexistent program of the registered engrams. The voluntary contribution has an initiation role, a sustaining or stopping the functional "torrent". The motric activity of the children in the experiment (figure 1.2) is interesting in regard to electromyographic registrations and their interpretation in histograms, (Figure 1, 2, 3, 4).

Physical therapy is based on the neuro-muscular physiology of engrams that are formed on the principle of repetition – as a base of obtaining the movements, postures or coordinate positions, and finally the global stato-kinetic function , posture , the gait and running as "final product".

If physical therapy is based on the idea of maintaining unaltered the physiological conditions of NMAK apparatus, it is obvious that the any type of dysfunctions will be the premise for the therapeutic kinesiology and functional recovery.

The necessary conditions for accomplishing the training therapeutic program, the therapeutic movement directed towards the precise, direct and conscious control in the studied groups were, (Figure 1.2.):

- understanding the directions and the capacity to cooperate dependent of age, IQ;
- establishing a quiet setting in the room so that the patient could concentrate;
- positioning the patient so that he/she is relaxed in the most areas (if not complete) of the muscular groups, eliminating the increasing of the general muscular tone;
- integrating the sensorial segment (sensitive feedback) in order to receive the correct motor performance, i.e. intact proprioception and teleception;
- absence of pain so that the patient can perceive very clearly the articular movement as being provoked by the muscular contraction;
- range of motion in joints with approximate 20° – 30° greater than the arch of motion that causes pain, if not the inhibition through fear of pain produces;
- freedom of movement, because the appreciation of the movement sensation in rapport to the muscular contraction represents the first important steps in creating the motor engrams;
- educating the active inhibition of the patient, which is the base of acquiring the motor engrams with selective excitation and inhibition;
- sequential progression of the motor activity towards scull-caudal direction, from slow, easy, isolated movements to more complex ones with an increasing effort, speed and force;

No matter the condition of the locomotor apparatus, the goals of the recovery program are based on recreating and maintaining the fundamental myo-arto-kinetic parameters for a life without pain, mobility, force, resistance, coordination, elasticity, flexibility with the purpose of raising the quality of patient's life (2,5)..

During the unipodal support the muscular chains (1) remain the same as in the bipodal orthostatic, the only difference is that the entire weight is transferred to the muscular chains of the lower limb that supports the weight.

An important role is played by the middle psoas-iliac-buttock muscle. Through its position, this muscle forms on the anterior area of the coxo-femur joint an authentic muscular strap that pushes the femur head backwards and thus becomes an anterior-intern stabilization until the middle buttock muscle is in a triangle position, with the angle facing the inside, forming a lateral muscular strap that pushes the lateral area of the great trohanter. The femur head pushes the cotil and becomes a lateral stabilization for the hip.

The dysfunction of the abductor muscles and especially of the middle buttock muscle triggers inevitably the basin disequilibrium. When the support is made on the affected limb (monoplegia, left hemiparesis etc.) the basin falls on the dysfunctional side, which means that the clinic sign is present, i.e. Trendelenburg sign.

The muscles that are responsible for the basin equilibrium belong to the pelvitrohanter group (middle buttock muscle, small buttock muscle, pyramidal muscle) and from pelvicrural group (tensor fascia-lata m., right anterior m, tailor m.), the result of their action is the muscular force equilibrated in unipodalism.

The anterior-posterior and lateral oscillations of the body that are necessary to maintain equilibrium in standing on one foot are greater than in standing on both feet, producing important modifications of pressure on the coxo-femural articulation and on the bone segments of the knee. The two functions are inseparable and interconditioned, because any posture is maintained or is changed through movement, and any movement starts with a correct, harmonious, and coordinate posture. Their reciprocal interconditioning is perfect for the ontohereditary evolution of the posture and human locomotion. Their separation is made only from a didactic point of view, with the purpose of a better systematization and representation of the data for the students during their study and practice.

The analyses can be easily made, and every lesson might include specific tools of measurement that allow data analyses. We can use the following: *peak to peak, maximum, minimum, slope, standard, deviation, frequency, BPM, delta time, mean, area and integral.*
There are available configurations like: ultimate, advanced, basic, core. Utilizing the device is the best method to study human or animal physiology, to experiment with it. Each BLS system contains a high performance unit of data acquisition, electrodes and transmitters.

The experiment content - Initial investigations

Figure 1.2. Distribution of the experimental group according to peri and post natal conditions – diagnosis (5)

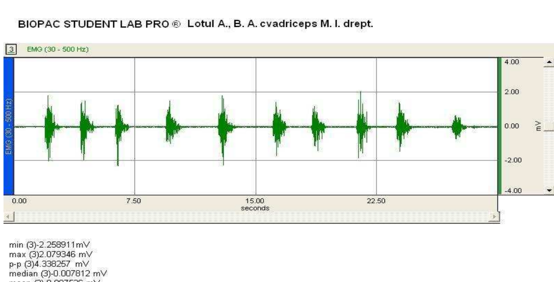
		Frequency	Percent
LOT A	Clinic healthy	24	31,6
LOT E	Neuromotor CP	15	19,7
LOT C	Hearing dysfunctions	12	15,8
LOT B	Mental retardation	9	11,8
LOT D	Sight dysfunctions (amblyopic)	16	21,1
	Total	76	100,0

The <u>conclusions during the initial tests</u> taken during the physical education classes and the movement or recreative therapy have showed the following major features: dysfunctions of postural and muscular equilibrium, uncontrolled orthostatic, unipodalism and locomotion. Some other features are:

- dysfunctions in regulating the muscular force of the lower limbs;
- difficulty to voluntarily accomplish to relax the muscular chains, muscular groups and the movement itself;
- precision of the movement is lower;
- difficulties of the voluntary muscle control;
- when the movement is executed in the absence of the eye control (experimental group D) there is the tendency to execute the movements like “in the mirror”;
- relaxation time is very much diminished, i.e. the active and passive time of action during a physical exercise (Ergosim and Biopac system testing / investigation) is very different.

Results of the Biopac System investigation

The following figures 1,2,3,4, (5) are just a few examples of the total number of registrations:



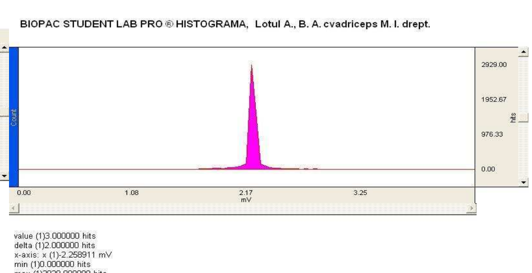


Fig . 1 Exemple of EMG and histogram of A group

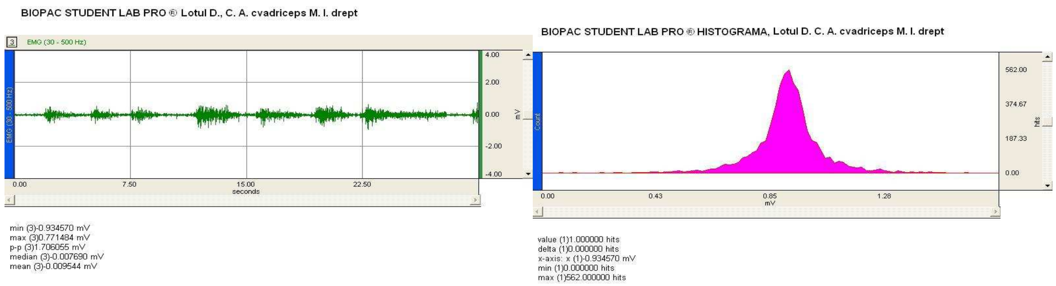


Fig . 2 Exemple of EMG and histogram of D group

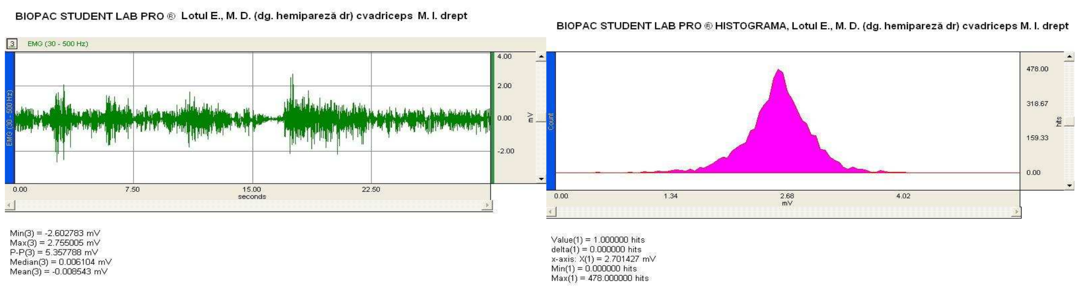
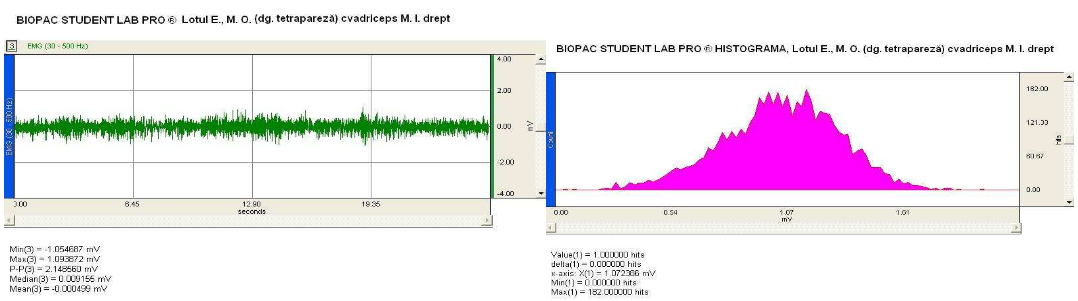


Fig . 3 Exemple of EMG and histogram of hemiparetic E group



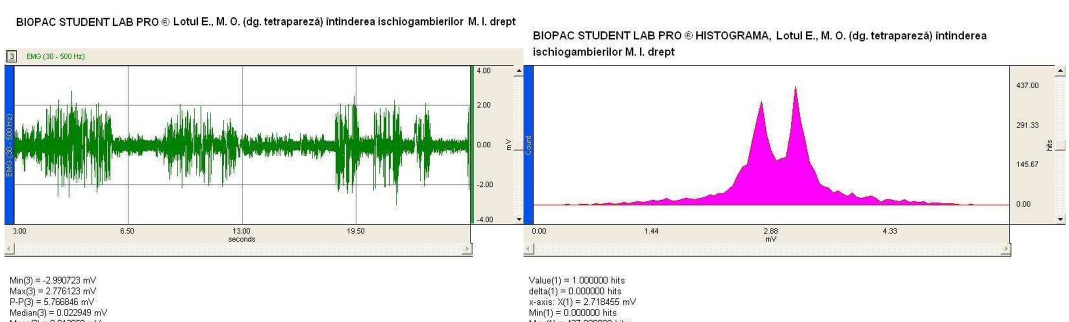


Fig . 4 Exemple of EMG and histogram of quadriplegic E group

The discussion regarding the electromyographic values of the right lower limb of the extensor quadriceps muscle is as follows:

The correlations regarding the comparisons of the entire experimental group has an average of the minimal values of -1, 62 mV, a maximum of 1,62 mV, variable p-p has an average of 3,25 mV and a median of -0,017mV.

The correlations made between the experimental in relation to their diagnoses have the **following minimal values**: Hearing dysfunctions ↔ amblyopic with the value t = -2,36 and a significant level of p <0,003, Hearing dysfunctions ↔ healthy children with the value t = 1,76 and a significant level of p <0,005, Amblyopic ↔ healthy children with the value t = 3,86 and a significant level of p <0,001.

The correlations between the experimental groups in relation to their diagnoses have the **following maximal values**: Hearing dysfunctions ↔ amblyopic with the value t = 2.46 and a significant level of p <0,002, Hearing dysfunctions ↔ healthy children with the value t = 1,32 and a significant level of p <0,001, Amblyopic ↔ healthy children with t = 3,63 and a significant level of p <0,001.

The correlations between the experimental groups in relation to their diagnoses have the **following index p-p:** Hearing dysfunctions ↔ amblyopic children with the value t = 2.46 and a significant level of p <0,002, Hearing dysfunctions ↔ healthy children with the value t = -1,63 and a significant level of p <0,011, Amblyopic ↔ healthy children with the value t = -3,97 and a significant level of p <0,001.

The correlations between the experimental groups in relation to their diagnoses has the **following median index** (the tendency of the central values): Hearing dysfunctions ↔ amblyopic children with the value t = -0,113 and a mediocre significant level of p <0,005, Hearing dysfunctions ↔ healthy children with the value t = -0,973 and a mediocre significant level of p <0,38, Amblyopic ↔ healthy children with the value t = -0,89 and a significant level of p <0,38.

The correlations between the experimental groups in relation to their diagnoses have the **following media index**: Hearing dysfunctions ↔ amblyopic with the value t = 0,295 and a mediocre significant level of p <0,05, Hearing dysfunctions ↔ healthy children with the value t = 1,40 and a mediocre significant level of p <0,17 Amblyopic ↔ healthy children with the value t = 1,228 and a significant level of p <0,23.

The discussion regarding the electromyographic of the left lower limb of the extensor quadriceps muscle is as follows:

The correlations in relation to the comparison to the entire experimental groups have an average of the **minimal values** of -3,51 mV with **a standard deviation** of 0,723, a maxim of 3,47 mV with a standard deviation of 0,760, the variable p-p has an average of 6,99 mV with a standard deviation of 1,48 and a median of -0,014 with a standard deviation of 0,008.

<u>The comparisons between the groups in relations to diagnoses have the minim, maxim, p-p, median and average values as follows:</u>

Minimum values; Hearing dysfunctions ↔ amblyopic children with the value t = 0,48 and a mediocre level of significance of p >0,63, Hearing dysfunctions ↔ healthy children with the value t = 1,92 and a limit level of significance of p <0,05, Amblyopic ↔ healthy children with the value t = 2,5 and a reasonable mediocre level of significance of p <0,02. **Maxim values**: Hearing dysfunctions ↔ Amblyopic with the value t = 0,576 and a mediocre level of significance of p <0,05, Hearing dysfunctions ↔ healthy children with the value t = -1,92 and a mediocre level of significance of p <0,066, Amblyopic ↔ healthy children with the value t = -3,97 and a very good level of significance of p <0,001.

Median values: Hearing dysfunctions ↔ Amblyopic with the value t = -2,82 and a mediocre level of significance of p <0,011, Hearing dysfunctions ↔ healthy children with the value t = 0,749 and a mediocre level of significance of p <0,05, Amblyopic ↔ healthy children with the value t = 0,777 and a mediocre level of significance of p <0,05. Average values: Hearing dysfunctions ↔ Amblyopic with the value t = -1,225 and a mediocre level of significance of p >0,22, Hearing dysfunctions ↔ healthy children with the value t = 0,09 and a mediocre level of significance of p <0,05, Amblyopic ↔ healthy children with the value t = 0,049 and a lower level of significance of p >0,9.

A special comparison was made between the children with neuromotor dysfunctions who have the muscular groups are spastic, an inappropriate voluntary muscular control and the children from the other experimental groups.

The discussion regarding the electromyographic values of the right lower limb of the extensor quadriceps muscle is as follows:

Minimal value: Neuromotor ↔ Hearing dysfunctions with the value t = -2,12 and an acceptable level of significance of de p <0,052, Neuromotor ↔ Amblyopic with the value t = -3,64 şi un grad de semnificaţie bună de p <0,003, Neuromotor children ↔ healthy children with the value t = 0,97 and a low level of significance of p >0,34.

Maximal value: Neuromotor children ↔ Hearing dysfunctions with the value t = 1,78 and an acceptable level of significance of p <0,009, Neuromotor children ↔ Amblyopic with the value t = 3,5 and a good level of significance of p <0,004, Neuromotor children ↔ healthy children with the value t = 0,97 and a low level of significance of p >0,377. The value p-p: Neuromotor children ↔ Hearing dysfunctions with the value t = 1,985 and a good level of significance of p <0,005; Neuromotor children ↔ Amblyopic children with the value t = 3,6 and a good level of significance of p <0,004, Neuromotor children ↔ healthy children with the value t = 0,98 and a low level of significance of p >0,333.

Median value: Neuromotor children ↔ Hearing dysfunctions with the value t = 2,47 and a good level of significance of p <0,002, Neuromotor children ↔ Amblyopic with the value t = 2,60 and a good level of significance of p <0,0023, Neuromotor children ↔ healthy children with the value t = 0,76 and an acceptable level of significance of p <0,47. Average value: Neuromotor children ↔ Hearing dysfunctions with the value t = 0,80 and an acceptable level of significance of p <0,434; Neuromotor children ↔ Amblyopic with the value t = 0,756 and an acceptable level of significance of p <0,465, Neuromotor children ↔ healthy children with the value t = 1,21 and an acceptable level of significance of p <0,241.

Conclusions:

1. Comparing the results of the initial tests (Ti) with the results of the final tests (Tf) between the experimental group and intra groups (76 patients) we can notice the following;
2. The increase of the neuromotor performance regarding the motor control and obtaining the final product of neuromotor maturization, the gait in Lot D and Lot E (neuromotor);
3. The muscular angles and values have increased in all experimental groups, the muscular force increased especially in lot D (Amblyopic) and C (Hearing dysfunctions);
4. Fighting the major dysfunctions for all experimental groups, especially the lots D,C and even E (neuromotor);independent gait with a better energetic consume especially in lot D (Amblyopic) and slower with a higher energetic consume in lot E (neuromotor);ameliorating the symptoms regarding the spastic muscles, reducing the effects especially at children with hemiparesis in lot E (neuromotor);
5. In some cases we obtained an independent running especially in the lot C (Hearing dysfunctions) and D (Amblyopic).
6. The muscular force of the quadriceps shows an increase to all experimental groups which is confirmed by the left/right knee mobility test, the combined box test, and EMG registrations for left and right limbs.
7. Our research offers a lot of practical data and the experiment has an applicative value that can be used as scientific material (using the system *Biopac*, physiological tests and somatometrics) for practicing motion therapy, using the most effective kinetic means, NFP techniques, muscular stretching in 6-9 children, with dysfunctions of the neuro-mio-artro-kinetic apparatus and other dysfunctions in obtaining the independent and correct locomotion and running, for a better quality of life.

8. We could not deal with all the problems related to stretching technique and other forms of assessment or tests (more actual and modern).
9. As a consequence the studied aspects can be dealt with in a future research, (modul and model Bernstein and the functional comportament development).

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