

## DEGENERATIVE-DESTRUCTIVE CHANGES IN THE MUSCULOSKELETAL SYSTEM AMONG PRESCHOOL CHILDREN: EARLY DIAGNOSIS OF DYSPLASTIC SCOLIOSIS

*Horoshko Viktoriia*

*National University «Yuri Kondratyuk Politechnic»*

### **Аномалії:**

**Abstract.** The increased risk of scoliosis is due to the rapid growth of the child's skeleton during the development of the body. Numerous studies on the detection of scoliosis in children show that this pathology is one of the most common diseases of the musculoskeletal system; it tends to progress to a maximum towards the end of the child's development. Conservative screening methods for scoliosis in preschool children often do not allow diagnosing scoliosis in the early stages of development. To date, there is no objective way to identify possible characteristic symptoms of scoliosis. In most cases, the external signs of scoliosis are present in the presence of severe spinal deformity. The diagnosis can be made on the basis of radiographs taken during the examination of the chest, kidneys, and also after fluorography. The aim of the study is to improve the diagnosis and treatment of early-stage scoliosis in children. The method proposed in the study is that the examination is carried out from behind in bright light and marks the place of abnormal hair growth in the form of circles of different diameters along the line of spinous processes or paravertebral lines, which determine the location of the anomaly or scoliosis. The symptoms we have described make it possible to identify the risk group of children for the possible development of dysplastic scoliosis during screening examination of children and, on recommendation, to observe children with additional clinical symptoms of degenerative and destructive changes in the spine. Medical examination and dynamic observation of children at risk determine the prevention, early diagnosis and timely treatment of scoliosis. The proposed method for diagnostics and therapeutic exercises of back muscles with elements of play for preschoolers increases the effectiveness of treatment. Early detection of scoliosis and the optimal complex of conservative therapy can improve the outcome of treatment of early stages of scoliosis in children.

**Дегенеративно-деструктивні зміни опорно-рухового апарату у дітей молодшого дошкільного віку: рання діагностика диспластических сколіозів**

*Горошко Вікторія*

*Анотація.* Підвищений ризик

сколіозу обумовлений швидким ростом дитячого скелета в процесі розвитку організму. Численні дослідження з виявлення сколіозу у дітей вказують на те, що ця патологія є одним із найпоширеніших захворювань опорно-рухового апарату, має тенденцію прогресувати ближче до кінця розвитку дитини. Консервативні методи скринінгу сколіозу у дітей дошкільного віку часто не дозволяють діагностувати сколіоз на ранніх стадіях розвитку. На сьогоднішній день не існує об'єктивного способу виявлення можливих характерних симптомів сколіозу. У більшості випадків зовнішні ознаки сколіозу присутні при наявності важкої деформації хребта. Діагноз можна поставити на підставі рентгенограм, зроблених під час обстеження органів грудної клітини, нирок, а також після флюорографії. Мета дослідження - поліпшити діагностику і лікування сколіозу на ранніх стадіях у дітей. Метод, запропонований в дослідженні, полягає в тому, що огляд проводиться ззаду при яскравому світлі і відзначає місце аномального росту волосся у вигляді кіл різного діаметру по лінії остистих відростків або паравертебральних ліній, які визначають місце аномалії або сколіоз. Описані нами симптоми дозволяють виявити групу ризику дітей по можливому розвитку диспластичного сколіозу при проведенні скринінгового обстеження дітей і за рекомендацією спостерігати дітей з додатковими клінічними симптомами дегенеративних і деструктивних змін хребта. Метою медичного огляду та динамічне спостереження за дітьми групи ризику визначають профілактику, ранню діагностику і своєчасне лікування сколіозу. Пропонований нами спосіб діагностики і лікувальної гімнастики м'язів спини з елементами гри для дошкільнят підвищує ефективність лікування. Раннє виявлення сколіозу і оптимальний комплекс консервативної терапії дозволяють поліпшити результат лікування ранніх стадій сколіозу у дітей.

**Дегенеративно-деструктивные изменения опорно-двигательного аппарата у детей младшего дошкольного возраста: ранняя диагностика диспластических сколиозов**

*Горошко Виктория*

**Аннотация.** Повышенный риск сколиоза обусловлен быстрым ростом детского скелета в процессе развития организма. Многочисленные исследования по выявлению сколиоза у детей показывают, что эта патология является одним из самых распространенных заболеваний опорно-двигательного аппарата, имеет тенденцию прогрессировать до максимума к концу развития ребенка. Консервативные методы скрининга сколиоза у детей дошкольного возраста часто не позволяют диагностировать сколиоз на ранних стадиях развития. На сегодняшний день не существует объективного способа выявления возможных характерных симптомов сколиоза. В большинстве случаев внешние признаки сколиоза присутствуют при наличии тяжелой деформации позвоночника. Диагноз можно поставить на основании рентгенограмм, сделанных во время обследования органов грудной клетки, почек, а также после флюорографии. Цель исследования - улучшить диагностику и лечение сколиоза на ранних стадиях у детей. Метод, предложенный в исследовании, заключается в том, что осмотр проводится сзади при ярком свете и отмечает место аномального роста волос в виде кругов разного диаметра по линии остистых отростков или паравертебральных линий, которые определяют место аномалии или сколиоз. Описанные нами симптомы позволяют выявить группу риска детей по возможному развитию диспластического сколиоза при проведении скринингового обследования детей и по рекомендации наблюдать детей с дополнительными клиническими симптомами дегенеративных и деструктивных изменений позвоночника.

Медицинское обследование и динамическое наблюдение за детьми группы риска определяют профилактику, раннюю диагностику и своевременное лечение сколиоза. Предлагаемый нами способ диагностики и лечебной гимнастики мышц спины с элементами игры для дошкольников повышает

эффективность лечения. Раннее выявление сколиоза и оптимальный комплекс консервативной терапии позволяют улучшить исход лечения ранних стадий сколиоза у детей.

<b>Key words:</b> <i>musculoskeletal system, scoliosis, diagnostics, degenerative-destructive changes.</i>	<b>Ключові слова:</b> <i>опорно-руховий апарат, сколіоз, діагностика, дегенеративно-деструктивні зміни.</i>	<b>Ключевые слова:</b> <i>опорно-двигательный аппарат, сколиоз, диагностика, дегенеративно-деструктивные изменения.</i>
---	--	--

---

**Introduction.** In recent years, there has been an increased interest in issues of individual health, which is confirmed by numerous studies by leading scientists in Ukraine and around the world. The health of our children is of particular concern, because the health of the nation and the progressive dynamics of society as a whole is linked to the health of young people and the future of the country. In modern society, there is an increase in morbidity for all major groups of diseases, an increase in mortality, a decrease in fertility, and life expectancy. Statistics show disappointing information that only 20% of school-age children do not have spinal curvature or scoliosis [3,7]. Experts define this condition as a stable lateral curvature of the child's spine with a change in the shape of the vertebrae. At the same time, statistical studies have shown that girls suffer from scoliosis five to six times more often than boys.

The lack of clarity of many issues of the etiology and pathogenesis of the scoliotic disease, the lack of timely diagnosis, and the lack of organization of screening examinations of the child population do not allow the use of sufficiently effective methods of prevention and early treatment of scoliosis. In addition, there is no unanimity of views on the methods of conservative treatment of scoliotic disease, and the methods of treatment themselves need to be clarified and refined. Insufficient attention is paid to the problems of rational organization in kindergartens and schools of the daily routine for children suffering from scoliosis, the creation of optimal conditions for learning in them, while at the same time contributing to the treatment of scoliosis. The progressive course of scoliosis in about 1 in 3 sick children, the absence of pathogenic treatment, and many other factors require new research in this area [1].

A large number of patients with scoliosis, the obvious absence of non-invasive methods for early diagnosis of scoliosis, the lack of a unified point of view on the choice of optimal treatment tactics, and this pathology in medicine causes physical, scientific, practical and organizational problems and shows the relevance of the chosen topic.

**Purpose of the work:** to improve the outcomes of grade I and II scoliosis in children through early diagnosis and an optimal complex of restorative treatment.

**Hypothesis:** the prevention of scoliosis in children will be successful if the developed methods and recommendations are followed, as well as with early detection of changes in the spine at regular medical examinations.

**Material and methods.** The causes of malformations of the spine must be sought and eliminated even at preschool age. Posture is developed as a child grows

and develops. It largely depends on the position of the spinal column and the development of the muscles that hold it in the correct position.

In the mother's uterus, the fetal spine is a uniform arc with an apex directed backward. Immediately after the baby is born, the spine becomes almost straight when the lungs begin to fill with air on the first breath. From this moment, the formation of posture begins and continues throughout the entire development of the child.

When the baby begins to turn and lay on the tummy, he moves his head to the sides, and then raises the head and holds it in a raised position. At the same time, his neck muscles develop. In the cervical part of the spine, a forward bend is formed. When the child begins to sit, a second curvature of the spine forms in the thoracic part, the bulge facing back. Later, when the child stands on the legs, his pelvis turns around the heads of the femurs, leans forward, causing the third bend of the spine in the lumbar part, the bulge facing forward [4].

Posture defects and scoliosis can occur even in infancy, when a large amount of nonostent (cartilage) tissue is present in the child's skeletal system. One of the reasons for their occurrence of scoliosis is incorrect - always on one hand - carrying a baby, which developed muscles that extend the back are not yet prepared to carry a static load.

The cause of the curvature of the spine can be either congenital or acquired. Congenital causes of curvature of the spine include abnormalities in intrauterine development, which leads to underdevelopment of the vertebrae, the appearance of additional wedge-shaped vertebrae and other diseases. The reasons for the violation of the development of a normal intrauterine device can be both the mother's malnutrition, the presence of bad habits, and the neglect of physical activity (physiotherapy exercises). An irregularly shaped mother's pelvis can also adversely affect the baby at birth.

Causes of the acquired curvature of the spine. All diseases (rickets, poliomyelitis, tuberculosis, inflammation of the pleura, radiculitis, etc.) and injuries (fractures of the spine) can cause the development of curvature of the spine. Incorrect body position as a result of the physiological characteristics of a person (flat feet, different leg lengths or the absence of one of them, strabismus or myopia due to which a person is forced to take the wrong posture when working) the same is the cause of the development of curvature of the spine [5].

Many other unfavorable factors that contribute to the development of posture disorders: a long-term illness (rickets) in a child or frequent illnesses that weaken his body, illnesses leading to paralysis. In young children, rickets causes skeletal deformities, disrupts metabolism and significantly worsen the course of other diseases[12]. In preschool age, vitamin D deficiency manifests itself in the form of muscle hypotension, inadequate calcification and softening of the long bones. In addition, rickets in early childhood can negatively affect the subsequent development of the child. Osteopenia and osteomalacia observed in infantile rickets lead to poor posture, flat feet, thickening and deformation of the hip bones, as well as the development of caries in older children.

The consequences of impaired absorption of calcium, phosphorus and magnesium can be muscle hypotension, autonomic dysfunction and impaired gastrointestinal motility. According to modern concepts, rickets is a disease characterized by a temporary inadequacy of the needs of a growing body for phosphorus and calcium and the absence of a system that ensures their delivery to the body. This is a disease of a growing organism caused by metabolic disorders (primarily phosphorus-calcium metabolism), the main clinical syndrome of which is damage to the skeletal system (impaired formation, proper growth and mineralization of bones), in which the pathological process is localized mainly in the area of bone metaepiphyses. Since the growth and rate of bone remodeling are highest in early childhood, lesions of the skeletal system are most pronounced in children in the first 2-3 years of life. Rickets is a multifactorial metabolic disease, in the diagnosis, prevention and treatment of which all pathogenetic factors should be taken into account: insufficiency and imbalance of calcium and phosphorus intake with food, immaturity of the child's endocrine system, concomitant diseases, etc. In addition to the pathology of phosphorus-calcium metabolism, protein metabolism disorders and microelements (magnesium, copper, iron, etc.), multivitamin deficiency, activation of lipid peroxidation. Children born in autumn and winter suffer from rickets more often and more severely. The disease is most severe in premature babies.

An important role in the formation of scoliosis is played by the incorrect general lifestyle of the child (passive rest, lack of walks, inadequate sleep), too soft beds, unhealthy unbalanced nutrition. Posture defects include inappropriate furniture for the child's height, uncomfortable clothing, not maintaining proper posture, improper sitting at the table, reading and drawing in bed, kicks and punches, etc [6].

Diagnostics of posture disorders and spinal deformities. Subjective methods. The method of visual diagnostics is widely used. Its obvious drawback is that the method does not exclude errors, there is no possibility to compare the data of repeated examinations and examinations of different doctors. It must be used in combination with objective techniques.

The main objective method for diagnosing spinal deformities is X-ray diagnostics. Scoliosis is usually assessed using conventional anteroposterior and lateral x-rays. The Cobb angle is the most widely used method in our country. There are many methods proposed and used to measure the rotation of the vertebrae: X-ray, computed tomography, magnetic resonance imaging, ultrasound. X-ray methods such as Nash and Moe, Perdriolle and Raimondi are still used by doctors to measure the rotation of the thoracic and lumbar vertebrae. These methods are not accurate enough when compared to measurements obtained with computed tomography or magnetic resonance imaging. As the details of the position of the vertebral body change, the rotation of the vertebrae can be confirmed on an X-ray image. The Nash, Moe and Perdriol methods are still widely used in clinical practice, but despite the many advantages of the above methods, radiographic methods are still the cheapest, safest and most widely used. They are used for

comparison with newly developed techniques. Radiographic measurements are usually taken while standing, while CT scans are taken while lying on your back. It is noteworthy that in terms of curvature and rotation, the scoliotic curves look less informative in the supine position. Additional diagnostic methods include electromyographic diagnostics and stabilography [8].

Electromyographic diagnostics. Conducted electromyographic (EMG) studies of the neuromuscular apparatus in the 60s – 80s. XX century. demonstrated significant differences in the bioelectrical activity of paravertebral muscles in patients with scoliosis and in a group of healthy peers. EMG diagnostics allows doctors to obtain information about the course of the disease (scoliosis). The difference in bioelectrical activity increases significantly with the progression of scoliosis compared to the slower progression. When the deformity of the spine stops, or during this time, it completely decreases or disappears. It is also possible to establish a relationship between damage to the spinal cord and its roots and the development of scoliosis[4,14]. Thus, in patients with spinal deformities, using EMG studies, it is possible to determine the cause and condition of the disease and the neuromuscular system. Functional status can be assessed to predict the progression of the condition and the effectiveness of treatment.

Stabilography. This type of study allows, on the basis of the results obtained (statokinesiogram), to clarify the idea of a patient with scoliosis as a whole. There is an assessment of the vertical posture and the balance function in a two-dimensional coordinate system along the trajectory of the person's center of pressure. Currently, for testing and training "Tergummed 3D" it is possible to measure the strength of the patient's back muscles in each plane (arrow, horizontal, front) under isometric load using a computerized device. Its use does not affect posture changes in children of younger preschool age.

Research results and discussion. The sooner a defect in posture, especially scoliosis, is detected and the necessary measures are taken, the more successful the elimination of the defect can be. Already from infancy, it is necessary to create conditions conducive to the development of the muscles of the child, that is, to correctly organize the general and motor system of his life. Wrapping up a child tightly and leaving him in this position for a long time is extremely harmful, as it restricts movement and negatively affects the work of internal organs. Several times a day, it's necessary to give the child the opportunity to look around and freely move his arms and legs[9].

There are ways to diagnose scoliosis, and tests are done while sitting, standing, and lying down. In the sitting position, the position of the pelvis is determined regardless of changes in the lower extremities, the degree of lumbar lordosis of the spine, lateral displacement of the trunk and lateral curvature of the spine are measured. When standing, the presence of contractions of the hip, knee and ankle joint, changes in the spinal lordosis and the degree of mobility of the lower back are measured, with kyphosis, the degree of deviation of the trunk and lateral curvature of the spine. and the position of the scapula and hip girdle is determined. Lying on your back, the condition of the abdominal muscles, diagonal

---

muscles of the trunk, heart, lungs and liver is checked. The disadvantage of this method is that it does not allow detecting congenital scoliosis. It is necessary to monitor children with congenital spinal defects in the early stages to prevent scoliosis.

A known method for diagnosing congenital scoliosis by visual inspection and identifying symptoms indicating the presence of anomalies in the development of the axial skeleton. To do this, place the patient barefoot on a hard surface and examine him from the front, back and sides. At the same time, the line of the spinous process, the position of the shoulder and the angle of the scapula, as well as the hip triangle are checked. Since scoliosis in preschool children is characterized by the formation of short, curved arches, when diagnosing, attention should be paid to the convex muscles that form on the convex side of the arch in the early stages of scoliosis. A classical examination of the spine of a small child is impossible, therefore it is examined in a horizontal position. The disadvantage of this method is that it is difficult to detect the symptoms of congenital spinal malformations at an early stage, so it is impossible to track children with congenital spinal defects to prevent serious scoliosis [10].

The task solved in our study is to provide early diagnosis of congenital malformations of the spine and to carry out preventive work with children with spinal anomalies to prevent the development of severe scoliosis. The problem is solved due to the fact that in the known method of early diagnosis of congenital and dysplastic scoliosis by visual examination and the identification of symptoms indicating the presence of anomalies in the development of the axial skeleton, in accordance with the observations, the examination is performed from the side of the back with enhanced lighting and is marked along the line spinous processes or along the paravertebral lines a place of atypical hair growth in the form of a swirl that resembles a cochlear shell, which determines an anomaly in the development of the axial skeleton, namely scoliosis[13].

A free trial of 30 children aged 2.5 to 4.5 years showed that 48% had symptoms of atypical hair growth in the form of curls that resemble snail shells (scoliosis). The top of the head is confirmed as a pathological symptom).

At the reception, an examination from the back of the patient was carried out under enhanced illumination and a place of atypical hair growth in the form of a swirl resembling a cochlear shell was noted along the line of spinous processes or along the paravertebral lines. The presence of this symptom indicated an anomaly in the development of the axial skeleton - scoliosis. In 90% of cases, the swirls are counterclockwise. In most cases, the middle of the vortex corresponds to the apex of the scoliosis arch, although it can be located one or two, less often three vertebrae above or below it. In patients with congenital scoliosis, the center of hair vortex projection exactly corresponds to the additional wedge-shaped hemivertebra.

During a routine examination, this symptom was noted in patients during a routine examination, which made it possible to identify scoliosis at the initial stage, when clinical diagnosis was difficult due to other signs - the line of spinous processes was not rejected, there was no rib hump, but later on radiographs the

incipient torsion of bodies was already visible vertebrae. This made it possible to promptly start treatment of scoliosis and prevent the development of severe scoliosis [15].

An examination from the side of the back with enhanced illumination and detection along the line of the spinous process or along the paravertebral line at the site of atypical hair growth in the form of a cochlear vortex allows the axial framework to reveal scoliosis at the preclinical stage. The application of this method does not require material costs and can be used to conduct preventive examinations of patients from early childhood.

The search for a universal way to eliminate the curvature of the spine has been going on for a long time. Recent orthopedic manuals contain descriptions of techniques that are very similar to manual therapy methods. However, until the middle of the 20th century, the nature of scoliosis was unknown and the treatment had no scientific basis. Therefore, the results were often negative. Many complications were also explained by the fact that doctors who had a primitive idea of the structure of the spine and used crude methods were involved in the "correction" of the curvature. It is important to know that diseases such as scoliosis do not heal on their own. Exercise therapy for this treatment should be performed in a comprehensive program of physiotherapy exercises, massage, swimming, orthodontic exercises.

Scoliosis massage stimulates blood circulation in the affected area and improves the condition of the spine. Therapeutic swimming promotes natural back relaxation. Considerable attention should be paid to the coordination of movements, without which it is impossible to master the correct posture. Corrective exercises help develop the muscles of the trunk. In various systems of corrective gymnastics, this type of movement is used as a reliable means for correcting and shaping posture, since balance requires keeping the spine in a straight position during any movement [7].

Prevention of diseases associated with scoliosis and flat feet includes a number of measures. The main influence on the formation of correct posture is the development of the skills of correct posture through control over oneself, daily life, various activities and rest. For acquired diseases, conservative and surgical methods of treatment are already being used. Surgical interventions will have a significant negative impact on the patient's life in the future. Therefore, it is used only at later stages of pathological development, when other means have become ineffective. Physiotherapy is one of the best methods that can be used at all stages of treatment, and not only for the prevention of spinal diseases [11].

Undoubtedly, classes are of great benefit, taking into account the control of the correct performance of medical gymnastics. Usually, in order to increase the intensity of the exercises performed, additional weights are used. As with other physical activities, exercise therapy classes should, if possible, be carried out under the supervision of a professional trainer who can competently distribute the load and control the exercise.

**Conclusion.** Summing up, we can say that early diagnosis of scoliosis and its systematic treatment is an opportunity to avoid progressive curvature of the spine in the future. The set of exercises compiled will only be an effective addition to the treatment prescribed by the specialist, which includes therapeutic massage, recreational swimming in the pool and corrective exercises.

**Prospects for further research.** In the fight against spinal deformities, preventive measures play a leading role, as well as the earliest possible detection of the disease and its timely treatment. Competently raising a child, developing the correct posture in him is one of the foundations for the prevention of this disease. Orthopedists believe that scoliosis treatment should be started when it is not yet there. Based on this, in order not to develop scoliosis, the main attention should be paid to the violation of the child's posture. Detection of scoliosis at an early stage of its development and, accordingly, timely treatment started to give the desired results. The best weapon in the fight against scoliosis is considered to be preventive examinations carried out in children's groups, since they make it possible to timely identify and exclude further development of spinal deformities.

The symptom we have described allows us to identify a risk group of children for the possible development of dysplastic scoliosis during screening examinations of children. The sample and the number of children were insufficient for an unequivocal statement that this symptom is 100% a diagnostic indicator of the disease. But it can be recommended when examining children as an additional diagnostic symptom of degenerative-destructive changes in the spine.

Clinical examination and dynamic observation of children at risk determine prevention, early diagnosis of emerging scoliosis and its timely treatment. The proposed method of electrostimulation of the back muscles and carrying out physiotherapy exercises with elements of games for preschool children increase the effectiveness of treatment. Early detection of scoliosis and the optimal complex of conservative therapy can improve the results of treatment of the initial stages of scoliosis in children.

#### Список літературних джерел

1. Ardran GM. et al. Assessment of scoliosis in children: low dose radiographic technique. The British journal of radiology. 1980. 53 (626). 146-147 p.
2. Bikbulatova AA, Andreeva EG. Dynamics of platelet activity in 5–6-year-old children with scoliosis against the background of daily medicinal-prophylactic clothes' wearing for half a year. Biomedical & Pharmacology Journal. 2017;10(3):1385.
3. Bouthors C. et al. Minimizing spine autofusion with the use of semiconstrained growing rods for early onset scoliosis in children. Journal of Pediatric Orthopaedics. 2018. 38. (10). 562-571 p.

#### References

1. Ardran GM. et al. Assessment of scoliosis in children: low dose radiographic technique. The British journal of radiology. 1980. 53 (626). 146-147 p.
2. Bikbulatova AA, Andreeva EG. Dynamics of platelet activity in 5-6-year-old children with scoliosis against the background of daily medicinal-prophylactic clothes' wearing for half a year. Biomedical & Pharmacology Journal. 2017;10(3):1385.
3. Bouthors C. et al. Minimizing spine autofusion with the use of semiconstrained growing rods for early onset scoliosis in children. Journal of Pediatric Orthopaedics. 2018. 38. (10). 562-571 p.



4. Burianov A. et al. Degenerative dystrophic diseases of joints and spine. Літопис травматології та ортопедії. 2018. (3-4). 97-126 с.

5. Calloni SF. et al. Back pain and scoliosis in children: When to image, what to consider. The neuroradiology journal. 2017; 30(5). 393-404 p.

6. Chuang CY. et al. Spino-pelvic alignment, balance, and functional disability in patients with low-grade degenerative lumbar spondylolisthesis. Journal of rehabilitation medicine. 2018. 50(10). 898-907 p.

7. Girdler S. et al. Emerging techniques in diagnostic imaging for idiopathic scoliosis in children and adolescents: a review of the literature. World neurosurgery. 2020. (136). 128-135 p.

8. Karol LA. The natural history of early-onset scoliosis. Journal of Pediatric Orthopaedics. 2019. (39). 38-43 p.

9. Lonstein JE, Carlson JM. The prediction of curve progression in untreated idiopathic scoliosis. J Bone Jt Surg. 1984. 32(10) 61-71 p.

10. Mulcahey MJ. et al. Neuromuscular scoliosis in children with spinal cord injury. Topics in spinal cord injury rehabilitation. 2013. 19(2). 96-103 p.

11. O'Donnell C. et al. Management of scoliosis in children with osteogenesis imperfecta. JBJS reviews. 2017. 5(7). 8 p.

12. Pugacheva N. Corrective exercises in multimodality therapy of idiopathic scoliosis in children-analysis of six weeks efficiency-pilot study. Stud Health Technol Inform. 2012. 176(3). 65-71 p.

13. Rogala EJ, Drummond DS, Gurr J. Scoliosis: incidence and natural history. A prospective epidemiological study. The Journal of bone and joint surgery. American volume. 1978;60(2):173-176.

14. Sudo H. et al. Automated noninvasive detection of idiopathic scoliosis in children and adolescents: A principal validation study. Scientific reports. 2018. 8(1). 1-10 p.

15. Tokunaga M. et al. Natural history of scoliosis in children with syringomyelia. The Journal of bone and joint surgery. British volume. 2001. 83(3). 371-376 p.

4. Burianov A. et al. Degenerative dystrophic diseases of joints and spine. Litopys travmatologii ta ortopedii. 2018. (3-4). 97-126 p.

5. Calloni SF. et al. Back pain and scoliosis in children: When to image, what to consider. The neuroradiology journal. 2017; 30(5). 393-404 p.

6. Chuang CY. et al. Spino-pelvic alignment, balance, and functional disability in patients with low-grade degenerative lumbar spondylolisthesis. Journal of rehabilitation medicine. 2018. 50(10). 898-907 p.

7. Girdler S. et al. Emerging techniques in diagnostic imaging for idiopathic scoliosis in children and adolescents: a review of the literature. World neurosurgery. 2020. (136). 128-135 p.

8. Karol LA. The natural history of early-onset scoliosis. Journal of Pediatric Orthopaedics. 2019. (39). 38-43 p.

9. Lonstein JE, Carlson JM. The prediction of curve progression in untreated idiopathic scoliosis. J Bone Jt Surg. 1984. 32(10) 61-71 p.

10. Mulcahey MJ. et al. Neuromuscular scoliosis in children with spinal cord injury. Topics in spinal cord injury rehabilitation. 2013. 19(2). 96-103 p.

11. O'Donnell C. et al. Management of scoliosis in children with osteogenesis imperfecta. JBJS reviews. 2017. 5(7). 8 p.

12. Pugacheva N. Corrective exercises in multimodality therapy of idiopathic scoliosis in children-analysis of six weeks efficiency-pilot study. Stud Health Technol Inform. 2012. 176(3). 65-71 p.

13. Rogala EJ, Drummond DS, Gurr J. Scoliosis: incidence and natural history. A prospective epidemiological study. The Journal of bone and joint surgery. American volume. 1978;60(2):173-176.

14. Sudo H. et al. Automated noninvasive detection of idiopathic scoliosis in children and adolescents: A principal validation study. Scientific reports. 2018. 8(1). 1-10 p.

15. Tokunaga M. et al. Natural history of scoliosis in children with syringomyelia. The Journal of bone and joint surgery. British volume. 2001. 83(3). 371-376 p.

**DOI: 10.31652/2071-5285-2021-11(30)-361-370**

**Відомість про автора:**

*Horoshko V.*; [orcid.org/0000-0002-5244-5648](https://orcid.org/0000-0002-5244-5648); [talgardat@gmail.com](mailto:talgardat@gmail.com); National University Yuri Kondratyuk Poltava Polytechnic, Pershotravnevyyi avenue, 24, Poltava, 36011, Ukraine.