

# OPTIMIZATION OF PREOPERATIVE PREPARATION METHODS IN SCOLIOTIC DISEASE IN CHILDREN AND ADOLESCENTS

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<https://doi.org/10.5281/zenodo.7974187>

**Abstract.** *The indications for the use of an optimized preoperative diagnostic and treatment complex for the preparation of paravertebral tissues and the contents of the spinal canal for radical correction in children with stage IV scoliosis were determined. The proposed method expands the possibilities of a practical orthopedic-vertebrologist in providing assistance to sick children with this disease.*

**Keywords:** *children, scoliosis, preoperative preparation.*

**Relevance.** The treatment of scoliotic spinal disease is one of the most challenging problems in modern vertebral pathology. Significant progress has been made in surgical treatment of this condition, but the outcomes of surgical interventions do not always satisfy both vertebral specialists and patients [2].

Issues arising in the surgery of scoliotic deformities due to the use of imperfect tools, functional diagnostics, and preoperative treatment indicate the need for the search and development of new, more effective comprehensive methodologies. These methodologies should incorporate not only precise standardized methods and functional diagnostics but also effective and safe methods of preoperative preparation and outcome prediction for surgical treatment [4].

The most widely used method for surgical instrumental correction of scoliotic deformities in Europe, known as CDI [3], is not always effective and safe. The degree of correction achieved with this technology in patients with a moderate scoliotic curvature of 55° is only 54.5%, and in the long term, only 41.9% of the correction is maintained [1]. The rate of complications remains high, reaching 26% [2], including acute neurological disorders that can reach 17%.

The preoperative therapeutic and diagnostic complex, now considered mandatory, includes simultaneous physiotherapeutic interventions. These include physical therapy exercises and discrete traction on a gravitational frame. This approach not only allows for the necessary mobility throughout the curvature, but also prepares the paravertebral tissues and spinal tissues with their contents for extreme conditions of radical correction. It also enables more precise preoperative planning, determination of surgical tactics, and prediction of the occurrence of neurological disorders.

**Research Objective:** To evaluate the effectiveness of preoperative preparation methods for scoliotic spinal disease in adolescents.

**Materials and Methods:** The study is based on data from the examination of 44 patients suffering from scoliotic spinal disease of various origins. The examined children were divided into two groups based on whether they underwent preoperative preparation. The main group consisted of 24 children who received modified preoperative preparation, while the comparison group comprised 20 children who received standard preoperative preparation.

In most cases (52.9%), patients in both compared groups were predominantly in the 15-18 age range. The mean age was  $14.3 \pm 0.79$  years. The distribution of patients by gender favored girls (1.7 times more).

**The study** included patients with grade IV scoliosis. The average angle of deformity in our observations was  $75.3 \pm 3.32^\circ$ , with a slight predominance of patients with a scoliosis angle ranging from 41 to  $90^\circ$ .

The goal of the developed preoperative preparation complex is to improve the effectiveness of preoperative planning and outcome prediction, increase surgical correction of scoliosis, and prevent the loss of correction, respiratory disorders, neurological and surgical complications.

This is achieved by using systematically repeatable suspensions of patients by the head with gradual increases in duration and load. The suspensions are performed in a deep head holder and involve cyclic and variable increases in the magnitude, frequency, and duration of traction. The achievement of maximum functional mobility and flexibility of spinal and thoracic deformations is determined through systematic chronological, anthropometric, and spirometric monitoring. Maximum traction indicators are registered through X-ray spondylography, anthropometry, and somatosensory evoked potentials.

The technical result obtained by implementing the method is the development of maximum functional mobility in scoliotic deformations of the spine, thoracic cage, and surrounding tissues in a short period. This reduces the loss of surgical correction of scoliosis, increases compensatory reserves and adaptive mechanisms of the respiratory, cardiovascular, nervous systems, and paravertebral tissues. The method standardizes the determination of maximum flexibility and mobility of deformations, evaluates the patient's anthropometric and physiological condition through testing and measurement, applies objective methods of instrumental and clinical diagnosis, and records standard physical values under standard conditions for modeling maximum functional correction of scoliosis.

The preventive effect of preventing the development of surgical complications, loss of scoliosis correction, respiratory and neurological disorders is directly related to the accelerated development of mobility and increased extensibility of the soft tissues that stabilize the spinal segments and surround the spine and thoracic cage. This increases the functional reserves of patients and reduces tissue resistance and tension during surgical correction.

The system of objective and instrumental control includes non-invasive methods of ongoing (daily) monitoring of traction, such as timing, anthropometry, and spirometry.

**Research Results:** The following level of spinal deformation mobility was achieved: the average hanging time on the gravitational frame without support for the main group was  $423 \pm 1.27$  seconds; the distance increased by  $5.8 \pm 0.23$  cm; the scoliotic curve angle decreased on average by  $48.3 \pm 0.63\%$ ; the kyphotic curve decreased by  $78.1 \pm 1.21$ .

During the preoperative preparation, regression of muscular paresis, which was present in one patient, was achieved (Table 1).

It is also worth noting that when using the modified preoperative preparation complex for children with scoliotic spinal disease, the height of the children increased on average by  $6.2 \pm 0.2$  cm more compared to children who underwent preoperative preparation using standard methods.

Table 1.

Comparative characteristics of spine mobility after preoperative preparation

Mobility indicators	Main group C"=141	Group comparison (π=2(>1
The average hanging time on the gravitational	423±1,27	-
Increase in distance (centimeters)	5,8±0,23	-
Reduction in scoliotic curve angle (%) (%)	48,3±0,63	34,1±0,52*
Reduction in kyphotic curve angle	78,1±1,21	45,6±1,3*
Increase in height (centimeters)	6,2±0,2	2,4±0,1*

Note: \* - statistically significant difference between the groups ( $P \leq 0.01$ )

According to the obtained results, out of the 34 examined patients with scoliotic (n=16) and kyphoscoliotic (n=18) spinal deformities, idiopathic scoliosis was present in 18 cases, dysplastic scoliosis in 7 cases, neurofibromatosis Recklinghausen type 2 in 2 cases, kyphoscoliosis due to congenital anomalies in 4 cases, neurogenic scoliosis (syringomyelia) in 2 cases, and Ehlers-Danlos syndrome in 1 case. The magnitude of the scoliotic component ranged from 41° to 90°, with an average of 108.7±12.43°.

During physical examination, the presence of pronounced spinal deformity was observed in all patients. Additionally, most patients exhibited minor developmental anomalies such as "flat" (5.9%) or "funnel-shaped" (2.9%) chest, flat feet (23.5%), and joint hypermobility (5.9%). This undoubtedly indicates the presence of congenital connective tissue dysplasia.

Clinical examination of the children revealed varying shoulder heights, asymmetry in scapula positioning, deviation of spinous processes from the midline, and the presence of rib hump and muscle bulge. The progression of scoliosis in children is determined by the nature of risk factors for its development and their combination. According to the obtained results, significant risk factors include the combination of cervical instability, joint hypermobility, congenital vertebral anomalies, gastrointestinal tract disorders, thyroid gland disorders, and the age of the child at the onset of spinal deformity.

Radiographic analysis revealed that in most cases, children with grade IV scoliosis had deformity angles ranging from 41° to 90°.

Based on MRI diagnostics, we found that 29.4% of children had an S-shaped type of scoliosis. Initial manifestations of osteochondrosis were registered in 44.1% of children, and disc protrusions were found in 5.9% of cases. Two cases of syringomyelia were detected.

**Conclusion:** In terms of preoperative examination, it is necessary to supplement standard X-ray imaging with magnetic resonance imaging (MRI) for a comprehensive assessment of skeletal deformity and detection of subclinical forms of organic nervous system involvement.

Analysis of traditional preoperative preparation methods revealed that these methods did not achieve the necessary mobilization of rigid curves of scoliotic deformity and preparation of paravertebral tissue and spinal tissue with its contents for the extreme conditions of radical correction. As a result, preoperative planning, determination of surgical tactics, and prediction of neurological disorders were insufficiently effective.

The obtained results have demonstrated that the modified method of preoperative

preparation allows for an individual assessment of the adaptive and reserve capabilities of each patient based on the gradual readaptation of the spinal cord and its vascular system to the future new conditions of a corrected spine. Consequently, it reduces the risk of neurological complications and decreases their severity.

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