

## **Abstract**

**This PhD thesis proposes a scientific argumentation and experimentation of a series of therapeutic and prevention procedures, looking for documented and scientifically proven answers to the following questions:**

- 1. How big is the social impact of spine disorders? Does solving them represent a significant social need?**
- 2. Is it normal to approach spine issues only when serious situations, pain or emergencies arise, or can we elaborate a series of indexes which should allow for prevention procedures?**
- 3. Can it be proven that the spectrum of interest in the issues approached regards both the performance in the daily activities of non-sportspersons and the performance of high-level sportspersons?**

## **Work hypotheses:**

1. Prevention and treatment of spine disorders represent a significant social need.
2. Passing from manual qualitative measurements of force and mobility, specific to kinetherapy, to computerised quantitative measurements allows for elaborating much more precise quantitative expression indicators for diagnosing the momentary status of the spine of sportspersons or non-sportspersons, presenting or not clinical symptoms of pain.
3. There are relationships between the functional status of the spine, the global and segmentary posture of the body and the indexes of muscular and articular functional proportionality of the spine.
4. Using the evaluation and optimisation method through motion control exercises with visual feedback has therapeutic effects of greater efficiency than the classical methods which use physical exercise without visual feedback.

## **Conclusions**

The theoretic and experimental plan achieved during the PhD paper has led to obtaining answers to the questions formulated when starting the PhD thesis:

### **1. How big is the social impact of spine disorders? Does solving them represent a significant social need?**

**1.1** The great need for recovery in these types of disorders is reflected in the high percentage of the total number of cases (68%) out of a sampling of 1,028 persons.

**1.2** The especially high incidence – 68% – of spine diseases is a fact which justifies the material, time and competence investment for carrying out:

- computerised diagnosis
- developing the optimisation method of the statokinetic spine function by

computerised methods with visual feedback, as a highly important requirement for preventing orthopaedic (non-structural, functional and structural changes) and degenerative arthritis-type disorders.

**2. Is it normal to approach spine issues only when serious situations, pain or emergencies arise, or can we elaborate a series of indexes which should allow for prevention procedures?**

**2.1** Tests, as they have been designed, have allowed for evaluating two categories of persons: **sportspersons** and **non-sportspersons**, with and without symptoms from the perspective of the functionality state of the spine.

**2.2** The proposed testing system presents a prevention character, enabling the identification and optimisation of muscular support disequilibrium of the spine before reaching the symptomatology characterised by local pain.

**2.3** The elaborated indicators, adjacent to the testing system based on the "Ergocontrol" technology, are the following:

**A. The index for muscular and articular thoracic anterior-posterior functional equilibrium *CETAP***

$$CETAP = tr.br.s [J] / tr.br.f [J] \text{ where:}$$

tr. br. f (J) **traction of the arms through the front (Joule)**

tr. br. s (J) **traction of the arms through the back (Joule)**

*The ratio between 0.85 and 0.90 of the CETAP parameter characterises a correct cervical-thoracic and scapular-humeral posture, determined by somatoscopic examination;*

**B. The index for muscular and articular thoracic-lumbar functional equilibrium**

$$CETOLO = ilio [J]/tr.br.f [J] \text{ where:}$$

tr. br. f (J) **traction of the arms through the front (Joule)**

ilio (J) **traction of the knees to the chest (Joule)**

***The ratio between 0.85 and 0.90 of the CETOLO parameter characterises a correct thoracic-lumbar posture in the anterior-posterior plane.***

The following practical observation related to the measurement results has led to inserting tests for the anterior thoracic area and the anterior half of the scapular belt as an individual indicator of the stabilisation potential of the spine in the anterior-posterior plane:

***At all investigated subjects, 110 sportspersons and 41 non-sportspersons, the measurement carried out for the anterior half of the scapular-thoracic belt area presents the highest energetic level [JJ].***

As a consequence, the values of the other two measurements on kinaesthetic chains (ilio and tr.br.s) have this indicator – tr.br.f – as a reference value.

From the perspective of somatoscopic evaluation, values lower than 0.85 of CETAP are associated with an accentuation of the thoracic curve, and values over 0.90 are associated with an effacement tendency, up to a reversal of the thoracic curve.

Likewise, values lower than 0.85 of CETOLO are associated with an accentuation of the lumbar curve, and values over 0.90 are associated with an effacement tendency of the lumbar curve.

### **3. Can it be proven that the spectrum of interest in the issues approached regards both the performance in the daily activities of non-sportspersons and the performance of high-level sportspersons?**

**3.1** Recovery protocols instituted for the four groups, two experimental and two control groups, and two sportspersons and two non-sportspersons groups, respectively, have led to reaching the therapeutic goals as follows:

- the recovery protocol through control exercises with visual feedback on force-amplitude curves has led to a total disappearance of pain, an optimisation of the global posture of the body, the growth of the muscular-articular functional proportionality indexes of the spine at the highest level possible within 20 sessions with a duration of 40-45 minutes each;

- the recovery protocol through classical exercises has led to a complete disappearance of pain, an improvement in the global posture of the body and a significant improvement, according to statistic processing, of the muscular-articular functional proportionality indexes of the spine within 20 sessions with a duration of 60 min. each.

**3.2** The recovery method with visual feedback on force-amplitude curves has proven much more efficient regarding the optimisation of the posture and of muscular-articular functionality of the spine. It has been proved that a better effect at a local and general level can be obtained in a shorter time by using computerised technology for spine recovery.

**3.3** The recovery plans enabled the elaboration of the work protocol with visual feedback on force-amplitude curves, adapted for the recovery of the spine, consisting of:

- determining the force and amplitude values where pain occurs – determining the pain threshold in the case of spine disorders;
- defining the painless domain;
- monitoring the work within this domain;
- precise dosage of exercises;
- rebuilding the agonists-antagonists coordination, followed by complete remission of the effects induced by the pain-killing reflex blockage.

**3.4** In the case of all subjects, the progress obtained at motion level was doubled by an improvement at functional level, due to the development of force at the level of the torso muscles. In the case of performance and high-performance sportspersons, this is especially important, as it enables them to successfully cope with strains from training and contests without endangering their health on a short and long term.

The research results are postulations for developing new research projects, in which the relationship between the muscular and articular functional equilibrium status of the spine and the walking pattern is envisaged, as the technology for this type of investigations is already patented within the scientific research project that was completed in December 2010 and bears the title “**System and Methodology for Analysing the Biomechanics and Neuromuscular Control of Displacements by Locomotion**”, contract no. 215 from 7.10.2008.