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# Kinetoprophylaxis of work position-induced lesions by alternating the support surface

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**Abstract**

*Background.* The use of the Global Postural System GPS 600 device to identify postural deficit induced by working posture, combined with a physical therapy program for the spine proved to be beneficial. Based on the data obtained from a complete posturography, customized kinetotherapy and medical recovery programs were developed.

*Aims.* The aim of this study was to prove the importance and benefits of a physical therapy program for prevention and treatment of the degenerative diseases of the spine. The study focused on adults involved in work activities that required maintaining a sitting position at the office. This study included 13 subjects with the age between 25 to 47 years old; the mean age was 32 years.

*Methods.* To remedy the musculoskeletal disorders that appear during the work in the office, our research team proposed a unique method of treatment by the technique of alternating support surfaces. The methods used for evaluation were joint and muscle balance as well as the visual analogue scale of pain, and the evaluation data provided by the GPS 600 system.

*Results.* At the end of the 14 days of treatment and physical therapy program, all subjects had a relief of symptoms and the alignment of the spine was significantly corrected.

*Conclusions.* The treatment using the Global Postural System GPS 600 combined with physical therapy is important to prevent degenerative diseases of the cervical spine both for the effect on the joints and for the general effect of postural balance.

**Keywords:** physical therapy, work posture, prevention

## Introduction

**The influence of the working posture at the desk for a long time on the musculoskeletal system**

While maintaining the same prolonged static position, the muscles which support the body's posture suffer a prolonged state of contraction, which leads to a decreased efficiency in the transport of sugars and oxygen to the dynamically contracted muscles and this leads to an accumulation of waste products in the muscles, such as carbon dioxide and lactic acid. Those changes can lead to muscle spasms and muscle fatigue. Sitting in the same position for a prolonged period also contributes to countless health problems such as lumbar and cervical pain, circulatory and renal diseases (Mani, 2018).

A study conducted in 2009 and published in "The Australian Journal of Physiotherapy" indicates that people who present pain at the cervical level have higher muscular activity and less rest for the cervical muscles (Szeto et al., 2009).

In addition to higher muscle activity, another study shows anterior positioning of the head, shoulder protraction, and stiffness of the upper trapezius muscle when the patient is working at the desk space (Kocur et al., 2019).

The musculoskeletal changes caused by maintaining an incorrect desk posture were researched by us and published in a study in 2019 (Chelaru & Bulduș, 2019).

The study included a screening phase attended by 150 subjects aged between 18-42 years, which aimed to identify the signs of physical deconditioning in the persons holding the position for 6-8 hours/day.

The result analysis reflected that 96% of the subjects presented anteriorization of the head: 32% in a range between 3 to 7 cm and 64% over 7 cm.

The projection of the gravity center was anteriorized by 1 to 7 cm in 62% of the subjects.

The subjects had a difference in loading the body weight on both feet: 46% overloaded the left foot and 38% overloaded the right foot. In total, 84% of subjects had a predominant balance on the left or right foot, which means an imbalance of the weight bearing.

In 84% of the subjects, the angle values represented a

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rotation that in time can produce spine lesions.

Based on the data obtained from a complete posturography, customized kinetotherapy and medical recovery programs were developed.

Reports in the scientific literature have suggested that computer users are at increased risk for upper extremity musculoskeletal disorders (MSD). Early studies often found high rates of MSD outcomes among keyboard users compared to non-users. Attention soon focused on specific aspects of the keyboard that could be responsible for the increase in the observed rate. Postural misalignments are an independent risk factor of modest magnitude for MSD among computer users. It appears that decreasing the height of the keyboard at or below elbow height and supporting the arms on the surface of the desk or armrests is associated with a reduced risk of MSD for the neck and shoulder. In general, the literature shows that daily or weekly computer use hours are more consistently associated with hand and arm MSD than neck and shoulder MSD (Gerr et al., 2004).

To date, the influence of specific sitting posture on head / neck posture and cervicothoracic muscle activity has been insufficiently investigated. In 2020, Chelaru et al. studied the influence of biofeedback in the treatment of ailments of head/neck and cervicothoracic posture deficiencies. Caneiro et al. (2009) in a study investigated whether three different thoracolumbar positions affect the posture of the head / neck and cervicothoracic muscle activity. There were significant differences in the lumbar and thoracic curves in the 3 different positions. This study shows that different sitting positions affect the posture of the head / neck and cervicothoracic muscle activity. The potential importance of postural adjustment of the thoracolumbar spine when training the head / neck posture is highlighted.

More neutral sitting positions reduce the demand on the cervical extensor muscles and modify the relative contribution of the cervical and thoracic extensors to the control of head and neck posture. Postures that promote these patterns of muscle activity can reduce cervical spine load and the development of posture-related neck pain (Edmondston et al, 2010).

In a study of the biomechanics and muscle function of the cervical spine, skilled workers simulated standardized electromechanical assembly work in eight positions of the spine in the sitting position. In the position with the trunk slightly tilted back, the arm suspension reduced the trapezoid overload. These findings indicate that arm support or arm suspension can be used to reduce the muscular load on the neck. A marked reduction in the level of activity was obtained when a posture with a slightly backward thoracolumbar spine was used (Schüldt, 1988).

This study contributes to the knowledge of the influence of body posture and stool configuration on the activity of postural muscles. Reducing biomechanical loads on postural muscles should be aimed at improving user comfort and safety (Bertolaccini et al., 2016).

The pelvis tilted to the maximum in a stable sitting position can induce low back pain due to unbalanced muscle activities (Watanabe et al., 2014).

Nowadays, a lot of office workers must stay at the office for many hours while doing their job. While sitting, the pelvis rotates back, and the lumbar lordosis is flattened. At the same time, it increases the load on the intervertebral discs and on the spine. Sitting in an inclined position is known to increase disc pressure even further and to aggravate chronic low back pain (Watanabe et al., 2007).

Tilt forward and lower tilt of the chair can increase lordosis, but subjects give a high degree of comfort to adjustable seats, which allow changes in position (Harrison et al., 1999).

Static sitting is thought to be related to low back pain. Among the various regular seating positions, the reclining sitting was suggested to cause viscoelastic creep. This, in turn, can compromise torso muscle activity and proprioception and increase the risk of low back pain (Wong et al., 2019).

In ergonomic clinical interventions that alter the curves of the spine and sagittal balance in sitting, the muscle activity used in those positions may differ between people with and without a history of back pain (Claus et al., 2018).

**The optimal posture for desk work**

The study published by Mani et al. in 2018 regarding ergonomics education for office computer workers researched the ideal posture for desk work and concluded that the ideal posture at the desk is with the back straight or slightly inclined at about 90-100°, the shoulders abducted less than 20°, the elbows bent at about 90-100°, the forearms pronated, and the wrist in a neutral position.

In the case of the thigh, the angle that proved to be optimal is 20-30° and this indicates a flexion of the thighs at an angle between 120-135°.

The knee joint should be flexed at about 80-90° so that the leg is perpendicular to the ground and the support is made along the entire surface of the soles (Mani, 2018).

To correct the deficient posture of the head and neck, lumbar support and an inclination of the seat backrest at an angle of 110° can be used (Horton et al., 2010).

**Kinetotherapy and kinetoprophylaxis of musculoskeletal injuries caused by the working posture**

To remedy musculoskeletal disorders that occur during desk work, our research team proposes a unique method of treatment by the technique of alternating support surfaces (TASS). This technique is based on the alternation of anatomical topographic regions of support on the chair during desk work hours and requires the use of a chair specially designed to support the body on other support surfaces than normal.

## Objectives

The objectives of this study are to determine the improvement of postural alignment using postural biofeedback and by implementing a method of prophylaxis of musculoskeletal injuries.

## Hypothesis

The aim of this study is to prove the importance and benefits of a physical therapy program for prevention and treatment of the degenerative diseases of the spine using the technique of alternating support surfaces (TASS) and postural biofeedback.

## Material and methods

For this study we had the approval of the Ethics Commission for conducting the research. The informed consent of the subjects participating in the research was obtained.

**Research protocol**

*a) Period and place of the research*

The period of the research was 14 days, between 31.01.-15.02.2021, at the HC Kinetic office, and treatment was performed with the *reverse Chair* at the workplace of each subject.

*Subjects and groups*

The study focused on adults involved in work activities that require maintaining a sitting position at the office. This study included 13 subjects aged between 25 and 47 years old; the mean age was 32 years.

*b) Applied tests*

The tests used in the study were:

- pain scale;
- head anteriority, center of gravity anteriorization obtained from the posturography;
- ground index test

Postural analysis was performed with The Posturograph or Global Postural System (GPS) which is an advanced postural analysis system that uses non-invasive diagnostic and evaluation techniques and methods in the field of medical recovery.

The posturograph includes 2 diagnostic units and one software:

- Podoscope - is used in the analysis of static foot disorders and the position of the center of gravity; with its help the captured images are processed, the exact length of each leg, the existence of static plantar disorders (flat foot, hollow, etc.), as well as possible deviations at the ankle level being determined.
- The unit of postural analysis - is used to determine the deficiencies in the spine, through a system of video cameras that allow the acquisition of high-resolution images that are then processed through the software, in order to analyze all segmental or global deviations of the body.

Postural analysis is performed from the front, back and profile and can diagnose the deficiencies of the spine in the sagittal or frontal plane (scoliosis, kyphosis, hyperlordosis).

The software allows the storage of the patient's medical data, both those resulting from the posturographic tests and those related to the medical history or the medical treatments that the patient follows. It is useful for monitoring the evolution of subjects and the effectiveness of the recommended therapies. The posturograph offers information in real time that can be used to perform postural biofeedback.

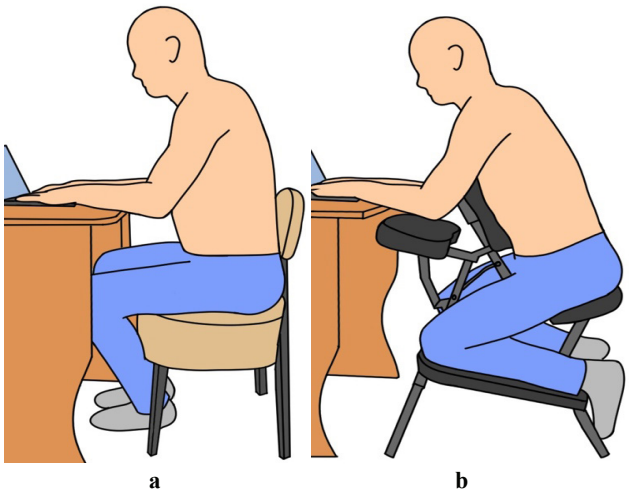
The alternate Chair or *Reverse Chair (RC)* is designed to support the body in anatomical regions other than those on which the support is made when a normal chair is used and to provide the possibility of alternating these surfaces. At the same time, the chair is configured and adjusted according to the instructions showed in Fig. 1.

The intervention protocol was:

- the biofeedback method - performed with GPS 600, included 2 sessions per week, each session consisted of maintaining the correct posture as indicated by the devices 10 times for 20 seconds.
- the method of alternating support surfaces by using the reverse seat. The use of the reverse chair was recommended for at least 2 hours from the work schedule.

*c) Statistical processing*

The applied computer statistical program was Microsoft Office/16/EXCEL EXE 2016.



a b

**Fig. 1 –** Work posture at the desk using normal (a) and reverse chair (b).

## Results

The initial and final values of the pain scale are presented in Fig. 2.

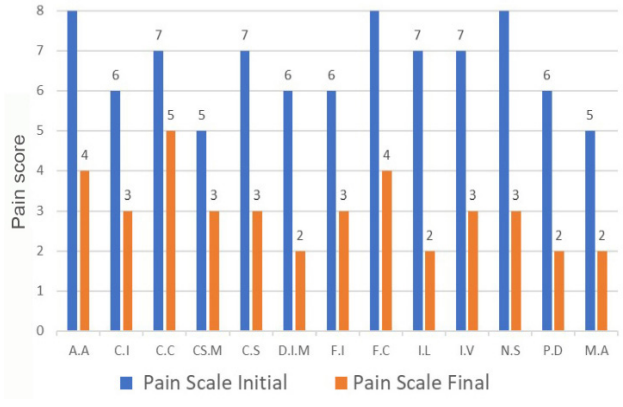



**Fig. 2** – Initial and final results of the pain scale.

The pain decreased significantly in all 13 subjects, as follows:

- in 15% subjects it decreased by 5 units;
- in 46% subjects it decreased by 4 units;
- in 23% subjects it decreased by 3 units;
- in 15% subjects it decreased by 2 units.

The initial and final results of the head anteriority are presented in Fig. 3.

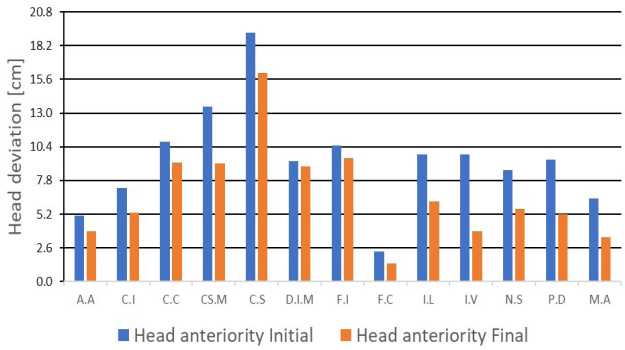



**Fig. 3** – Initial and final results of head anteriority.

The head anteriority was changed as follows:

- in 46% subjects the anteriority of the head was reduced between 0.0-2.0 cm;
- in 30% subjects the anteriority of the head was reduced between 2.1-4.0 cm;
- in 15% subjects the anteriority of the head was reduced between 4.1-5.0 cm;
- in 7% subjects the anteriority of the head was reduced between 5.1-6.0 cm.

The initial and final results of center of gravity anteriorization are presented in Fig. 4.

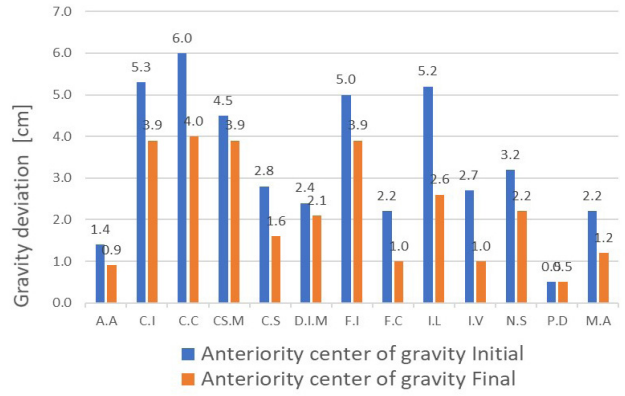



**Fig. 4** – Initial and final results of center of gravity anteriority.

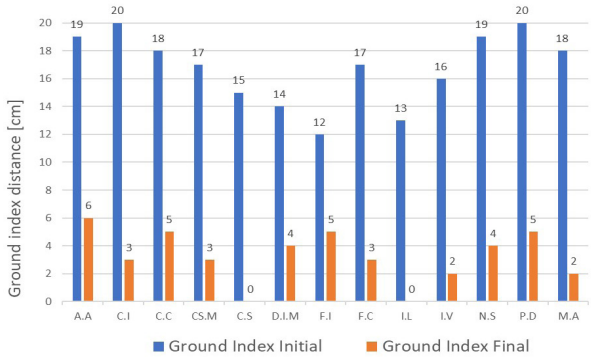



**Fig. 5** – Initial and final results of ground index.

The center of gravity projection in anteriority was reduced by the following values:

- in 38% subjects between 0-1 cm;
- in 46% subjects between 1.1-2 cm;
- in 7% subjects between 2.1-3 cm;
- in 7% subjects it showed no changes.

The initial and final results of the ground level index distance are shown in Fig. 5.

The ground level-index distance difference changed as follows:

- in 7% subjects it changed by 7 cm;
- for 30% subjects it changed between 7-13 cm;
- in 61% subjects it changed between 14-17 cm.

**Table I**

Statistical significance of the studied indicators.

| Indicators | IR | FR | p |
|---|---|---|---|
| Pain scale | 6.51 | 3.00 | 0.0001 |
| Head anteriority | 9.37 | 6.74 | 0.0001 |
| Center of gravity | 634 | 644 | 0.0020 |
| Ground index | 16.76 | 3.2 | 0.0001 |

IR=initial results; FR=final results.

## Discussions

The method of treatment and prophylaxis proposed by us in this study had positive effects.

The most important results are that the pain decreased in all the test subjects, by alternating the support points during the sitting position on the chair. In 8 of 13 subjects, the pain decreased by 50%.

The anteriority of the head changed in all the subjects, which means that the sitting position on the chair alternating the support points is also beneficial for the muscles of the cervical spine and the entire cervical muscle belt. In 10 subjects out of 13, the anteriority of the head was reduced by up to 4 cm.

The anteriority of the center of gravity projection decreased, which means that the standing stability improved. Alternating the support points in the sitting position on the chair leads to an improved condition with the anterior muscle chain working in balance with the posterior muscle chain.

The values in the ground level-index test for 12 subjects out of 13 improved between 10-17 cm, which indicates an increase in the mobility of the lumbar spine and an increased flexibility of the tissues in the lumbar area in 90% of the test subjects.

The use of the method proposed by us, which includes the alternation of the supporting surfaces, can be a method of prophylaxis of the muscular-skeletal injuries induced by the office position.

The center of gravity deviations and ground index are statistically significantly reduced (Table I).

## Conclusions

1. The anteriority of the center of gravity projection deviation decreased statistically significantly after the intervention.
2. Head anteriority decreased statistically significantly after the intervention.
3. The pain scale index decreased statistically significantly after the intervention.

4. The ground level-index test improved after the intervention, which indicates an increase in the mobility of the lumbar spine and an increased flexibility of the tissues in the lumbar area.

**Conflict of interests**

No conflicts

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