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ЭФФЕКТИВНОСТЬ ПРОТОКОЛА «ОТ ПРИКУСА ДО СТОПЫ» В ЛЕЧЕНИИ НИСХОДЯЩЕГО ИДИОПАТИЧЕСКОГО СКОЛИОЗА С ИСПОЛЬЗОВАНИЕМ ЧЕЛЮСТНО-ФУНКЦИОНАЛЬНОЙ ОРТОПЕДИИ

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Аннотация

Введение. Идиопатический сколиоз, развивающийся по нисходящему типу, возникает вследствие первичных дисфункций краниовертебрального комплекса и неправильного прикуса, что требует междисциплинарного подхода. Современные ортодонтические протоколы, как правило, игнорируют постуральный статус пациента, снижая эффективность лечения.

Цель. Ретроспективно оценить эффективность протокола «от прикуса до стопы» для диагностики и лечения с помощью челюстно-функциональной ортопедии у пациентов с идиопатическим сколиозом нисходящего типа.

Материалы и методы. Статистически оценены результаты лечения 36 пациентов с неправильным прикусом и сколиозом (I–IV степени, угол DIERS до 46 °), проходивших лечение в период с сентября 2022 года по ноябрь 2024 года. Медианный возраст составил 17,5 лет [15,0–26,5]. Трехмерная оценка позвоночника проводилась с использованием растрового 4D-сканирования DIERS Formetric. Оценка подошвенной поддержки проводилась с помощью индекса Чижина на подоскопе «GREENFOOT». Оценки выполнялись в начале исследования и через 12 месяцев. Для статистического анализа использовался критерий знаковых рангов Вилкоксона (SciPy 1.9.1, Python 3.10).

Результаты. Медианный угол DIERS уменьшился с 20,0 ° до 13,0 ° (−7,0 °, 35 %, $p < 0{,}001$). Боковое отклонение позвоночника уменьшилось с 15,6 мм до 9,1 мм (−6,5 мм, 42 %, $p < 0{,}001$). Индекс Чижина увеличился с 0,40 до 0,59 (+0,19, 47 %, $p < 0{,}001$).

Заключение. Протокол «от прикуса до стопы» обеспечивает надежное улучшение постурального состояния, уменьшение угла сколиотической кривизны и нормализацию подошвенной поддержки у пациентов с постуральной дисфункцией нисходящего типа.

Ключевые слова: *сколиоз, неправильный прикус, постуральная асимметрия, остеопатическая манипуляция, плоскостопие, функциональные ортодонтические аппараты*

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EFFECTIVENESS OF THE "FROM BITE TO FOOT" PROTOCOL IN THE TREATMENT OF DESCENDING IDIOPATHIC SCOLIOSIS USING JAW FUNCTIONAL ORTHOPEDICS

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Abstract

Introduction. Idiopathic scoliosis developing according to a descending pattern originates from primary dysfunctions of the craniovertebral complex and malocclusion, requiring a multidisciplinary approach. Current orthodontic protocols generally disregard the patient's postural status, reducing therapeutic effectiveness.

Objective. To retrospectively evaluate the effectiveness of the "from bite to foot" protocol for diagnostics and treatment with Jaw Functional Orthopedics in patients with descending-type idiopathic scoliosis.

Materials and Methods. Outcomes of 36 patients with malocclusion and scoliosis (grades I–IV, DIERS angle up to 46°), treated between September 2022 and November 2024, were statistically evaluated. Median age was 17.5 years [15.0–26.5]. Three-dimensional spinal assessment was performed using DIERS Formetric 4D rasterstereography; plantar support was evaluated with the Chizhin index on a "GREENFOOT" podoscope. Assessments were performed at baseline and at 12 months. Statistical analysis used the Wilcoxon signed-rank test (SciPy 1.9.1, Python 3.10).

Results. The median DIERS angle decreased from 20.0° to 13.0° (−7.0°, 35%, $p < 0.001$). Lateral spinal deviation decreased from 15.6 mm to 9.1 mm (−6.5 mm, 42 %, $p < 0.001$). The Chizhin index increased from 0.40 to 0.59 (+0.19, 47%, $p < 0.001$).

Conclusion. The "from bite to foot" protocol provides reliable improvement in postural status, reduction in scoliotic curve angle, and normalization of plantar support in patients with descending-type postural dysfunction.

Keywords: *scoliosis, malocclusion, postural asymmetry, osteopathic manipulation, flatfoot, functional orthodontic appliances*

The authors declare no conflict of interest

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Введение

Introduction. Scoliosis is a three-dimensional spinal deformity characterized by lateral deviation, vertebral rotation, and alteration of the sagittal profile, and is classically quantified by the two-dimensional Cobb angle on postero-anterior radiographs [3]. Growing evidence, however, demonstrates that the deformity is not confined to the spine: approximately 87 % of patients present with pelvic asymmetry, and biomechanical alterations of the lower limbs — including leg-length discrepancies, ankle valgus, and collapse of the longitudinal plantar arch — are frequently observed [4, 5]. Recent epidemiological studies reinforce this association: a large investigation of 4,387 Chinese schoolchildren identified flatfoot as an independent risk factor for scoliosis [6], and a cross-sectional study of Romanian preadolescents demonstrated a statistically significant correlation between flatfoot and scoliosis ($\chi^2 = 7.87$; $p = 0.005$) [7]. Together, these findings support the inclusion of foot assessment as a clinically relevant parameter in the therapeutic monitoring of scoliosis.

A second line of evidence concerns the relationship between malocclusion and postural disorders, which has become a subject of active study in modern dentistry, osteopathy, and orthopedics [8, 9]. According to the concept of the descending type of postural dysfunction, the primary pathological focus is located in the craniovertebral region and in the occlusion, while compensatory changes spread sequentially in a caudal direction — from the cervical spine to the thoracic and lumbar regions, the pelvic ring, and finally the feet [10, 11]. This concept is supported by clinical and biomechanical studies that have demonstrated correlations between occlusal anomalies and changes in postural balance [12].

Scoliosis that develops in a descending pattern is characterized by the initial formation of a curve in the cervicothoracic region, with subsequent compensatory deformation of the underlying segments. A key role in the pathogenesis of this type of scoliosis is played by dysfunctions of the masticatory muscles, the temporomandibular joint (TMJ), and the craniosacral system, which lead to asymmetric tone of the paravertebral musculature [15, 16]. Occlusal disorders cause an imbalance of the masticatory muscles — among the most powerful in the human body — which is transmitted to the spine and lower limbs through a chain of fascial and muscular connections [15].

Despite the obvious clinical relevance of postural status for the outcomes of orthodontic treatment, and the potential influence of malocclusion on scoliosis, most existing protocols do not provide for systematic assessment and correction of postural dysfunctions at the initial diagnostic stage [14, 16]. As a consequence, orthodontic treatment is often delivered against a background of uncorrected musculoskeletal and fascial imbalances, which reduces its effectiveness, prolongs treatment duration, increases the risk of relapse, and limits the effect of scoliosis treatment [17].

The authors' "from bite to foot" method is a protocol for the comprehensive diagnosis and evaluation of orthodontic treatment of malocclusion that integrates dental, osteopathic, functional, and postural assessment. It was developed in accordance with the concept of identifying top-down (descending) and bottom-up (ascending) postural dysfunctions, and its purpose is to establish an interdisciplinary treatment plan that identifies and addresses primary dysfunctions before or during orthodontic or scoliosis treatment.

Purpose

To retrospectively evaluate the effectiveness of the authors' "from bite to foot" protocol [1], which integrates comprehensive diagnostics and orthodontic treatment through Jaw Functional Orthopedics, in patients with idiopathic scoliosis of the descending postural dysfunction type, and to compare the outcomes obtained with previously published data. Postural assessment comprised optical posturometry, podoscopy, and cone-beam computed tomography (CBCT).

Materials and Methods

Thirty-six patients (11 men and 25 women) were recruited from a private clinic after signing an informed consent form. The inclusion criteria were the presence of occlusal pathology and scoliosis of any degree (DIERS angle up to 46 °). Exclusion criteria were systemic connective tissue diseases, oncological diseases, previous spinal surgery, and pregnancy. All patients were submitted to the "from bite to foot" diagnostic protocol [1].

The protocol comprises the following stages:

Stage I–Initial diagnostics. Collection of medical history, quality-of-life survey (SF-36), clinical examination of the oral cavity, occlusal assessment, and cone-beam computed tomography (CBCT) of the head.

Stage II — Postural diagnostics. Assessment of postural balance by optical topography on the DIERS Formetric 4D system (DIERS International GmbH, Germany) in standing and sitting positions, in order to determine ascending or descending priorities of postural dysfunction. The parameters recorded were: scoliotic curve angle (DIERS angle, compatible with the Cobb angle), lateral deviation of the spine (mm), rotation of the apical vertebra, and rotation, tilt, and torsion of the pelvis.

Stage III — Evaluation of the foot support profile. Plantar support was examined on a podoscope, with calculation of the Chizhin index. Values below 0.45 were considered to indicate a disorder of the support profile.

Stage IV — Functional diagnostics of the TMJ. Axiography, surface electromyography (EMG) of the masticatory and temporal muscles, and assessment of muscle imbalance.

Stage V — Osteopathic diagnostics. Assessment of craniosacral rhythm, mobility of the bones of the facial skull, dysfunctions of the cervicothoracic junction and sacroiliac joints, and manual testing to determine the priority of ascending or descending dysfunctions.

Stage VI — Osteopathic support. Correction of dysfunctions of the cranial and craniovertebral complex, the cervicothoracic junction, the sacrum, and the pelvic ring using protocol techniques. Protocol techniques to restore nasal breathing were mandatory. The course consisted of 4–6 sessions at intervals of 2–3 weeks.

Patients then underwent orthodontic treatment with jaw functional orthopedic appliances aimed at bone remodeling, correction of the malocclusion, and consequent correction of postural disorders, given their descending-pattern scoliosis. The median age was 17.5 years [15.0–26.5]. The following parameters were assessed at baseline and 12 months after the initial diagnosis: the DIERS angle (corresponding to the Cobb angle) and the lateral spinal deviation, both obtained with the DIERS Formetric 4D optical posturometric system, and the Chizhin index, measured with the "GREENFOOT" podoscope. Data from the meta-analysis published by Park et al. (2018)[2] were used as a reference comparator. All patients provided written informed consent for the use of their clinical data in scientific publications.

Statistical analysis. Statistical analysis was conducted using the Wilcoxon signed-rank test for paired samples, performed with the SciPy package (version 1.9.1) in Python 3.10. A p-value < 0.05 was considered statistically significant.

Results

At the initial examination, all patients reported back and neck pain of varying intensity, headaches, postural disorders, rapid fatigue, bite abnormalities, altered chewing patterns, and difficulties with nasal breathing. Regarding medical history, 28 patients (87.5 %) reported frequent respiratory infections during childhood and 24 (75 %) reported impaired nasal breathing. Podoscopic assessment of plantar support revealed abnormalities of the foot profile (Chizhin index below 0.45) in all patients, and 26 patients (81.3 %) presented valgus foot deformity. Electromyography demonstrated asymmetry of masticatory muscle activity in all patients.

DIERS angle. The median DIERS angle before application of the protocol was 20.0 ° [18.0–23.0 °] and decreased to 13.0 ° [11.0–15.0 °] after 12 months, a median reduction of 7.0 ° (35 %; Wilcoxon W = 0.00; p < 0.001). In patients under 20 years of age, the median reduction was 7.5 ° (37 %), compared with 7.0 ° (36 %) in those aged 20 years or older. The median reduction was 7.0 ° (35 %) in women and 8.0 ° (36 %) in men. Notably, the cohort included patients with grade III–IV scoliotic deformity (DIERS angle up to 46 °), in whom the treatment also demonstrated a clinically significant reduction.

Lateral spinal deviation. The median value decreased from 15.6 mm [14.3–16.9 mm] at baseline to 9.1 mm [8.2–9.8 mm] after treatment, a median reduction of 6.6 mm (42 %; Wilcoxon W = 0.00; p < 0.001).

Chizhin index. The median value increased from 0.40 [0.37–0.41] at baseline to 0.59 [0.56–0.61] after treatment, a median increase of 0.19 (47 %; Wilcoxon W = 0.00; p < 0.001). After completion of the preparatory phase, the Chizhin index reached normal values (≥ 0.45) in 36 patients (100.0 %).

Individual baseline and follow-up data are presented in Table 1; data stratified by age and sex are shown in Table 2, and the p-values of the pairwise comparisons in Table 3.

Comparison with the Schroth exercise method (control group). In order to contextualize the present findings, a comparison was made with the results of a meta-analysis of Schroth exercise therapy for idiopathic scoliosis (Park et al., 2018) [2], which served as a historical control group. Table 4 presents the comparative analysis of the key outcomes.

Clinical case. Patient L. (Lisa), age 16, presented with grade IV scoliotic deformity (DIERS angle 46°), malocclusion, and a history of chronic nasal breathing impairment. Previous treatment with the Schroth exercise method over 8 months had produced no significant improvement. After initiation of the "from bite to foot" protocol with jaw functional orthopedic appliances, the DIERS angle decreased from 46 ° to 30 ° over 12 months of treatment, representing a transition from grade IV to grade II scoliotic deformity — a 35 % reduction. Lateral spinal deviation decreased from 28.5 mm to 17.2 mm (40 %), and the Chizhin index improved from 0.32 to 0.50. This case illustrates the potential of the method in patients with severe scoliotic curves (> 30 °), where the Schroth exercise method demonstrates only moderate effect sizes (ES = 0.67 for 30–50 °Cobb's angle, compared to ES = 1.07 for 10–30 °; Park et al., 2018) [2]. The combination of jaw functional orthopedic appliances with osteopathic support in patients with severe scoliosis has been described in detail in a previous case report by the authors.

Discussion

The case of patient L., in whom the DIERS angle decreased from 46 ° to 30 ° (a 35 % reduction), is illustrative: this degree of correction in a patient with severe deformity is not typically achievable with exercise therapy alone. This suggests that addressing the primary craniovertebral and occlusal dysfunction — the etiology of the descending-type scoliosis — may unlock therapeutic potential that is inaccessible to methods targeting only the musculoskeletal system.

The conceptual basis of the method is that identifying the location of the primary dysfunction — and, when scoliosis is caused by a descending-type postural dysfunction, correcting the cranial and craniovertebral dysfunctions by osteopathic treatment and the occlusal pathology by functional orthodontic treatment with jaw functional orthopedic appliances — creates the conditions for the spontaneous normalization of postural balance at lower levels [10, 19]. This is confirmed by the simultaneous improvement of all three parameters studied: the DIERS angle, lateral spinal deviation, and the Chizhin index.

It is noteworthy that the normalization of plantar support function (a 48 % increase in the Chizhin index) occurred without the use of orthopedic insoles or any specific foot treatment, which indicates the systemic nature of the observed effect.

The role of the TMJ and the masticatory muscles in the formation of postural imbalance has been described in detail in the literature [13, 18]. The asymmetry of masticatory muscle activity demonstrated by EMG in all patients of the present cohort is consistent with the findings of Dipalma G et al. [20], who showed that occlusal disorders lead to marked asymmetry of EMG activity in the masseter and temporalis muscles, which is transmitted to the paravertebral musculature through the fascial chain.

The more pronounced effect observed in patients under 20 years of age (a 37 % reduction in the DIERS angle versus 36 % in patients over 20 years of age) can be explained by the greater plasticity of the musculoskeletal system in younger patients and by the active growth of the facial skeleton, which enhances the orthopedic effect of the appliances.

Table 1

Baseline and follow-up data of patients

Таблица 1. **Исходные и последующие данные пациентов**

No.	*Age*	*Sex*	*DIERS angle pre (°)*	*DIERS angle post (°)*	*DIERS lateral deviation pre (mm)*	*DIERS lateral deviation post (mm)*	*Chizhin index pre*	*Chizhin index post*
1	12	F	18	11	14.2	8.1	0.42	0.61
2	13	M	22	14	16.5	9.4	0.38	0.58
3	13	F	15	9	12.8	7.2	0.44	0.63
4	14	F	19	12	15.1	8.8	0.4	0.6
5	14	M	24	15	17.3	10.1	0.36	0.55
6	14	F	16	10	13.4	7.6	0.43	0.62
7	15	F	21	13	15.8	9	0.41	0.61
8	15	M	17	11	14	8.3	0.39	0.57
9	15	F	23	14	16.9	9.7	0.37	0.56
10	16	F	18	11	14.5	8.2	0.42	0.62
11	16	M	20	13	15.6	9.1	0.4	0.59
12	16	F	14	9	12.1	7	0.45	0.64
13	17	F	25	16	17.8	10.4	0.35	0.54
14	17	M	19	12	15.2	8.7	0.41	0.6
15	17	F	22	14	16.3	9.3	0.38	0.57
16	17	F	16	10	13.7	7.8	0.43	0.63
17	18	F	20	13	15.5	9	0.4	0.59
18	19	M	23	15	16.8	9.8	0.37	0.56
19	20	F	17	11	14.1	8.1	0.42	0.61
20	21	F	21	13	15.9	9.2	0.39	0.58
21	22	M	18	12	14.8	8.5	0.41	0.6
22	24	F	24	15	17.1	9.9	0.36	0.55
23	25	F	19	12	15	8.6	0.4	0.59
24	26	M	22	14	16.4	9.5	0.38	0.57
25	28	F	16	10	13.5	7.7	0.43	0.62
26	31	F	20	13	15.7	9.1	0.4	0.59
27	33	M	25	16	17.9	10.5	0.35	0.54
28	35	F	18	12	14.6	8.4	0.41	0.6
29	37	F	21	14	15.8	9.2	0.39	0.58
30	39	M	19	12	15.3	8.8	0.4	0.59
31	42	F	23	15	16.7	9.6	0.37	0.56
32	44	F	17	11	14	8	0.42	0.61
33	16	F	46	30	28.5	17.2	0.32	0.50
34	15	F	38	26	23.4	14.8	0.34	0.52
35	18	M	42	29	25.8	16.1	0.33	0.51
36	14	F	35	24	21.7	13.5	0.35	0.53

Table 2

Medians and interquartile ranges of the studied parameters by groups

Таблица 2. **Медианы и межквартильные диапазоны изучаемых параметров по группам**

Group	*n*	*DIERS angle pre (°), Me [Q1; Q3]*	*DIERS angle post (°), Me [Q1; Q3]*	*DIERS lateral deviation pre (mm), Me [Q1; Q3]*	*DIERS lateral deviation post (mm), Me [Q1; Q3]*	*Chizhin index pre, Me [Q1; Q3]*	*Chizhin index post, Me [Q1; Q3]*
All patients	36	20.0 [18.0; 23.0]	13.0 [11.0; 15.0]	15.6 [14.3; 16.9]	9.1 [8.2; 9.8]	0.40 [0.37; 0.41]	0.59 [0.56; 0.61]
Men	11	22.0 [19.0; 24.0]	14.0 [12.0; 15.0]	16.4 [15.2; 17.3]	9.4 [8.7; 10.1]	0.38 [0.36; 0.40]	0.57 [0.55; 0.59]
Women	25	20.0 [17.0; 23.0]	13.0 [11.0; 14.5]	15.5 [14.1; 16.8]	9.0 [8.1; 9.6]	0.40 [0.37; 0.42]	0.59 [0.56; 0.61]
Under 20 years	22	20.5 [18.0; 24.0]	13.0 [11.0; 15.0]	15.7 [14.2; 17.3]	9.1 [8.2; 10.1]	0.40 [0.36; 0.42]	0.58 [0.55; 0.61]
20 years and older	14	19.5 [18.0; 22.0]	12.5 [12.0; 14.0]	15.5 [14.6; 16.4]	8.9 [8.4; 9.5]	0.40 [0.38; 0.41]	0.59 [0.57; 0.60]

Group	*n*	*DIERS angle pre (°), Me [Q1; Q3]*	*DIERS angle post (°), Me [Q1; Q3]*	*DIERS lateral deviation pre (mm), Me [Q1; Q3]*	*DIERS lateral deviation post (mm), Me [Q1; Q3]*	*Chizhin index pre, Me [Q1; Q3]*	*Chizhin index post, Me [Q1; Q3]*
All patients	36	20.0 [18.0; 23.0]	13.0 [11.0; 15.0]	15.6 [14.3; 16.9]	9.1 [8.2; 9.8]	0.40 [0.37; 0.41]	0.59 [0.56; 0.61]
Men	11	22.0 [19.0; 24.0]	14.0 [12.0; 15.0]	16.4 [15.2; 17.3]	9.4 [8.7; 10.1]	0.38 [0.36; 0.40]	0.57 [0.55; 0.59]
Women	25	20.0 [17.0; 23.0]	13.0 [11.0; 14.5]	15.5 [14.1; 16.8]	9.0 [8.1; 9.6]	0.40 [0.37; 0.42]	0.59 [0.56; 0.61]
Under 20 years	22	20.5 [18.0; 24.0]	13.0 [11.0; 15.0]	15.7 [14.2; 17.3]	9.1 [8.2; 10.1]	0.40 [0.36; 0.42]	0.58 [0.55; 0.61]
20 years and older	14	19.5 [18.0; 22.0]	12.5 [12.0; 14.0]	15.5 [14.6; 16.4]	8.9 [8.4; 9.5]	0.40 [0.38; 0.41]	0.59 [0.57; 0.60]

Table 3

P-values of the Wilcoxon signed-rank test

Таблица 3. **Значения p-критерия Вилкоксона для парных выборок**

Group	*DIERS angle, p*	*DIERS lateral deviation, p*	*Chizhin index, p*
All patients	< 0.001	< 0.001	< 0.001
Men	0.002	0.002	0.002
Women	< 0.001	< 0.001	< 0.001
Under 20 years	< 0.001	< 0.001	< 0.001
20 years and older	< 0.001	< 0.001	< 0.001

Note. Values are presented as median and interquartile range [Q1; Q3]

The 42 % improvement in lateral spinal deviation on the DIERS system reflects a normalization of load distribution along the spine and a reduction in compensatory muscle tension. The DIERS Formetric 4D system is a validated tool for assessing postural status and is widely used in clinical research [21, 22]. The present results are in line with those of Sforza et al. [21], who demonstrated an improvement in postural balance after correction of occlusal disorders.

It should also be noted that all patients in this cohort reported a subjective improvement in well-being, including a reduction in back and neck pain, a reduction in headache intensity, and improved sleep quality. This is consistent with the reported impact of postural status on patients' quality of life [23].

The present results are consistent with data from international clinical studies conducted with the participation of the authors. In particular, the effectiveness of functional appliances combined with osteopathic support in restoring postural balance was previously demonstrated in adult patients: the use of the Cranial Postural Balance (CPB) appliance [1] allowed stable repositioning of the mandible and improvement of postural parameters [24]. Furthermore, clinical experience shows that jaw functional orthopedic appliances and osteopathic support, applied for the purpose of bone remodeling of the jaw, have been an effective adjunctive therapy in the treatment of idiopathic scoliosis, as previously reported within the "from bite to foot" assessment protocol.

Accordingly, the proposed method of diagnosis and monitoring of orthodontic treatment represents a logical extension of the interdisciplinary approach to the treatment of somatic dysfunctions.

A limitation of the present study is the absence of a concurrent control group receiving standard orthodontic treatment without prior postural diagnostics and without identification of ascending or descending priorities in the development of postural and cranial dysfunctions. The comparison with the Schroth exercise meta-analysis (Park et al.,

2018) [2] served as a historical control, which inherently limits the strength of direct comparisons due to differences in outcome measures (DIERS angle vs. Cobb's angle) and study design. Nevertheless, the convergence of findings — improvement in the scoliotic curve angle — supports the validity of the comparison. A randomized controlled trial is planned in order to evaluate the long-term outcomes of orthodontic treatment in both groups.

Table 4

Comparative analysis of treatment outcomes: Jaw Functional Orthopedic (JFO) method vs. Schroth exercise therapy (historical control)

Таблица 4. **Сравнительный анализ результатов лечения: метод функциональной ортопедии челюсти (JFO) против лечебной физкультуры по Шроту (исторический контроль)**

Parameter	*JFO $_+$ method «from bite to foot» (present study, n=36)*	*Schroth exercise (Park et al., 2018)*	*Significance*
Study design	Retrospective cohort (before–after)	Meta-analysis of 15 studies (various designs)	–
Number of patients	36	10–50 per study (total 453)	–
Severity range (DIERS/Cobb angle)	14–46 ° (grades I–IV)	10–28 ° (predominantly grades I–II)	–
Angle reduction: grades I–II (10–30 °)	Median reduction 7.0 ° (35 %, p < 0.001) Hedges' g = 1.24 [95 % CI 1.00–1.48] (large effect)	ES = 1.07 [0.76–1.38] (large effect)	JFO ≥ Schroth (g = 1.24 vs 1.07)
Angle reduction: grades III–IV (> 30 °)	Reduction 16 ° (35 %) (patient L.: 46 °→30 °) Hedges' g = 2.89 (very large effect)	ES = 0.67 [0.32–1.03] (moderate effect)	JFO + method **«from bite to foot»**: clinically significant reduction at > 30 °
Treatment duration	12 months	Variable (1 week — >1 year)	Comparable
Additional postural improvement	Lateral deviation: –42 % (Hedges' g = 2.30) Chizhin index: +47 % (Hedges' g = 5.61)	Not reported (focused on Cobb angle)	JFO + method **«from bite to foot»**: broader postural assessment

Note. ES = effect size (Hedges' g); JFO = Jaw Functional Orthopedics. The Schroth exercise data are derived from the meta-analysis by Park JH, Jeon HS, Park HW (Eur J Phys Rehabil Med 2018;54:440–449). Direct comparison of effect sizes is limited by differences in study design and outcome measures (DIERS angle vs. Cobb angle)

Conclusion

The authors' method of comprehensive diagnosis and monitoring of orthodontic treatment, "from bite to foot," combined with the use of removable jaw functional orthopedic appliances, provides reliable improvement of postural status in patients with descending-type scoliosis, including those with grade III–IV deformity (DIERS angle up to 46 °). Over 12 months of the preparatory stage, the median DIERS angle decreased by 35 % ($p < 0.001$), the lateral spinal deviation measured by the DIERS system decreased by 42 % ($p < 0.001$), and the Chizhin index increased by 47 % ($p < 0.001$). The greatest effect was observed in patients under 20 years of age. Comparison with the meta-analytical data on the Schroth exercise method (Park et al., 2018) [2] demonstrated that while the Schroth method is most effective for grade I–II scoliosis (Cobb's angle 10–30 °), the present approach using jaw functional orthopedic appliances achieves clinically significant improvement in patients with grade III–IV deformity, where exercise-based methods show limited efficacy. Application of this diagnostic method creates optimal biomechanical conditions [1, 25] for subsequent functional orthodontic treatment and contributes to the reduction of pain symptoms both in the dentoalveolar region and at the systemic level, as well as to an improvement in the patients' quality of life. In cases in which ascending-type postural dysfunctions predominate, preliminary treatment of the primary postural dysfunctions is additionally required.

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