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ȘCOALA DOCTORALĂ

Recovery through biofeedback
of postural disorders caused by occupational
osteoarticular stress

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Summary:

The thesis consists of 3 chapters grouped in two sections:

The first section, THE CURRENT STATE OF KNOWLEDGE comprises one chapter.

I. The state of knowledge of the topic.

The second section, PERSONAL RESEARCH ON POSTURE DISORDER comprises two chapters.

II. Preliminary research on identifying balance disorders induced by office working posture using posturography.

III. Personal research on the analysis of postural disorders of subjects in an office workplace

Introduction

Posture is a function of the locomotor apparatus directed by the nervous system represented by the infinity of positions and movements that constantly duplicate the mental activity of the individual.

Posture is the result of synergistic action between the central and peripheral nervous system and the locomotor system. The postural system is a unitary structure with multiple connections and several complementary functions: it combats gravity by maintaining an upright posture, opposes external forces, orients the individual in space and time, and balances the body in movement. Correct body posture is a sign of the individual's psycho-physical balance (Bronstein et. al., 2004).

Modern biofeedback is the technique of using electronic equipment to reveal to patients and therapists certain physiological imbalances instantly and to teach patients to improve these otherwise involuntary misalignments by manipulating displayed signals (usually visual and/or acoustic).

The objectives of the research are to build a theoretical and experimental framework on the influences of an intervention program on:

- posture and postural control for active population and performance athletes.
- to determine the improvement of postural alignment using postural biofeedback
- implementation of a method for the prophylaxis of musculoskeletal injuries using the technique of alternating support surfaces (TASS);
- identification of postural changes in research subjects.
- biofeedback intervention to correct posture deficits.
- kinesiology intervention for postural re-education.

- analysis of the results and interpretation to conclude.

Scientific originality

The originality of this thesis lies in the idea of capturing the changes induced by occupational overstrain in the two extremes of working posture: the first, maintaining a desk posture and lack of movement, and the second, in professional athletes who overstrain the musculoskeletal system through excessive movement.

Apparently, the movements performed by the athlete do not reflect the existence of these compensations, and a thorough investigation with advanced technological means is required.

With the help of posturography technology, it is possible to identify deviations in the center of gravity, the points of support, the degree of loading, the distribution of weight on the plants, anterior, posterior, or compressed posture, body asymmetries, and through interpretation in a biomechanical context, it is possible to identify possible compensations or decompensations.

The originality and innovation of our research lies in the fact that we use the posturograph both to identify deficits and to correct them in real time, using the information provided by the device, a technique known as biofeedback.

Biofeedback is a technique by which a person trains themselves through voluntary control. In biofeedback training, individuals receive information (feedback) about an aspect of their physical condition and then attempt to change that condition.

In the content of this thesis, the first part covers the theoretical foundation of the researched topic, with aspects related to the benefits of physiotherapy on postural impairment, the definition of postural impairment, and the classification of the degree of impairment.

I. Theoretical foundation of the researched topic

1.1. Biomechanica echilibrului în menținerea posturii corecte

1.2. Importanța aferențelor somatosenzoriale în reeducarea posturală

1.3. Controlul vizual al echilibrului stabil

1.4. Percepția de echilibru stabil

1.5. Tulburările posturale induse de munca la birou

1.6. Tulburările induse de suprasolicitarea în sport

1.7. Deficitele posturale

1.8. Biofeedback-ul

The second section comprises personal research on posture disorder and presents chapters II and III.

II. Identifying balance disorders induced by office posture using posturography

Preliminary research and experimental research supplemented by means of intervention in improving posture and postural control using kinesitherapy as a means of improving posture and postural balance.

The research aimed to identify posture changes induced by office work using modern technical methods.

The objectives of the preliminary research were to obtain a database with reference to postural changes occurring during postural deconditioning in adults using posturographic analysis.

The results outline the pattern of postural changes generated by office work and are used as a basis for personal research studies.

The postural changes identified in this study form the basis for the formulation of intervention program objectives to correct postural deficits of subjects in the personal research studies.

Research hypothesis

By evaluating more than one hundred subjects who work at a desk and maintain a seated position for more than 6 hours a day, we will be able to model the postural changes that occur in this context, changes based on which we will be able to produce the results of the following doctoral studies.

Preliminary research conclusions

A significant percentage of the subjects investigated in this study show postural changes and these are largely multiple. The changes are multiple because the body can adapt to new postures, working through compensatory postures. These compensatory postures are given by the changes that are produced over time by a new working position.

The most common dysfunction is anterior head posture and this is accompanied by anterior projection of the centre of gravity. This dysfunction is the most common because gravity forces us to lean forward, and the office working position requires a great deal of

attention and concentration, which leads to a prolonged fixation of the eyes, involuntarily leading the head towards anteriority.

Other dysfunctions identified were the imbalance between the weight loading on both legs and the twisting of the body identified by a rotation angle of the transverse axis

The postural deficits identified can produce musculoskeletal injuries over time associated with prolonged sitting posture at the desk.

Chapter III of this thesis contains the personal research, materialized in four studies.

III. Personal research on the analysis of postural disorders in subjects with office workplaces

Study 1. *Controlling posture at the desk by alternating the support surface.*

Study 2. *Postural biofeedback in associated kinesiotherapy of patients with postural deficit caused by overwork.*

Study 3. *Biofeedback in postural rehabilitation of athletes.*

Study 4. *Monitoring the effects of a postural rehabilitation program using biofeedback.*

The experimental research convinces by the relatively large number of studies four in number studies from personal research of the effects of the intervention program in correcting postural deficiencies in both those working at a desk in the sitting position for 6-8 hours and athletes and the maintenance of the effects over time.

The aim of this studies is to prove the importance and benefits of a kinesiotherapy programme for the prevention of spinal injuries caused by poor posture, using the technique of alternating support surfaces (TASS) and postural biofeedback.

The first study addresses an innovative idea, using alternating support surfaces while working in the sitting position. With this study we demonstrate the importance and benefits of a kinesiology programme for the prevention of spinal injuries caused by poor posture using the technique of alternating support surfaces (TASS) and postural biofeedback.

The second study investigates the importance and benefits of biofeedback treatment using the Global Postural System GPS 600 combined with a physiotherapy programme in postural deficits of adults involved in occupational activities that require sitting at a desk.

The third study investigates the influence of a physiotherapy programme combined with a postural biofeedback training programme on improving postural control in professional athletes.

The last study demonstrates the preservation over time, after a period of six months, of the postural balance acquired by athletes through biofeedback treatment using the GPS 600 device accompanied by a physiotherapy programme.

General conclusions of the research

Research on physical deconditioning in adults professionally involved in activities involving prolonged sitting at a desk using the posturograph, together with clinical examination, somatoscopy and somatometry led to the development of a baseline database. The data obtained were a particularly useful tool in the personal research studies of this thesis.

The postural deficits identified in the subjects included in this study are responsible for the occurrence over time of musculoskeletal injuries associated with prolonged office posture.

The postural deficits present in competitive or professional athletes, even if not identifiable by clinical and stomatoscopic examination, were identified with the help of the posturograph and thus made it possible to intervene kinesiology to optimise the athletes' balance.

The postural deficits identified by our proposed method, carried out both by physiotherapy intervention through alternating support surfaces and with the help of posturography through biofeedback, were significantly corrected. Individually applied physiotherapy has helped to reduce symptoms caused by poor posture and to correct postural deficits.

Biofeedback treatment using the Global Postural System GPS 600 modified the muscle engram, causing the muscle fibres to maintain the newly learned correct position.

The results obtained from the postural retraining protocol in the study on performance athletes (study 3) were maintained 6 months after the intervention (study 4) showing that the improved posture was stored in the muscle fibres and movement memory.

Key words: posture, biofeedback, visual biofeedback, postural deficit, physical deconditioning, physical therapy, postural re-education, athletes, alternation of support surfaces, office work posture.