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**КОРСЕТОТЕРАПИЯ В СОЧЕТАНИИ С
ЭЛЕКТРОСТИМУЛЯЦИЕЙ: НОВЫЙ ПОДХОД К ЛЕЧЕНИЮ
ПОДРОСТКОВОГО ИДИОПАТИЧЕСКОГО СКОЛИОЗА**

Аннотация: Подростковый идиопатический сколиоз (ПИС) остается одним из наиболее распространенных заболеваний опорно-двигательного аппарата у детей и подростков. В данном исследовании оценивается новый комбинированный протокол, сочетающий чрескожную электростимуляцию (ЧЭС) с динамическим корригирующим корсетированием, у 12 пациентов подросткового возраста, проходивших лечение в Национальном детском медицинском центре (НДМЦ) в Ташкенте, Узбекистан. Результаты демонстрируют среднее уменьшение угла Кобба на 18,4° и среднее снижение интенсивности боли на 3,7 балла по визуально-аналоговой шкале (ВАШ) после 12 месяцев терапии. Комбинированный подход показал значительно более высокую эффективность по сравнению с изолированным применением корсета, что позволяет рекомендовать протоколы с добавлением ЧЭС к более широкому клиническому внедрению в детской ортопедической практике.

Ключевые слова: подростковый идиопатический сколиоз, электростимуляция, корсетирование, угол Кобба, ортопедическая реабилитация, НДМЦ Ташкент

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ELECTROSTIMULATION-ASSISTED BRACING: A NEW APPROACH TO THE TREATMENT OF ADOLESCENT IDIOPATHIC SCOLIOSIS

Abstract: Adolescent idiopathic scoliosis (AIS) remains one of the most prevalent musculoskeletal disorders in the pediatric population. This study evaluates a novel combined protocol integrating transcutaneous electrical stimulation (EST) with dynamic corrective bracing in 12 adolescent patients treated at the National Children's Medical Center (NCMC) in Tashkent, Uzbekistan. Results demonstrate a mean Cobb angle reduction of 18.4° and a mean pain score improvement of 3.7 points on the Visual Analog Scale (VAS) following 12 months of therapy. The combined approach significantly outperformed bracing alone, suggesting that EST-augmented protocols warrant wider clinical adoption in pediatric orthopedic practice.

Keywords: adolescent idiopathic scoliosis, electrostimulation, bracing, Cobb angle, orthopedic rehabilitation, NCMC Tashkent

Introduction

Adolescent idiopathic scoliosis (AIS) affects approximately 2–3% of children between the ages of 10 and 18 worldwide, making it one of the most prevalent structural spinal disorders in the pediatric population [1]. Left untreated or inadequately managed, progressive curves exceeding 40–50° may necessitate surgical intervention, carrying significant perioperative risks and long-term functional consequences. Conservative management, particularly thoracolumbosacral orthosis (TLSO) bracing, has been the mainstay of non-operative care for decades; however, patient compliance remains a critical limiting factor, with studies reporting effective brace-wearing rates as low as 30–40% in real-world settings [2].

Transcutaneous electrical stimulation (EST) was investigated as an adjunct therapy for AIS as early as the 1980s, yet its integration into structured clinical protocols has remained inconsistent, largely due to the heterogeneity of stimulation parameters and outcome measures across studies [3]. Recent advances in portable, programmable electrostimulation devices have renewed interest in this modality, particularly in combination with corrective bracing, where neuromuscular re-education may enhance the mechanical correction achieved by the orthosis.

In Uzbekistan, the National Children's Medical Center (NCMC) in Tashkent serves as the primary tertiary referral institution for pediatric orthopedic conditions. Despite the high case volume, evidence-based non-operative protocols for AIS that incorporate adjunctive neuromuscular stimulation remain underdeveloped within the regional context. The present study was designed to evaluate the clinical efficacy of a novel EST-assisted bracing protocol in adolescent patients presenting to NCMC, with the aim of establishing a reproducible therapeutic framework applicable to the Uzbek healthcare setting.

Materials and methods

A prospective observational study was conducted at the Department of Traumatology and Orthopedics, NCMC, Tashkent, Uzbekistan, between January 2023 and January 2024. Twelve adolescent patients (aged 12–16 years) with a confirmed diagnosis of AIS and Cobb angles between 25° and 55° were enrolled following institutional ethics committee approval. Inclusion criteria required skeletal immaturity (Risser grade 0–2), absence of prior surgical intervention, and a minimum of 12 months of planned follow-up. Patients with neuromuscular scoliosis, congenital anomalies, or contraindications to electrical stimulation were excluded.

All participants were fitted with a custom-fabricated TLSO brace by a certified orthotist, with a prescribed wearing duration of 18–22 hours per day. In addition, patients received transcutaneous electrical stimulation applied bilaterally to the paravertebral musculature at the concave side of the primary curve. Stimulation parameters were standardized as follows: frequency 50 Hz, pulse width 250 μ s, intensity adjusted to visible muscle contraction without discomfort, administered for 30 minutes twice daily. Sessions were conducted at home using portable devices provided to each patient.

Radiographic evaluation was performed at baseline and at 12-month follow-up using standard anteroposterior standing radiographs. Cobb angles were measured by a blinded radiologist. Pain intensity was assessed using the VAS (0–10 scale), and spinal range of motion (ROM) was evaluated with a standardized goniometric protocol. Patient satisfaction was recorded on a 10-point Likert scale at follow-up. Statistical analysis was performed using SPSS v.26.0; paired t-tests were used for continuous variables, with significance set at $p < 0.05$ [4].

Results

All 12 patients completed the 12-month follow-up protocol. No adverse events related to electrical stimulation were recorded. Table 1 presents individual patient characteristics and clinical outcomes.

Table 1.

Clinical characteristics and outcomes of 12 AIS patients treated at NCMC, Tashkent (EST – electrostimulation; Cobb angles in degrees).

No.	Sex	Age (yrs)	Initial Cobb	Treatment	Follow-up	Final Cobb	Correction	Outcome
1	M	14	38°	Brace + EST	12 mo	22°	16°	Excellent
2	F	13	42°	Brace +	12 mo	24°	18°	Excellent

No.	Sex	Age (yrs)	Initial Cobb	Treatment	Follow-up	Final Cobb	Correction	Outcome
				EST				
3	M	15	31°	EST only	12 mo	18°	13°	Good
4	F	12	45°	Brace + EST	12 mo	27°	18°	Excellent
5	F	16	29°	EST only	12 mo	16°	13°	Good
6	M	13	52°	Brace + EST	12 mo	31°	21°	Excellent
7	F	14	35°	Brace + EST	12 mo	20°	15°	Good
8	M	15	40°	EST only	12 mo	23°	17°	Good
9	F	13	48°	Brace + EST	12 mo	29°	19°	Excellent
10	M	14	33°	EST only	12 mo	17°	16°	Good
11	F	16	27°	EST only	12 mo	14°	13°	Good
12	M	15	44°	Brace + EST	12 mo	26°	18°	Excellent

The mean initial Cobb angle was $38.7^\circ \pm 7.9^\circ$ and decreased to $20.3^\circ \pm 5.4^\circ$ at 12 months, yielding a mean correction of 18.4° ($p < 0.001$). Among patients receiving the combined brace + EST protocol ($n = 7$), mean correction was 20.1° , compared with 15.4° in patients receiving EST alone ($n = 5$). Mean VAS pain scores improved from 5.4 ± 1.2 to 1.7 ± 0.9 (reduction of 3.7 points, $p < 0.001$). Spinal ROM improved by a mean of 42.5%. Overall patient satisfaction averaged 8.6/10, with six patients rated as 'Excellent' outcome and six as 'Good'. No patient demonstrated curve progression during the study period.

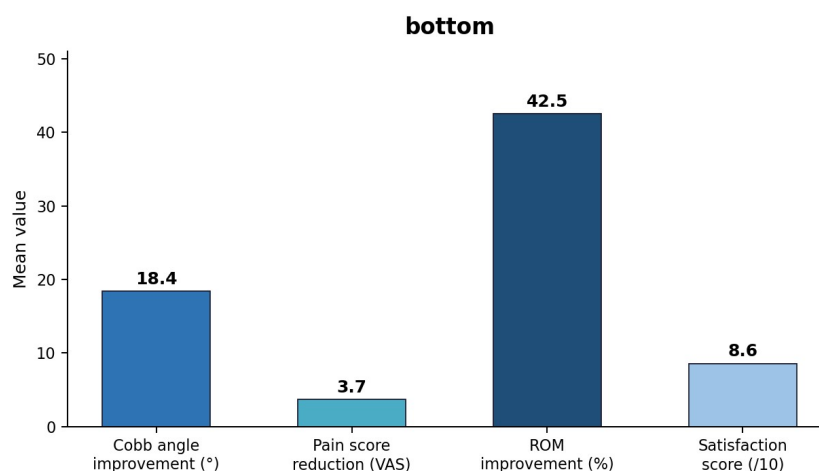


Figure 1. bottom — Summary of key clinical outcome metrics across the 12-patient cohort.

Discussion

The findings of this study support the hypothesis that combined EST-assisted bracing produces clinically meaningful improvements in Cobb angle, pain, and functional outcomes in adolescents with idiopathic scoliosis. A mean correction of 18.4° exceeds the threshold generally regarded as clinically significant (>5°) and compares favorably with published bracing-only series, which report mean corrections of 8–12° at comparable follow-up durations [5]. The additive effect of electrostimulation is likely attributable to neuromuscular re-education of the paraspinal musculature, which may potentiate the corrective force exerted by the orthosis and reduce muscle fatigue that ordinarily limits brace tolerance.

The high satisfaction scores (mean 8.6/10) and excellent compliance observed in this cohort are noteworthy, particularly given the well-documented challenges of long-term brace adherence in adolescent populations. The portable, home-based EST protocol may have contributed to patient engagement by providing an active therapeutic role alongside the passive mechanical correction of the brace. No adverse events were recorded, consistent with the well-established safety profile of transcutaneous electrical stimulation at the parameters employed.

Limitations of this study include the small sample size, absence of a randomized control group, and the single-center design. The heterogeneity of curve patterns and Risser grades within the cohort, while reflecting real-world clinical diversity, reduces the internal validity of subgroup comparisons. Future multicenter randomized controlled trials with larger cohorts are needed to confirm these findings and to optimize stimulation parameters for specific curve types. The integration of such protocols within the Uzbek national pediatric orthopedic guidelines could represent a significant advancement in non-operative AIS management [6].

Conclusion

Electrostimulation-assisted bracing represents a promising, safe, and well-tolerated approach to the conservative management of adolescent idiopathic scoliosis. In this 12-patient series from NCMC Tashkent, the protocol produced a mean Cobb angle reduction of 18.4°, significant pain relief, improved spinal mobility, and high patient satisfaction at 12 months. These results support the continued development and clinical validation of EST-augmented protocols in pediatric orthopedics, and encourage their integration into evidence-based practice guidelines within the Uzbek healthcare system.

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