

## A COMPARATIVE REVIEW OF NON-INVASIVE SCOLIOSIS TREATMENT IN CHILDREN AND TEENAGERS

**Iskander Kasimov<sup>1</sup>**  , **Ivan Oshchepkov<sup>2</sup>** 

Health Recovery Centre, Ulyanovsk;  
GUTA - Clinic, Moscow, Russia



[download article \(pdf\)](#)

 [Olesyatrapy2010@mail.ru](mailto:Olesyatrapy2010@mail.ru)

### ABSTRACT

Pediatric and adolescent scoliosis is one of the most common and prevailing orthopedic pathologies leading to spinal deformation. Cases of scoliosis where curving of the spine is <45% treated mostly surgically. However, when the spine is straightened with an implant, there are risks and complications. Hence, interest to conservative treatment methods has increased significantly.

This article discusses advantages and disadvantages of non-invasive methods for treating scoliosis. The disadvantage is the duration of treatment: treating scoliosis using conservative methods such as physical therapy and wearing bondages can take a long time to achieve results. Also, there is a need for regular control: conservative treatment of scoliosis requires regular control by doctors and specialists to assess progress and change treatment plan if necessary.

The most promising methods of conservative treatment, including correction of the muscular system, have been identified – adaptation physical exercises and gymnastics due to physical impact on kyphotic and scoliotic deformity. This includes breathing and physical exercises, therapeutic horse riding and wearing rigid torsion brace.

**Keywords:** adolescent idiopathic scoliosis (AIS), spinal deformity, leg length discrepancy, physical therapy, pathology, therapeutic riding, physiotherapeutic scoliosis-specific exercises, therapeutic aqua aerobics.

### INTRODUCTION

The number of children and teenagers who suffer from posture disorders and spinal deformities is increasing every year. According to clinical check-up among children and students in 2023 in Russia, 29% children and teenagers under the age of 16 have scoliosis; the prevalence of this disease in school-age children reaches 15-30%. [13]. The prevalence of adolescent idiopathic scoliosis (AIS) with a Cobb angle above 10° has been reported to vary from 0.93 to 12% worldwide [17]. Such difference in data may be attributed to differences in diagnosis and control. In Russia, alongside conventional medicine manual therapists and chiropractors treat scoliosis, which leads even to overdiagnosis of scoliosis cases compared to other countries.

Statistical data affirms that 6 from 10 children with orthopedic pathology have different degrees of scoliosis, which significantly actualizes the problem [13].

The term “scoliosis” includes a heterogeneous group of conditions in which there are changes in the form and position of spine, chest and trunk. In fact, the definition and range of spinal deformities have not been fully defined yet: the general term “scoliosis” includes conditions such as idiopathic scoliosis, congenital scoliosis, Scheuermann’s kyphosis, spondylolisthesis and other pathologies [8].

Regarding methods described in this article, it worth noting that they are hardly mentioned in the literature,

despite the promise of therapy and their effectiveness in treatment of scoliosis.

The preference for non-invasive methods of scoliosis treatment is determined with several factors. A meta-analysis of 15 research on the effect of Schroth exercises on idiopathic scoliosis showed that they could be useful for this pathology with a Cobb angle of 10 to 30% ( $p = 0,724$ ). While surgical treatment was used in patients with a Cobb angle more than 40% [14]. The advantage of non-invasive method is the ability to avoid potential risks associated with surgical procedures. Moreover:

1. The period after surgical correction of scoliosis can occur with all kinds of complications. The results of 70% of patients, who were treated by surgical method, were satisfactory or poor. The deformity of trunk has not changed or get worse. Surgical intervention does not eliminate the curvature of the spine or leads to irreversible changes, the long-term impact of which has not been studied [15].
2. Although non-invasive methods of scoliosis treatment often take longer time to achieve results, they avoid rapid and radical correction of the spine. It is especially important for children and teenagers whose spine is still growing up. Non-invasive methods can provide smoother and more controlled recovery.
3. After surgical correction of scoliosis, there is a limitation in body activity, as implants (pins, screws, rods, etc.) are used to stabilize and stretch spine. However, these implants limit the mobility and flexibility of the spine.

Non-invasive treatment methods allow maintaining natural activity and flexibility, which is especially important for children and teenagers.

It is important to note that the choice of scoliosis treatment method depends on degree and characteristics of scoliosis, the patient's age, health and other factors. An individual method for each patient helps to determine the most effective treatment strategy.

Nowadays, there are many methods of non-surgical solution to scoliosis problem; however, the effectiveness of treatment is due to a list of reasons including the development of an individual therapy plan for each patient. First of all, methods of treatment and prognosis depend on the severity of scoliosis.

Method for assessing grade of scoliosis is to measure the Cobb angle. This is a technique used to evaluate angle of the spine scoliosis. The Cobb angle is measured on an x-ray of spine and is a standard measure for determining grade and progress of scoliosis. It is measured between vertical lines drawn through the outermost vertebra located above and below the scoliosis curvature. The Cobb angle is usually measured in degrees and helps doctors to determine some needs for treatment. It also monitors changes during treatment [16]. The Cobb angle is measured on x-rays and indicates the curvature of spine. According to the classification of scoliosis grades by Cobb angle:

1. Weak grade (I grade): Cobb angle ranges from 1 to 20 degrees. Usually this slight curvature may be seen but does not cause serious problems or limitations.
2. Moderate grade (II grade): Cobb angle ranges from 21 to 50 degrees. In this case, the curvature is more seen and can cause functional problems, pain or discomfort.
3. Severe grade (III grade): Cobb angle ranges from 51 to 80 degrees. The curvature of spine is serious and can cause problems such as problems with breath system, narrowing of chest and deterioration quality of life at all.
4. Critical grade (IV grade): Cobb angle is more than 80 degrees. This is the most severe grade of scoliosis and can lead to serious and progressive complications such as cardiovascular problems, constant pain and limitation of movement.

It is important to underline that grade of scoliosis is not the only factor that influences what kind of treatment should be better for patient. Age, progress of illness and potential problems with spinal curvature must be taken into account when considering treatment plan.

Scoliosis is mainly diagnosed at 2<sup>nd</sup> grade of spine curvature, when the pathology becomes apparent.

Current interest in scoliosis problem among specialists in various fields leads to the annual emergence of new non-surgical treatment methods for spinal deformities. American orthopedist Augusto Sarmiento and his colleagues [9, 12] actively support the use of non-invasive treatment methods. They noted that in the field of treatment of fractures as well as various pathologies with spinal deformities, doctors often have to deal with bias. In this regard, there is a need to introduce new methods that will be more effective in practice. Modern diagnostic equipment and surgical innovations provide enormous benefits to society and medicine. However, this does not mean that non-surgical treatment methods, including treatment of scoliosis, have become outdated and ineffective [12].

## REVIEW OF THE METHODS

Scoliosis deformity of the spine is a manifestation of genetically determined dysplastic body development. This one explains the long process of treating disease, which includes a complex of various treatments. One of these methods is therapeutic horseback riding, the effectiveness of which is cited by E.I. Gurkovich and O.S. Pokhmurko in their studies [7].

### THERAPEUTIC HORSEBACK RIDING

This method belongs to one of the physical rehabilitation form and has a positive effect on children suffering from thoracolumbar scoliosis. This is confirmed by the results of researching conducted in the Evpatoria Republican Children's Clinical Sanatorium (Health Centre) in 2003. 24 children aged 13-14 years with disease duration of 3 - 5 years, were divided into two groups of 12 people. The first group of patients had a course of spa treatment, including therapeutic massage and gymnastics, arotholassotherapy compliance with the orthopedic treatment and primary physioprophyaxis.

The second group received a similar treatment in combination with therapeutic horseback riding (5 times a week, 10-15 minutes, total is 24 sessions during the experiment). In addition to learning how to ride, children did special breathing exercises at the 10th minute of each training as well as self-stretching exercises, etc. Before the start of exercises and before discharge, functional checkup of patients' spine mobility and condition of their trunk muscles was carried out. To assess the effectiveness of treatment, generally accepted methods were used, after which the data obtained were processed variation statistics method with determination of differences significance according to Student's criterion [10].

The obtained practical results showed that in the second group of patients (where horse-riding technique was used), three positive dynamics were revealed: static endurance of the back muscles, strength endurance of the trunk muscles on the left and dynamic endurance of the abdominal muscles. In turn, in the first group of children (who received standard treatment), only the dynamic endurance of the abdominal muscles showed positive dynamics. This allows us to state that horse-riding method, included in treatment process, trains muscles, eliminates its disproportion, develops correct posture and helps to develop balance, which stimulates the will of child, organizes him and develops self-confidence in the patient suffering from scoliosis [19].

In studying process, conservative methods of treating patients with spinal deformities seem appropriate to consider the currently existing variants of physiotherapeutic scoliosis specific exercises (PSSE) used by various scoliosis schools all around the world and approach that they use in alternative therapy.

The term PSSE – Physiotherapeutic Scoliosis Specific Exercises – has been used by the International Society on Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT). Since its establishment in 2004, it has been internationally promoting conservative and evidence-based treatment options for this disease as well as providing information and recommendations regarding therapies for the disease [4, 20].

O.V. Biketov notes in his article that today there are four main schools of scoliosis, which use their own treatment methods [7]. In fact, there are many more of them; however, the key elements of the approaches have minimal differences, so the basic schools and their treatment options can be considered as the fundamental basis for the conservative scoliosis treatment.

### LYON METHOD

*Lyon method (France)* involves the combination of special exercises with fixation by an asymmetric rigid polycarbonate torsion brace Lyon ARTbrace [21]. The presented method has several goals:

- fixation as a method of motivating patients;
- helping patients to become aware of postural defects;
- motion range development as one of the necessary treatment elements;
- coordination and muscle strength development;
- breath system training [8].

The Lyon method uses visualization with video and mirrors and includes five stages, the final of which is the development of an individual plan with the selection of exercises for each patient and training in their implementation.

### SCHROTH METHOD

Schroth method (Germany) – breathing exercises developed by Katharina Schroth is an effective method of scoliosis treatment, which patients can even use on their own. The effectiveness of such gymnastics has

been proven by Western medicine, there are also training centers all around the world where patients are introduced to special exercises and in a number of countries this technique is included in the compulsory health insurance program [14, 22].

Katharina Schroth drew attention to the fact that patients with scoliosis, when breathing, involuntarily use that part of chest, which accounts for the convex side of scoliotic spine curvature (hump). This leads to the rapid development of deformity against the background formation of the costal hump. Based on knowledge and researching, Schroth created a breath system aimed at developing chest part of patients with scoliosis, which allows not only to stop the curvature, but also to return spine to the correct posture, provided that the pathological process is not running.

## SEAS (SCIENTIFIC EXERCISE APPROACH FOR SCOLIOSIS) METHOD

SEAS method (Italy) is an adaptive exercise program based on modern research and dynamically evolved with the introduction of new knowledge [3, 23]. The methodology is based on a specific technique of active self-correction, which is performed without outside help and is included in functional exercises. The choice of exercises that are optimal for each patient is made by passing evaluation tests. The main aim of SEAS is to improve the spine stability: exercises train the neuromotor function, reflexively stimulating self-correcting posture in everyday life. Exercises that are included in this program can be done both on an outpatient basis (2-3 times a week for 45 minutes) and at home (every day for 20 minutes).

The SEAS method is also used in the treatment of patients wearing corrective brace/bandages [2]. Since such corrective items cause a "negative body image" in children and teenagers mind, which over time leads to a decrease in self-esteem, psychological problems and illness, special exercises reduce the percentage of disabilities caused by wearing brace/orthosis, and also level out the feeling of inferiority that occurs among children and teenagers against the background of their coevals. Thus, this method plays big psychological role for the development of patients with scoliosis.

The SEAS method differs from other non-surgical treatment options in that it completely adapts the treatment program to each individual patient: an individual choice of adapted self-correction occurs in accordance with the results of x-ray and postural assessment as well as observed asymmetries [4].

## DOBOMED METHOD

Dobomed method (*Poland*) is a biodynamic 3D auto-correction method based on the pathomechanics of idiopathic scoliosis [4]. Auto-correction, in this case, involves moving the primary curve toward correcting the curve with emphasis on "kyphotization" of the thoracic spine and/or "lordotization" of the lumbar spine [1, 18, 24]. Thus, the primary curve is mobilized in closed kinetic chains and develops on the pelvis and shoulder girdle, which are symmetrically located to each other. This is the uniqueness of Dobomed method: the pelvis and shoulders remain stable throughout the implementation of exercises set against the background of active asymmetric breathing.

However, all these methods show their inefficiency when teenagers have scoliotic spinal deformity with leg length discrepancy [2, 25]. To date, the development of such pathology reaches 87-94% among scoliosis patients. Right choice for suitable height of the corrector as one of the most acceptable ways to solve the problem in this case does not work, because children and teenagers' lower limbs develop unevenly. Therefore, doctors prefer to use non-orthopedic methods for correcting static scoliosis. These methods include health-improving gymnastics in water - a method of non-surgical correction, excluding pressure on the legs.

However, the presented method has not only advantages, but also disadvantages: first, due to the limited and monotonous movements, the therapeutic effect of therapeutic swimming in scoliosis may not be observed. This is because the muscle chains that form scoliosis are not fully involved in physical activity, which reduces the effectiveness of water exercises [9].

L. O.-S. Parshutina and L. A. Emelyanova made a solution of this problem with the original method of health improving via aqua aerobics [4]. Advantages of this method is involvement in training process all muscle groups that are involved in the formation of scoliosis as well as in providing double concentric muscle train, which allows strengthening muscles of the chest muscle corset. The latter is one of the key factors in scoliosis sanogenesis.

In order to identify the effectiveness of conservative treatment option, there was an experimental research on 38 teenagers aged 12 to 14 years old with mild scoliosis of 1-2 grade. Complication of disease was shortening the length of patients' legs (from 2 to 6 cm according to the results of x-ray). There were two groups of participants: the main group, which was engaged in traditional therapeutic swimming, and the experimental one, which was trained by the method of Parshutina-Emelyanova.

An exercise plan for the experimental group was complemented with Debbie Laurence programs [6, 10]. This research lasted 8 months, after which the results of stabilometric studies were analyzed. They showed

that water aerobics training program brought significant positive changes in functional spine state of the participants who practiced according to the author's method, while there were practically no positive changes in the main group (with standard therapeutic swimming) [4].

In addition, it is worth paying attention to such method for non-invasive correction of scoliosis as using hands and techniques of manual physical influence on the muscle system and spinal trunk. These technologies have the potential to make changes in vertebral position and spinal trunk structure in patients with idiopathic adolescent scoliosis. [26].

Training exercises according to a specially designed program, even for a rather short time, made it possible to eliminate all static disorders dealing with leg length discrepancy - a typical concomitant symptom of scoliosis. That is, it would be objective to assume that long-term exercises of therapeutic aqua aerobics will bring significant positive results and eliminate secondary anthropometric defects connecting with the development of disease.

## RESULTS AND DISCUSSION

Existing methods review of non-surgical scoliosis treatment suggests that all of them, to a greater or lesser extent, are based on the basic schools principles and modified in accordance with the author's position and attitude to the problem. At the same time, it is impossible to choose one or another treatment method that is suitable for all patients without exception. Non-invasive scoliosis treatment is a complex and multifaceted process, which includes a set of measures that allow achieving success in the spinal deformity treatment.

Further research in the field of non-invasive correction of scoliosis should be aimed at development and application of new technologies, improvement of existing treatment methods, creation of more effective orthoses and development of early diagnostic methods. Another sphere of research could be to study the effects of physical exercise using innovative medical equipment based on the principles of biomechanics. The development of new methods for non-invasive correction of scoliosis may also include development of improved braces that provide more precise and individual treatment of the spinal deformity.

Therapeutic physical and breathing exercises, therapeutic horse riding and manual therapy are effective and have a number of advantages in the correction of scoliosis. They are not traumatic, have positive effect on several systems of the body (muscle, nervous, bone), in contrast to invasive ones. In addition, thanks to non-invasive methods, higher nervous activity becomes better, and it helps the individual as a whole.

## CONCLUSION

Additional research and development for non-invasive correction methods of scoliosis are needed. Despite the great results in the treatment of spinal deformities without surgery, non-invasive correction of scoliosis remains challenging. Existing methods include exercises, braces and various vertebral manipulation techniques.

Thus, additional research and development of non-invasive scoliosis treatment techniques will improve the quality of patients' life, providing them more effective and individualized methods for correcting spinal deformities.

## REFERENCES

1. Christa Lehnert-Schroth. Three-Dimensional Treatment for Scoliosis: A Physiotherapeutic Method for Deformities of the Spine // Martindale Press. 2007:278.
2. Gaume M, Hajj R, Khouri N, Johnson MB, Miladi L. One-way self-expanding rod in neuromuscular scoliosis preliminary results of a prospective series of 21 patients. JB JS Open Access. 2021; 6:e21.00089. DOI: [10.2106/JBJS.OA.21.00089](https://doi.org/10.2106/JBJS.OA.21.00089)
3. Migliorini F, Chiu WO, Scrofani R, Chiu WK, Baroncini A, Iaconetta G, Maffulli N. Magnetically controlled growing rods in the management of early onset scoliosis: systematic review. J Orthop Surg Res. 2022; 17:309. DOI: [10.1186/s13018-022-03200-7](https://doi.org/10.1186/s13018-022-03200-7)
4. Negrini, S. 2016 SOSORT guidelines: orthopedic and rehabilitation treatment of idiopathic scoliosis during growth/ S.Negrini, S.Donzelli, A.G. Aulisa, D.Czaprowski, S. Schreiber, J.C. de Mauroy, H.Diers, T.B. Grivas, P.Knott, T.Kotwicki, A.Lebel, C.Marti, T.Maruyama, J. O'Brien, N.Price, E.Parent, M.Rigo, M.Romano, L.Stikeleather, J.Wynne, F.Zaina // Scoliosis Spinal Disord. 2018; 13:3. DOI: [10.1186/s13013-017-0145-8](https://doi.org/10.1186/s13013-017-0145-8)
5. Amerkhanov, R.R. Influence of the systemic mobilization method of the body with the foot on scoliosis / R.R. Amerkhanov, R.R. Amerkhanov// Manual therapy 2021, volume 84, No 4, p. 44-54.
6. Boldyrev, A.Yu. The role of small height differences of the lower extremities in the genesis of frontal spine curvature / A.Yu. Boldyrev // Functional aspects of somatic pathology. - M.: Vita, 2019, p.

25-28.

7. Borodina T.N., Kiseyaenko A.S., Borodinova E.H. The first experiment of the scoliosis spa complex treatment for children. Bulletin of Physiotherapy and Balneology. - 2002. – No 2, 12 p.
8. Bubnovsky S. M. Back and joints health without drugs. How to cope with acute and chronic pain by body forces // Moscow: EKSMO. – 2020, p. 67-75.
9. Karimi M.T., Kavyani M. Comparison of surgical and orthopedic long-term scoliosis treatment in teenagers // Russian Journal of Biomechanics. 2023; 2:67-74. DOI: 10.15593/RZbBiomech /2023.2.06.
10. Kokushin D.N., Khusainov N.O. Aspects of the ventral dynamic correction use in the surgical treatment for patients with idiopathic scoliosis // International Journal of Applied and Fundamental Research. - 2021. – No 12, p. 51-55.
11. Merzenyuk, O.S. Principles of scoliosis classification and rehabilitation tactics for children and teenagers from the manual medicine teaching / O.S. Merzenyuk, V.K. Akopov, I.A. Mashkov // Manual Therapy 2019.- No 2 (50), p. 59-63.
12. Sarmiento A. Traumatology and mythology: some advice for beginners // Pediatric traumatology, orthopedics and reconstructive surgery. - No. 2(1). – 2014. DOI: [10.17816/PTORS2185-88](https://doi.org/10.17816/PTORS2185-88)
13. Scoliosis – what is it: grades, causes, treatment. URL: <https://gemotest.ru/info/spravochnik/zabolevaniya/skolioz/>
14. Park J-H, Jeon H-S, Park H-W. Effects of the Schroth exercise on idiopathic scoliosis: a meta-analysis. Eur J Phys Rehabil Med. 2018 Jun;54(3):440-449. DOI: [10.23736/S1973-9087.17.04461-6](https://doi.org/10.23736/S1973-9087.17.04461-6)
15. Martha Hawes. Impact of spine surgery on signs and symptoms of spinal deformity. Pediatr Rehabil. 2006 Oct-Dec;9(4):318-39. DOI: 10.1080/13638490500402264
16. Horng M-H, Kook C-P, Fu M-J. Cobb Angle Measurement of Spine from X-Ray Images Using Convolutional Neural Network. Comput Math Methods Med. 2019 Feb 19:2019:6357171. DOI: [10.1155/2019/6357171](https://doi.org/10.1155/2019/6357171)
17. Sung S, Chae H-W, Lee H-S, Kim S, Kwon J-W, Lee S-B, Moon S-H, Lee H-M, Lee B H. Incidence and Surgery Rate of Idiopathic Scoliosis: A Nationwide Database Study. Int J Environ Res Public Health. 2021 Aug; 18(15): 8152. DOI: [10.3390/ijerph18158152](https://doi.org/10.3390/ijerph18158152)
18. Lonstein JE. Congenital spine deformities: scoliosis, kyphosis, and lordosis. Orthop Clin North Am. 1999 Jul;30(3):387-405, DOI: [10.1016/s0030-5898\(05\)70094-8](https://doi.org/10.1016/s0030-5898(05)70094-8)
19. Masahiro Ihara, Masayo Ihara, Misato Doumura. Effect of therapeutic riding on functional scoliosis as observed by roentgenography. Pediatr Int. 2012 Feb;54(1):160-2. DOI: [10.1111/j.1442-200X.2011.03456.x](https://doi.org/10.1111/j.1442-200X.2011.03456.x)
20. Berdishevsky H, Lebel VA, Bettany-Saltikov J, Rigo M, Lebel A, Hennes A, Romano M, Białek M, M'hango A, Betts T, de Mauroy JC, Durmala J. Physiotherapy scoliosis-specific exercises - a comprehensive review of seven major schools. DOI: [10.1186/s13013-016-0076-9](https://doi.org/10.1186/s13013-016-0076-9)
21. de Mauroy J.C, Lecante C, Barral. "Brace Technology" Thematic Series - The Lyon approach to the conservative treatment of scoliosis. Scoliosis. 2011 Mar 20:6:4. DOI: [10.1186/1748-7161-6-4](https://doi.org/10.1186/1748-7161-6-4)
22. Ceballos-Laita L, Carrasco-Uribarren A, Cabanillas-Barea S, Pérez-Guillén S, Pardos-Aguilella P, Del Barrio SJ. The effectiveness of Schroth method in Cobb angle, quality of life and trunk rotation angle in adolescent idiopathic scoliosis: a systematic review and meta-analysis. Eur J Phys Rehabil Med. 2023 Apr;59(2):228-236. DOI: [10.23736/S1973-9087.23.07654-2](https://doi.org/10.23736/S1973-9087.23.07654-2)
23. Romano M, Negrini A, Parzini S, Tavernaro M, Zaina F, Donzelli S, Negrini S. SEAS (Scientific Exercises Approach to Scoliosis): a modern and effective evidence based approach to physiotherapeutic specific scoliosis exercises. Scoliosis. 2015 Feb 5:10:3. DOI: [10.1186/s13013-014-0027-2](https://doi.org/10.1186/s13013-014-0027-2)
24. Wnuk B, Stepanik M, Milewska-Mączka E, Huta M, Wolicka J, Karcz A, Szoltysek J, Durmała J. Assessment of the Reliability of the DoboMed Exercise Method Mastery Evaluation Scale in People with Adolescent Idiopathic Scoliosis. Ortop Traumatol Rehabil. 2023 Apr 30;25(2):73-81. DOI: [10.5604/01.3001.0053.6160](https://doi.org/10.5604/01.3001.0053.6160)
25. Kobayashi K, [Ando K](#), [Nakashima H](#), [Machino M](#), [Morozumi M](#), [Kanbara S](#), [Ito S](#), [Inoue T](#), [Yamaguchi H](#), [Mishima K](#), [Ishiguro N](#), [Imagama Sh.](#) Scoliosis Caused by Limb-Length Discrepancy in Children. Asian Spine J. 2020 Dec; 14(6): 801–807. DOI: [10.31616/asj.2019.0374](https://doi.org/10.31616/asj.2019.0374)
26. Lotan S, Kalichman L. Manual therapy treatment for adolescent idiopathic scoliosis. J Bodyw Mov Ther. 2019 Jan;23(1):189-193. DOI: [10.1016/j.jbmt.2018.01.005](https://doi.org/10.1016/j.jbmt.2018.01.005)

