FUNCTIONAL INSTABILITY OF THE SPINE: SELECTION MEASURES FOR DIAGNOSIS AND TREATMENT USING COMPUTER STABILITY

O. V. Farion-Navolska, I. R. Mysula, O. V. Denefil

Ternopil National Medical University named by I.Ya.Horbachevsky Ministry of Health of Ukraine

Abstract

Osteochondrosis of the spine is one of the most common chronic diseases of the human musculoskeletal system, in which there is a degenerative-dystrophic lesion of the vertebrae, intervertebral discs and ligaments.

The aim of the study was to analyze the problems of pain and instability of the spine that occur in osteochondrosis, kinesiological methods of their diagnosis and treatment, and the criteria for selecting patients for the treatment of spinal instability.

Material and methods of investigation. Literature sources were analyzed to substantiate the feasibility of selecting patients with disorders of functional stability of the spine and the use of computer stabiloplatform for diagnosis and treatment.

Results. 4 groups of people were selected for examination and treatment. All individuals were selected from patients who applied to the Milon Center, which specializes in helping patients with kinesiodiagnostics and kinesiotherapy, therapeutic massage. All patients gave informed consent to use their examination and treatment data, if necessary, using a stabiloplatform. The first group included people who did not have osteochondrosis, but led a sedentary lifestyle, mostly traveling by car, ie were at risk of developing osteochondrosis. Their age was 22–28 years; the distribution by sex was - 12 men and 16 women. The second

included patients who had hypermobility of the spine. Their age was 25-35 years; the distribution by sex was - 18 men and 23 women. The third group included patients with hypomobility of the spine. Their age was 28-45 years; the distribution by sex was - 15 men and 20 women. The fourth group included patients with spinal instability. Their age was 30-50 years; the distribution by sex was - 22 men and 32 women.

Expected results. In each of the groups of subjects is expected to improve the functional stability of the spine, reduce disorders of the autonomic nervous system, reduce psychological disorders, improve sleep quality. The selection of the number of procedures is set individually, depending on the quality of the detected changes. Long-term results of stabilometry application are expected to be investigated.

Conclusion. Osteochondrosis is a modern disease that leads to a deterioration in the quality of people of working age. The use of computer stabilometry can improve the functional stability of the spine.

Кey words: computer stability, ;instability of the spine

Introduction. Osteochondrosis of the spine is one of the most common chronic diseases of the human musculoskeletal system, in which there is a degenerative-dystrophic lesion of the vertebrae, intervertebral discs and ligaments [1, 2]. In the structure of the incidence of the adult population, lumbar osteochondrosis accounts for 48-52%. In the structure of disability caused by diseases of the musculoskeletal system, the share of destructive-dystrophic diseases of the spine is 20.4%, and the level of disability due to these diseases is 4 per 10,000 [3, 4]. The problem of osteochondrosis of the spine has been in the spotlight for many decades, but it still cannot be considered fully studied [5].

The aim of the study was to analyze the problems of pain and instability of the spine that occur in osteochondrosis, kinesiological methods of their diagnosis and treatment, and the criteria for selecting patients for the treatment of spinal instability.

Material and methods of investigation. Literature sources were analyzed to substantiate the feasibility of selecting patients with disorders of functional stability of the spine and the use of computer stabiloplatform for diagnosis and treatment. Ostochondrosis is based on the primary dystrophic-degenerative-destructive process in the intervertebral disc, with the subsequent development of reactive and compensatory changes in the intervertebral joints and ligaments, and then in the bodies of adjacent vertebrae and, as a result, total damage to all elements of the vertebral motor .

The prevalence of low back pain is now so widespread that, according to WHO experts, it has reached epidemic proportions in developed countries [6, 7, 8, 9]. The one-month and one-year prevalence are 30.8% and 38.0%, respectively, and account for 23% of outpatient visits [10, 11].

Back pain is the second most common reason for seeking medical attention, and is the third most common cause of hospitalization, after acute respiratory viral infections. According to T.H. Kim [12], 21 million people in the United States experience back pain every year, and 80% of adults have ever suffered from it. In about 20% of adults, back pain periodically recurs, of which 80% of cases disappear with treatment within a month, but in 10-20% of people of working age, acute pain is transformed into chronic [13, 14]. The peak in the prevalence of pain in the spine falls on the mature, most efficient age - from 35 to 55 years. Some authors argue that low back pain is the third most expensive disease, after cardiovascular and oncological [15, 16]. At the same time, 50% of patients in the state hospital are ill with surgical operations.

The causes of back pain are numerous, often the clinical manifestations of chronic pain are largely determined by the psychoemotional status of the patient, the influence of social, cognitive, and cultural factors [17, 18].

It is proposed to consider the mechanisms of development of back pain can be understood using the example of the sensorimotor reflex. Nociceptive impulses, regardless of the source, arrive through the dorsal roots into the neurons of the dorsal horns of the spinal cord, from where they reach the central nervous system via nociceptive pathways. Pain impulses activate α- and γ-motoneurons of the anterior horns of the spinal cord, while activation of the anterior motoneurons causes spasm of the muscles innervated by this segment of the spinal cord [19, 20]. With muscle spasm, stimulation of nociceptors occurs, local ischemia develops in the spasmodic muscle, which enhances the activation of muscle fiber nociceptors [20]. As a result, the spasmodic muscle acts as a source of additional nociceptive impulses entering the cells of the posterior horns of the same segment of the spinal cord [21, 22, 23]. The flow of painful impulses enhances the activity of the anterior motor neurons, which further enhances muscle spasm. As a result, a typical vicious circle is observed: "pain - muscle spasm - pain - muscle spasm" [24, 25, 26]. With degenerative-dystrophic changes in the spine, the risk of trauma to the receptors of the surrounding tissues and spinal nerve roots increases in the presence of posterior and posterolateral osteophytes, disc protrusion and prolapse, especially in conditions of hypermobility and instability of the affected vertebral segment [27, 28, 29].

Spinal instability is a pathological condition characterized by the occurrence and progression of non-physiological displacements and deformations in pathologically altered vertebrae and / or vertebral segments within the spinal column. Such changes lead to the impossibility of maintaining the shape and functions of the spine under normal physiological loads.

These pathological displacements and deformities can cause vertebrogenic damage to the spinal cord, its roots, cause critical disorders of hemodynamics in the spinal cord, which is manifested by the emergence and increase of neurological deficits. In the vast majority of cases, spinal instability is manifested by varying degrees of pain, impaired shape and function of the spine (static disorders, restricted movement). Today, people under the age of 45 often limit their activity due to constant back and neck pain. The prevalence of chronic back pain is 26-32% among the adult population. In the structure of morbidity with disability of the adult population more than 50% are diseases of the peripheral nervous system. Among the disabled with diseases of the peripheral nervous system in 80% of cases there are vertebrogenic lesions.

Spinal instability is a clinical and radiological syndrome of osteochondrosis, which is manifested by functional failure of the spine under static-dynamic load, and is characterized by excessive pathological mobility in the horizontal plane with subsequent displacement of one vertebra relative to another, which leads to a violation of its stability. Given the gradual development of spinal instability, degenerative processes occur diffusely only in the tissues of the disc and there is pathological mobility of the vertebrae in the horizontal plane; then the process involves small arcuate joints of the spine, ligaments and muscles; and finally the above structures and an arch of a vertebra with its resorption, sliding of a vertebra forward, that is degenerative spondylolisthesis are struck. It is accepted to allocate four types of disturbance of mobility of a backbone: 1 - hypermobility, 2 - hypomobility, 3 - instability, 4 - complete lack of mobility [30].

Diagnosis is carried out by X-ray examination: non-contrast examination and functional (in the position of maximum flexion and extension in lateral projection) radiography, according to the indications - radiography with contrast of subarachnoid (myelography) or epidural (epidural-canal) resonator space, vertebral or spinal tomography.

Treatment of osteochondrosis of the spine should be aimed at all parts of the pathogenesis, taking into account the location of the lesion, stage, form and stage of the disease, the functional state of the organism and its individual systems. Usually this effect gives a comprehensive use of various tools (medications, exercise therapy, massage, traction,

chiropractic, etc.) depending on the indications. The plan of treatment and rehabilitation measures is made individually for each patient taking into account the prevailing pathological syndromes.

In recent years, stabilography and stabilometry have been used for therapeutic purposes. Today stabiloplatforms are widely used for sports research, organization of biomanagement, assessment of pain syndromes and the impact of exercise, in ergonomics [31], risk assessment of falls, effectiveness of exposure and analysis of patients, assessment of vertical posture stability at different times [32], influences movement of the tongue on the stability of posture [33] as the main tool for assessing the stability of vertical posture, to study the systemic mechanisms for regulating the stability and controllability of vertical posture.

Stabilometry is a method for assessing the balance function of a person, in which the movements of the center of pressure of the patient's feet to the platform of the device are analyzed [34]. A significant advantage of stabilography is its physiology. The study is carried out with the natural observance of a vertical posture by a person and does not cause any pathological and physiological reactions [35]. By the change in the center of pressure on the stabilometric platform, fluctuations in the center of mass of the human body are judged, while the statokinesiogram curve is recorded. The statokinesigram reflects the dynamics of the movement of the general center of mass of the human body. Postural disorders are investigated based on the analysis of the stabilographic signal using the following methods: statistical, spectral and visual analysis of statokinesiograms. There are special and universal stabilometric indicators. Universal indicators assess any stabilographic signal, and special ones are focused on a specific technique [36]. Using the method of computer stabilometry, it is possible to study the balance of vertical stability and a number of transient processes. The method is based on the registration and analysis of parameters characterizing the movement of the horizontal projection of a person standing in a relaxed posture [37].

The method of computer stabilometry is used for functional diagnostics of the musculoskeletal system, nervous system, vestibular, visual, proprioceptive and other systems of the body. Many authors confirm the use of stabilometry as a nonspecific indicator of the functional state of the nervous system and the psychoemotional state of a person [38, 39]. Stabilometric data are not always consistent with clinical or laboratory studies. The inconsistency of these data shows that the information obtained by stabilometry is not duplicated and is unique [38]. In a real examination of both a healthy person and with disorders of the musculoskeletal system, oscillations are noted in which the center of gravity has different accelerations [39]. In the process of stabilometric research, the line of the body

vector or vertical descends from the center of the head (the level of which corresponds to the opening of the auricle), passes 1 cm in front of the line of the inner ankles. In this state, the hip and knee joints are closed passively and do not require energy expenditure. The ankle joint is actively closed by tension of the triceps muscle of the lower leg [40]. With age, there are tendencies towards a shift of the center of gravity forward in the sagittal plane and an increase in vertical stability [41].

Results and discussion. 4 groups of people were selected for examination and treatment. All individuals were selected from patients who applied to the Milon Center, which specializes in helping patients with kinesiodiagnostics and kinesiotherapy, therapeutic massage. All patients gave informed consent to use their examination and treatment data, if necessary, using a stabiloplatform. The first group included people who did not have osteochondrosis, but led a sedentary lifestyle, mostly traveling by car, ie were at risk of developing osteochondrosis. Their age was 22–28 years; the distribution by sex was - 12 men and 16 women. The second included patients who had hypermobility of the spine. Their age was 25-35 years; the distribution by sex was - 18 men and 23 women. The third group included patients with hypomobility of the spine. Their age was 28-45 years; the distribution by sex was - 15 men and 20 women. The fourth group included patients with spinal instability. Their age was 30-50 years; the distribution by sex was - 22 men and 32 women.

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Conclusion. Osteochondrosis is a modern disease that leads to a deterioration in the quality of people of working age. The use of computer stabilometry can improve the functional stability of the spine.

REFERENCES

1. Gioev P.M. Complex treatment of diseases of the lumbar spine. - SPb: "IPTP". 2003. 248 p.

2. Prodan A. I., Radchenko V. A., Korzh N. A. Degenerative diseases of the spine / A. I. Prodan, V. A. Radchenko, N. A. Korzh. - Kharkiv: IPP "Contrast". 2007. 272 p.

3. Boody B.S., Rosenthal B.D., Jenkins T.J., Patel A.A., Savage J.W., Hsu W.K. Iatrogenic Flatback and Flatback Syndrome: Evaluation, Management, and Prevention // Clin. Spine Surg. 2017;30(4):P.142–149.

4. Vlaeyen J.W.S., Linton S.J. Fear-avoidance and its consequences in chronic musculoskeletal pain: A state of the art // Pain. 2000;85:317–332.

5. Buchbinder R., Staples M., Jolley D. Doctors with a special interest in back pain have poorer knowledge about how to treat back pain // Spine. 2009;34:1218–1226.

6. Cher D., Polly D., Berven S. Sacroiliac joint pain: burden of disease // Med. Devices (Auckl). 2014;12(7)7:73–81.

7. Hasenbring M.I., Hallner D., Klasen B., Streitlein-Böhme I. et al. Pain-related avoidance versus endurance in primary care patients with subacute back pain: Psychological characteristics and outcome at a 6-month follow-up // Pain. 2012;153:211–217.

8. Quintero S., Manusov E.G. The disability evaluation and low back pain // Prim. Care. 2012;39(3):553–559.

9. Vereščiagina K., Ambrozaitis K.V., Špakauskas B. Health-related qualityoflife assessment in patients with low back pain using SF-36 questionnaire // Kaunas: Medicine. 2007;43:607–613.

10. Hill J.C., Whitehurst D.G., Lewis M. et al. Comparison of stratified primary care management for low back pain with current best practice (STarT Back): A randomised controlled trial // Lancet. 2011;378:1560–1571.

11. Hoy D.G., Bain C., Williams G. et al. A systematic review of the global prevalence of low back pain // Arthritis Rheum. 2012;64(6):2028–2037.

12 Kim T.H., Kim E.H., Cho H.Y. The effects of the CORE programme on pain at rest, movement-induced and secondary pain, active range of motion, and proprioception in female office workers with chronic low back pain: a randomized controlled trial // Clin. Rehabil. 2014;29(7):653–662.

13. Erdes S.F. Principles of diagnosis and treatment of pain in the lower back // Scientific and Practical. rheumatol. 2006;2:37–44.

14. Vad V.B., Bhat A.L., Basrai D. et al. Low back pain in professional golfers: The role of associated hip and low back range-of-motion deficits // The American Journal of Sports Medicine. 2004;32:494–497.

15. Cher D., Polly D., Berven S. Sacroiliac joint pain: burden of disease // Med. Devices (Auckl). 2014;12(7):73–81.

16. Devlin N., Parkin D., Browne J. Using the EQ-5D as a performance measurement tool in the NHS // Health Econ. 2010;19(8):886–905.

17. Golubev V.L., Vein A.M. Neurological Syndromes: A Guide for Physicians - 2nd ed., Add. and revised - M: MEDpress-inform. 2007. 736 p.

18. Laplante B.L., Ketchum J.M., Saullo T.R., DePalma M.J. Multivariable analysis of the relationship between pain referral patterns and the source of chronic low back pain // Pain Physician. 2012;15(2):171–178.

19. Bickley L.S. The neurological system. In: Bickley LS (ed). Bates' Guide to Physical Examination and History Talking (10th edn) // Philadelphia, PA: Lippincott, Williams and Wilkens. 2009. 1024 p.

20. Cher D.J., Frasco M.A., Arnold R.J., Polly D.W. Cost-effectiveness of minimally invasive sacroiliac joint fusion // Clinicoecon Outcomes Res. 2015;18(8):1–14.

21. Greenberg D., Aminoff M., Simon R. Clinical neurology. M:Medpress inform. 2004. 700 p.

22. Skoromets A.A., Skoromets A.P. Topical Diagnosis of Nervous System Disorders: A Guide for Physicians; 5th ed. SPb, 2005. 399 p.

23. Stephanidi A.V., Sorokovikov V.A., Balabanova N.V., Dukhovnikova I.M. The role of impairment of proprioceptive information in the pathogenesis of chronic muscle-fascial pain in the lower back // Bulletin of the East Siberian Scientific Center of the Siberian Branch of the Russian Academy of Medical Sciences. 2006;5:181–185.

24. Podchufarova E.V. Acute pain in the lumbosacral region: examination and treatment from the standpoint of evidence-based medicine // Ros. Honey. Journal. 2007;10:845–849.

25. Thomas J.S., France C.R. The relationship between pain-related fear and lumbar flexion during natural recovery from low back pain // European Spine Journal. 2008;17:97–103.

26. Van Wingerden J.P., Vleeming A., Ronchetti I. Differences in standing and forward bending in women with chronic low back or pelvic girdle pain: Indications for physical compensation strategies // Spine. 2010;33(11):33–41.

27. Novoseltsev S.V., Malinovsky E.L., Smirnov V.V. Features of biomechanical disorders in the spine with protrusions and hernias of intervertebral discs // Manual therapy. 2010;2(42):38–47.

28. Petrov P.I. Tactics of hip arthroplasty with concomitant syndrome of intervertebral joints of the lumbar spine: Abstract of the thesis. Cand. honey. sciences / P.I. Petrov. M., 2018. 24 p.

29. De Froda S.F., Daniels A.H., Deren M.E. Differentiating Radiculopathy from Lower Extremity Arthropathy // Am. J. Med. 2016;129(10):1124–1127.

30. Tarasenko O. M., Sharmazanova O. P., Mironchuk L. V. Rukhomist of the ridge in the sagittal area for radiological signs in spinal cord injury in the practice of MSEC // Bulletin of problems of biology and medicine. 2014; 2 (108): 164-168.

31. Kunitsa M.N. Stabilometry in assessing the effectiveness of rehabilitation measures in children and adolescents: dis. ... Cand. honey. sciences. Moscow, 2010. 151 p.

32. Likhachev S.A., Kachinsky A.N. The value of some indicators of static stabilometry // Vestn. otorhinolaryngology. 2011;2:33–37.

33. Likhachev S.A., Tarasevich M.N. Evoked vestibular myogenic potentials: anatomical and physiological aspects of their implementation and clinical application // Zh. neurology and psychiatry S.S. Korsakov. 2011;2:84–89.

34. Skvortsov D.V. Theoretical and practical aspects of modern posturology // Mater. international symposium, clinical posturology, posture and bite. - SPb., 2004. P. 30–31.

35. Vasemazov S.N. Computer stabilometry in the diagnosis of neurological manifestations of lumbar osteochondrosis: dis. ... Cand. medical sciences. Saratov, 2010. - 133 p.

36. Chernikova L.A. Methods of diagnostics and training of the balance function based on the computer stabilizer analyzer with biofeedback "Stabilan-01" in neurology. A guide for doctors. - M .:2007. 50 p.

37. Sidorova O.A. Features of the morphofunctional development of the organism of children in the pre- and pubertal period of ontogenesis with different conditions of motor activity: author. diss. Cand. biol. sciences. Tyumen, 1998. 20 p.

38. Furman J.M. Role of posturography in the management of vestibular patients // Otolaryngol. Head Neck Surg. 1995;112(1):8-15.

39. Kohen Raz R., Volkmar F.R., Cohen D.J. Postural control in children with autism // J. Autism. Dev. Disord. 1992;22(3):419–432.

40. Skvortsov D.V. Clinical analysis of movements, stabilometry. M:Antidor, 2000. 189 p.

41. Savelyev M.Yu. Physiological substantiation of stabilometry in the assessment of static balance in children of primary school age in health and with impaired motor function: dis. ... Cand. honey. sciences. Arkhangelsk, 2005. 123 p.