

The lumbar spine symptoms modifications due to vertebral spine posture optimization

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Abstract. Aim: The aim of this study is to assess the evolution of the lumbar spine symptoms and mobility secondary to posture optimization. Material and methods: The two groups of patients had received two different physical therapy protocols. The first protocol was concerned on the cervical spine posture rehabilitation, mostly on supine positions and the second was the Williams protocol, dedicated for lumbar degenerated discs and sciatic nerve compression. Results: There was a totally of 81 patients studied, organized in two homogenous groups of man and women, aged between 26 and 64. The patient’s evolution was assessed with Modified Schober Test and with Visual Analogue Scale (VAS). The positive evolution of symptoms and lumbar spine mobility were proved by the results, and the statistics revealed that both physical therapy protocols had the same evolution, $p=0.114$ at Modified Schober Test, and $p=0.168$ at VAS Test.

Key Words: posture, low back pain, spine stress, Williams lumbar flexion exercises.

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Introduction

Posture itself is very hard to be defined and it’s even harder to define an ideal posture. Despite this, the posture has been described as a temporary position that the body adopts before the following posture (Roaf 1978).

Movement and posture are essential for a harmonious physical and mental development. The physical and mental status are interconnected and they have to be treated as one.

From a different point of view the correct posture is the status which stresses the least the active and passive structures of the spine (Paterson 2009).

When we talk about the correction of the posture, we don’t mean to bring the spine to an ideal position, but to optimize it to each individual. This way the vertebral spine structures are properly loaded and they will have the optimum functionality, based on each individual posture.

Posture is influenced by the constitutional body type, age, sex, heredity, environmental factors, emotional status, physical training status (Solberg 2008; Paterson 2009).

The instability of the spine can be induced by the agonist-antagonist spine muscles imbalances, cocontraction of these muscles and the laxity of the spine ligaments. This may lead to postural faults and tissue lesions which will contribute to onset of the low back pain. The causes of low back pain can be very complex, so as the treatment. The researchers have established the factors and structures that can produce pain: vertebral bodies, intervertebral discs, the posterior elements of the lumbar spine (ligaments, zygapophysial joints, sacroiliac joint, “kissing spines”, lamina impaction, and spondylolysis), muscles (sprain, spasm, imbalance, trigger points), thoracolumbar

fascia pathology (compartment syndrome, fat herniation), dura mater pathology, epidural plexus, radiculopathies (Liebenson 2007; Bogduk 2005).

The literature describes some postural patterns: ideal posture (the line of gravity passes through: middle of mastoid process, in front of the scapula humeral joint, center of gravity L3, middle or slightly backward of the hip joint, in front of knee joint, and at 3-4 cm in front of the ankle joint), round back, hyperlordosis, flat back, Scheuermann disease (Paterson 2009; Kisner & Colby 1990).

Taking into consideration all what’s been said above, the study analyses the biomechanical and symptomatic changes of the lumbar spine as a result of the two physical therapy protocols. Each protocol has the same goal but different principles and applications.

This study follows the evolution of the lumbar spine from the biomechanical and pain point of view, after pursuing the two physical therapy protocols: the Williams protocol, designed for sciatic compression and disc degenerations and the experimental protocol designed for cervical posture realignment and muscle power improvement of the extensor spine and abdominal wall muscles.

The study also evaluates the efficiency of the two physical therapy protocols, taking into consideration the impact of environment, sex, physiotherapy, and medication on the patients’ evolution.

Materials and methods

The study took place at the Recovery Clinical Hospital from Cluj-Napoca during January 2013 and December 2014.

Table 1. Modified Schober test evolution between groups

	Modified Schober test Day 1	Modified Schober test Day 5	Modified Schober test Day 10	Visual Analogue Scale Day 1	Visual Analogue Scale Day 5	Visual Analogue Scale Day 10
Mean	6.185	6.321	6.383	4.691	3.568	2.407
Std. Deviation	1.269	1.218	1.410	2.354	2.185	2.144

The study includes 81 patients, 41 in the research group and 40 in the control group. All patients suffered from low back pain and sciatic nerve compression. Each patient was prescribed 10 days of treatment which consisted of: physical therapy, pool physical therapy, sedative spine massage and physiotherapy. The assessment tests were: modified Schober test and visual analogue scale (VAS).

The patients were assessed in the first, the fifth and the tenth day of treatment by the PHD student.

The actual research was approved by the Ethic Committee from "Iuliu Hatieganu" Medicine Faculty from Cluj-Napoca and given the registration number 284/19.04.2011. Each patient had given his signed approval of being studied in the informed consent.

Inclusion criteria:

- low back pain
- sciatic nerve compression

Exclusion criteria:

- hip and knee arthrosis or hip congenital dysplasia
- mental disorders
- rheumatoid arthritis
- stroke
- shoulder impingement
- severe cardiopulmonary diseases
- total hip or knee prosthesis
- pregnant women

The Williams protocol consists of supine exercises, position from which the patient flexes and extends the lower limb to provide flexion and extension movement of the lumbar spine. First the patients mobilize the spine from the neutral point and then they put the spine into the extension by flexing the arms near the head. They continue with the rotation spine movements from supine. From the same position they contract the abdominal muscles in order to memorize the optimum pelvis tilt, and then they strengthen the iliopsoas muscle and also stretch the hamstrings.

From the quadruped position, they mobilize the entire spine, stretch the iliopsoas muscle and strengthen the extensors of the spine.

The quadruped position is followed by spine mobilization from sitting position, squads for lower limb power training and hanging exercises for spine elongation and abdominal muscles strengthening.

The third phase of the Williams protocol is comprised of exercises for strengthening the gluteus maximus muscles, abdominals and stretches the iliopsoas muscles and tensor fascia lata using Kabat diagonals. The Williams protocol also uses PNF (proprioceptive neuromuscular facilitation) techniques for lumbar extensors relaxation and for strengthening the abdominals (Sbenghe 1987).

The experimental protocol comprises exercises from supine for muscle relaxation. From this position, the patients must keep the head down on the mattress and to execute flexion-extension,

lateral rotations and "A" character drawing in the air with his nose. This closed kinetic chain exercises are followed by stretching exercises for the neck muscles, which will prepare that area for isometric contractions.

On the second phase, from supine, the patients execute stretching for the entire spine and strengthening exercises for shoulder external rotators, romboideus muscles, latissimus dorsi muscle and abdominal muscles.

From the prone position, the patients have to execute isometric contractions for the cervical extensors, followed by relaxation with the cervical spine in elongated position and head supported on the arms which are crossed on the mattress beneath the forehead.

In the last phase, the patients execute dynamic stabilization exercises for cervical spine in the standing position.

Statistical analysis was carried out using MedCalc Statistical Software version 15.5 (MedCalc Software bvba, Ostend, Belgium; <https://www.medcalc.org>; 2015). The following tests were used chi-square, ANOVA for repeated measures. A p value lower than 0.05 was considered statistically significant.

Results

Both groups followed 10 days of physiotherapy and physical therapy. One group followed the Williams protocol and the other group followed the experimental physical therapy protocol. Based on the results from modified Schober test and Visual Analogue Scale (VAS), the statistics showed that there are not eloquent differences between the two protocols ($p=0.114$ at modified Schober test, and $p=0.168$ at VAS test) (table 1, table 2).

Table 2. Pain evolution between groups

	Group	Mean	Std. Deviation
Visual Analogue Scale	Research	4.6	2.262
Day 1	Control	4.78	2.465
Visual Analogue Scale	Research	3.875	1.977
Day 5	Control	3.268	2.356
Visual Analogue Scale	Research	2.625	1.944
Day 10	Control	2.195	2.326

As we see in Table 2, both groups had a favorable pain evolution, and the best results were gained between day 5 and day 10 (table 3).

The study also analyses if the location of the herniated disc has any influence on the evolution of mobility and pain of the two groups (table 4).

Next, we analyzed if there are modifications on outgoing results concerning the associated pathology like: hip and knee arthrosis, flat foot, spine degenerated discs and dorso-lumbar scoliosis. The necessity of this analyze comes from the well known fact that the biomechanical changes determined by lower limb

and spinal arthrosis, lead to low back pain (O'Leary 2013). Beside the above mentioned factors, we took into consideration the influence of working habits, for example if one works on sitting or on standing position. The working position can stress the articular structures which will cause the onset of inflammation and pain.

Table 3. Time related pain evolution

Visual analogue scale	Mean	Std.deviation	P
Day 1- 5	1.124	1.977	<0.001
Day 5-10	1.161	1.699	<0.001
Day 1-10	2.284	2.192	<0.001

Table 4. The location of the herniated disc

Diagnostic	P
Right herniated disc	0.102
Left herniated disc	0.482
Bilateral herniated disc	0.405
Chronic low back pain	0.204

The statistics showed that the above mentioned pathology didn't influence the results of the modified Schober test or VAS test (table 5).

Table 5. Arthrosis and work conditions influences

Pathology	P
Dorso-lumbar scoliosis	0.853
Gonarthrosis	0.156
Spine degenerated discs	0.979
Coxarthrosis	0.126
Sitting or standing work	0.964
Flat lumbar spine	0.541
Flat foot	0.273
Dorsal cyfosis	0.934
Lumbar hiperlordosis	0.365

Table 6. Influence of sex, age and physiotherapy

Variables	P	
Sex	0.217	
Age	0.09	
Physiotherapy	Ionization	0.128
	Ultrasounds	0.243
	Diadinamic currents	0.542
	TENS	0.684
	Alternating bath	0.768
	Lymfatic drainage	0.098
	Laser	0.249
	Parafin	0.103
	Pool physical therapy	0.642
Sedative massage	0.722	

Other factors that have been studied were sex, age and physiotherapy. The statistical calculations prove once again that the above factors didn't influence the evolution of the two groups (table 6).

We also have to mention that both group of patients had took drugs. They received analgesic and anti-inflammatory drugs. That's why we analyzed once again if the drugs had changed the assessment results. Statistics said that there is no influence of the drugs on the study results (table 7).

Table 7. Drug's influence

Medication	P
Oral analgesic	0.172
Oral NSAID	0.95
Local NSAID	0.116

Discussions

The Williams protocol, also called Williams lumbar flexion exercises are a set or system of related physical exercises intended to enhance lumbar flexion, avoid lumbar extension, and strengthen the abdominal and gluteal musculature in an effort to manage low back pain non-surgically. The system was first devised in 1937 by Dr. Paul C. Williams (1900-1978) who was an orthopedic surgeon.

His technique advanced over time, setting the goals of physical therapy according to the syndrome stage: acute, subacute, chronic or complete remission. In the acute stage we apply general relaxation methods on the lumbar muscles (Lee et al 2015). The actual physical therapy program begins in the subacute stage, when besides relaxation methods, a series of techniques to strengthen the lower torso are being applied. In the first stage, the patient is treated only in supine position, to unload the weight of the patient's torso (Blackburn& Portney 1981). A vicious circle is being created at the level of the motor nerves and muscles of the lower region of the back. Lower-back morbidity is actually a conflict between lumbar discs, nerves and mechanical load, along with local inflammation. Irritation and inflammation lead to pain and pain produces muscle stiffness. To close this vicious circle, muscle contractions of the abdominals and of the iliopsoas muscles is necessary, which leads to the relaxation of the paravertebral muscles. Physical therapy exercises in this phase also contributes to the partial recovery of lumbar joint mobility. Even limited movement obtained during exercise helps to feed the disc and to restore its height by absorbing liquid, called inhibition phenomenon. This phase lasts for about 2 weeks (Prentice& Voight 2001; Moldovan 2012). In the second stage of the program, the exercises prepare the spine to support a heavier weight like in a vertical position. Basically it is about switching from a horizontal position to a vertical one. This verticalization complies with the principles of accessibility and gradual loading. Exercises from the first stage become warm-up exercises for the second stage. The long term immobilization is not recommended, even in the acute phase, because of its negative effects (Liebenson 2007).

The verticalization will be performed gradually, by using exercises which allow the patient to make this transition without pain. In the third stage, the clinical remission is already achieved

and the program aims are the pelvis tilt rehabilitation, restoring body symmetry, correcting the vicious posture and providing the patient with an accessible exercise program (at home) with the purpose of preventing and improving body outfit control (Calvosa&Dubois 2008). Physical therapy continues with strengthen exercises for the lumbar and abdominal muscles. The aim of strengthening the abdominal muscles and back extensors, in orthostatism, is to achieve a neutral position of the pelvis and to create an abdominal pressure capable of taking some of the pressure placed on the lower lumbar intervertebral discs. Getting a neutral position depends upon stretching the extensor lumbar muscles (paravertebral muscles and iliopsoas) and strengthening the abdominals (which pull the pelvis up) and the buttocks (which pull down the posterior part of the pelvis) (Ponte et al 1984; Moldovan 2012).

It is very well known that both acute or chronic pain of musculoskeletal system are due to micro cumulative traumatism. The stressing agents, as they have been defined by Mueller and Maluf (Sahrmann 2011) as the wrong movement patterns, car accidents, wrong posture or faulty repetitive slow intensity movements, lead to micro traumatism and tissue lesions.

Mueller and Maluf, who developed the physical stress theory (Sahrmann 2011), remark the importance of the injured or stressed tissue healing process. They also underline the importance of elimination of the factors that stressed the tissues, and the importance of the gradual integration of the mechanic stress or movement over the injured area. They postulate that an injured tissue is more predisposed to new injury compared with a healthy one.

The healing process takes time, and the progression onto activity will be gradually. The body structures will stay healthy as long as they will function in the physiological range of motion (O'Sullivan 2007).

Based on these principles, the experimental physical therapy protocol paid a great amount of attention on the relaxation of the active and passive spine structures. Most of the postural correction exercises and strengthening exercises were executed from supine and sitting postures.

The sitting position exercises were only isometric and stretching maneuvers. The standing exercises were dedicated for cervical spine dynamic stabilization and for body stamina training. The first phase of Williams protocol also consists of supine exercises for lower limbs which will mobilize the lumbar spine. The exercises of the second phase are executed on the hanging position, position that will elongate the spine and will train the patient postural awareness. The third phase exercises stretch the lumbar extensors muscles and will strengthen the abdominal wall. The disadvantages of the Williams protocol compared to the experimental one, consists of the short period of integrated treatment in the hospital (only 10 days). Only a few patients will evolve into better condition over these 10 days of treatment, thus they will be not able to benefit from the all three phases of Williams protocol so the physical therapy treatment will be incomplete. Another disadvantage of the Williams protocol is that the patients with upper limbs arthritis or older patients cannot exercise from hanging position.

Conclusion

Based on the above arguments and tissue healing principles we consider that the experimental protocol is better adapted for all types of patients and for a short period of time treatment.

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