

## Efficiency of kinesiotaping application in the complex rehabilitation of children with idiopathic scoliosis

GORSHA O. V.<sup>1</sup>, APLEVICH V. M.<sup>2</sup>, ZUKOW W.<sup>3</sup>

<sup>1</sup>Ukrainian Research Institute of Medicine Transport, Clinical Department of Medical Rehabilitation, Odesa, UKRAINE

<sup>2</sup>City Children's Polyclinic No. 1, Odesa, UKRAINE

<sup>3</sup>Faculty of Earth Sciences, Nicolaus Copernicus University, Torun, POLAND

Published online: September 30, 2017

(Accepted for publication August 31, 2017)

DOI:10.7752/jpes.2017.03177

### Abstract:

**Introduction.** Distribution violations of posture and scoliosis in children, according to various authors, up to 46.9%, while it is idiopathic scoliosis (IS) is about 80.0 - 85.0% of all diagnosed cases of scoliosis.

The aim of the study was performed to study the basic pathogenic mechanisms of influence and effectiveness of restorative treatment with the additional attraction kinesiotaping children high school age, patients with idiopathic scoliosis early stages. **Material and Methods.** The material of the work is based on examination of 134 children of senior school age with a diagnosis of idiopathic scoliosis of 1-2 degrees. For 12 months, children were under dynamic observation and received restorative treatment. The data of the anamnesis, the results of biomechanical and roentgenological studies were studied. In addition, X-ray densitometry and biochemical examination of markers of the state of the musculoskeletal system were performed. Assessment of the quality of life and the structural and functional state of the musculoskeletal system was carried out in accordance with the International Classification of Functioning, Limitation of Life and Health (ICF). Basic rehabilitation treatment and rehabilitation of children was carried out, based on the recommendations of the local protocol. In patients of the main group, the standard protocol was supplemented with the use of kinesiotaping. The method of kinesiotaping is based on noninvasive fixation of muscle fibers in certain anatomical segments, muscle stimulation, due to the effect on proprioceptors. **Results.** Restorative treatment with kinesiotaping in children of senior school age, patients with idiopathic scoliosis 1 - 2 degrees allows to significantly improve their clinical and functional state (decrease in the angle of curvature of the spinal column, back pain, decrease in the structure and function of the spine and paravertebral muscles, Communication and social activity for all the ICF indicators reviewed, improvements in the biomechanics of the spine), the state of enzyme systems (decreased activity of alkaline and acid phosphatases of blood), metabolism of minerals (increase of phosphorus in the blood, decrease in calcium in the urine) and organic compounds (decrease in glycoproteins and chondroitin sulfate content, increase in blood creatinine, decrease in levels of hydroxyproline and uronic acids in urine) based on the results of biochemical research. **Conclusion.** It is proved that the effectiveness of standard restorative treatment of children, patients, idiopathic scoliosis, with osteopenia is significantly lower than in the absence of it.

**Key words:** children, idiopathic scoliosis, rehabilitation, kinesiotaping.

### Introduction

Distribution violations of posture and scoliosis in children, according to various authors, up to 46.9%, while it is idiopathic scoliosis (IS) is about 80.0 - 85.0% of all diagnosed cases of scoliosis [1 - 3].

At present, non-surgical treatment for scoliosis initial stages mainly used tough posture correctors. But it should be noted that the rigid fixation is often quite painful, and can sometimes contribute to poor circulation fixed body segments, deepen hypokinesia child, which generally contributes to a vicious circle etiopathogenetical factors of the disease [4, 5].

An alternative method that can be used for the treatment of posture and the initial stages of idiopathic scoliosis is kinesiotaping muscles of the trunk. Kinesiotaping - a method based on the activation of proprioceptors muscle fibers, improving blood circulation and lymph [6, 7]. In recent years, techniques kinesiotaping features allow consideration to its application to correct spinal deformities.

The aim of the study was performed to study the basic pathogenic mechanisms of influence and effectiveness of restorative treatment with the additional attraction kinesiotaping children high school age, patients with idiopathic scoliosis early stages.

### Material and research methods

The material was of the data obtained during the examination of 134 children of high school age with a diagnosis of idiopathic scoliosis of 1-2 degrees. During the year, the children were under the dynamic supervision and receive restorative treatment on an outpatient basis. Depending on the methods of restorative

treatment, patients were divided into groups: I group (basic) - which used a standard treatment protocol and kinesiotaping - 68 children; Group II (equalizing) - used standard (basic) treatment protocol - 66 children.

Criteria for inclusion in the study, verified the diagnosis of idiopathic scoliosis 1st and 2nd degree, patients age 12 to 17, voluntary consent to participate in the study. Criteria for exclusion from the study: severe scoliosis, somatic diseases that can cause secondary osteoporosis; related diseases in the state of decompensation; individual sensitivity in the form of allergic reactions to components tapes material, intellectual disorders.

Pain quantitatively assessed by visual analog pain scale (VAS) from 0-10 points. We investigated the presence of hypermobility syndrome (HMS) according to criteria Beyton. For Beyton hypermobility recommended to consider persons who has 4 or more criteria (maximum points - 9). Biomechanical parameters that were used to assess functional status of the spine include: goniometry stand (tilt forward, backward and side) and defining benchmarks mobility of the spine.

X-ray used for diagnosis and monitoring the effectiveness of subsequent restorative treatment. Radiographic stage scoliosis was determined by Cobb. Additional X-ray densitometry was performed. Assessment of quality of life and structural and functional state of the musculoskeletal system conducted under the International Classification of Functioning, Disability and Health (ICF). ICF chose criteria that meet the parameters characterizing disability and violation of the structure and function of the musculoskeletal system. Biochemical markers condition the musculoskeletal system include (in serum determined activity of alkaline and acid phosphatase (ALP, CF), calcium, phosphorus, glycoproteins, hondroyitinsulfat, creatinine and the activity of creatine phosphokinase (CPK) in daily urine - content oxyproline, uronic acids calcium and phosphorus).

All studies were carried out according to standardized methods. The survey was conducted prior to restorative treatment and 12 months of treatment.

### Methods of treatment

Standard (basic) restorative treatment and rehabilitation of children carried out according to local protocol included: rational mode during the day, a diet with sufficient protein (both animal and vegetable origin), exercise therapy, massage, physiotherapy (phonophoresis with chondroxyde on paravertebral section, magnetic therapy for back muscles), calcium supplements. Patients core group of standard treatment protocol was amended application kinesiotaping. Frequency of treatments blending tapes - 1 every 5-7 days with a break of 2 days and subsequent repetition in the same interval. Duration of use from 6-12 months and appears obtaining stable clinical effect and the absence of negative dynamics.

Mathematical analysis: statistical description of samples carried variational methods of assessing series [8]. We determined the arithmetic mean (M) and its standard deviation (SD). The significance of differences between samples (groups surveyed) was assessed using parametric (t-Student test) and nonparametric (U-Mann-Whitney criterion) methods for dependent and independent samples. The criterion of reliability assessments served as the level of significance indicating the probability of erroneous assessments (p). Data processing studies performed with the software STATISTICA for Windows 6.0 (StatSoft Company, USA).

For the organization of research methodology complies consensus on biomedical ethics and conducted under the principles of evidence-based medicine (Act number 2/15 of the expert committee on 12.01.2017 y.)

### Results and discussion

Complaints from the back in the form of discomfort when walking long established 12.12% discomfort during exercise - at 12.12% and pain during exercise - in 75.76% of children. Stigma embryogenesis as alar blades were set at 9.09% strain chest - 15.15% of children were absent in 75.76% of children. Encumbrance continuity of the musculoskeletal 1-2 family line from one of the parents was found in 15.15% of the two parents - in 6.06% of children; detected in 78.79% of children. Type violations burden of inheritance in the form of flat set to 9.09%, scoliosis - at 9.09%, scoliosis and flat feet - 3.03% in children. On examination deviation direction spinal column was found in the left 19.70%, right - in 80.30% of children. Joint hypermobility on a scale Beyton was  $4.21 \pm 1.71$  points. Back pain in all cases (VAS  $2.05 \pm 1.56$  points), violation of indicators of functional state spine (42.54 - 59.70% of cases), functional limitations in training, communication and social activity (at 42.54 - 49.26% of cases), violation of the most indicators of biomechanics of the spine and violation of the state enzyme systems, exchange of minerals and organic compounds (deviation of 1.5 - 2 times of normal value content of alkaline phosphatase, acid phosphatase, glucose and chondroitin sulfate proteid in blood and oxyproline, uronic acids, calcium in the urine).

The use of standard restorative treatment for children has led to several positive results. Thus, in these children was significantly reduced back pain by VAS from  $2.06 \pm 1.58$  to  $1.77 \pm 1.23$  points ( $p < 0.0007$ ), improved back function in many ways IFF and reduced restrictions in education and communication. Decreased angle of curvature of the spine radiography the results of  $7.30 \pm 2.36$  to  $6.70 \pm 2.62$  ° ( $p < 0.0001$ ). Also significantly improved biomechanics of the spine, bending the spine decreased from  $5.67 \pm 0.90$  to  $5.35 \pm 0.79$  cm ( $p < 0.0001$ ), rotation of the spine from  $43.48 \pm 2.16$  to  $42.29 \pm 2.22$  ° ( $p < 0.0001$ ), improved all indicators goniometry.

In addition, standardized restorative treatment reduced the enzyme activity of alkaline phosphatase from  $557.7 \pm 373.9$  to  $438.7 \pm 190.1$  U / L ( $p < 0.0002$ ) (rate of  $346,0 \pm 25,6$  U / L) and KF of  $5.65 \pm 1.77$  to  $4.47 \pm 0.87$  U / L ( $p < 0.0001$ ) (rate of  $4,10 \pm 0,19$  U / L), the content of glycoproteins from  $0.87 \pm 0.10$  to  $0.66 \pm 0.10$  g / dL ( $p < 0.0001$ ) (rate of  $0,58 \pm 0,02$  g / l) and cholesterol from  $0.15 \pm 0.04$  to  $0.08 \pm 0.02$  mmol / l ( $p < 0.0001$ ) (rate of  $0,070 \pm 0,004$  mg / l), increased phosphorus from  $1.43 \pm 0.38$  to  $1.51 \pm 0.40$  mmol / l ( $p < 0.0001$ ) ( rate of  $1,50 \pm 0,05$  mmol / l) and creatinine from  $77.83 \pm 9.99$  to  $87.17 \pm 11.19$  mmol / l ( $p < 0.0001$ ) (rate of  $84,53 \pm 2,14$  mmol / l) in blood led to increased activity CPK from  $120.9 \pm 25.19$  to  $122.2 \pm 25.31$  U / L ( $p < 0.0001$ ) (rate of  $122,6 \pm 4,57$  U / L) and content f SFOR from  $1.37 \pm 0.31$  to  $1.39 \pm 0.32$  g / day ( $p < 0.0001$ ) (rate of  $1,30 \pm 0,08$  g / day) to reduce the content oxyproline from  $47.82 \pm 19.82$  to  $36.64 \pm 9.10$  mg / day ( $p < 0.0002$ ) (rate of  $27,4 \pm 1,58$  mg / day), the UK with  $6.00 \pm 1.80$  to  $5.25 \pm 1.66$  mg / day ( $p < 0.0001$ ) (rate of  $4,30 \pm 0,11$  mg / day) and calcium from  $304.5 \pm 120.5$  to  $235.9 \pm 62.31$  mg / day ( $p < 0.0001$ ) (rate of  $180,3 \pm 9,03$  mg / day) in the urine of children.

Most of the above studies achieved the indicators did not meet regulations. Only three indicators (phosphorus and creatinine in blood CPK activity in urine) reached normal values. The value of bending the spine has not reached normal values. The value of other indicators usually set higher than the normal value.

Thus, the use of standard restorative treatment for children high school age, patients with idiopathic scoliosis of 1-2 degrees, can significantly improve the clinical and functional status (decrease the angle of curvature, back pain, improve function back in many ways IFF, reducing constraints in education and communication, improve the biomechanics of the spine), a condition of enzyme systems (reducing the activity of enzymes and alkaline phosphatase levels KF) exchange of minerals (increased phosphorus in the blood, decreased urinary calcium) and organic compounds (glycoproteins and reduction of cholesterol, increased creatinine levels, reduction of oxyproline UK and urine) on the results of biochemical research. However, most clinical, functional, instrumental and biochemical parameters after such treatment does not reach normal values.

Patients core group of standard treatment protocol was amended application kinesiotaping. We have found that the inclusion of restorative treatment kinesiotaping led to a significant decrease in back pain by VAS (from  $2.04 \pm 1.56$  to  $0.38 \pm 0.65$  points,  $p < 0.0001$ ), a significant improvement in back function on all counts IFF and reducing all functional restrictions. According to X-ray indicated a significant decrease spinal curvature angle of  $7.28 \pm 2.27$  to  $6.10 \pm 2.24$  ° ( $p < 0.0001$ ). Also significantly improved biomechanics of the spine, to which indicated a decrease bending of  $5.60 \pm 0.81$  to  $4.69 \pm 0.58$  cm ( $p < 0.0001$ ), extension of  $34.13 \pm 1.74$  to  $32.72 \pm 1.34$  ° ( $p < 0.0001$ ) and rotation of the spine from  $43.38 \pm 2.23$  to  $41.56 \pm 1.98$  ° ( $p < 0.0001$ ) improvement in all indicators goniometry.

Application kinesiotaping significantly reduced the activity of the enzyme alkaline phosphatase from  $587.2 \pm 390.9$  to  $406.8 \pm 158.1$  U / L ( $p < 0.0001$ ) (rate of  $346.0 \pm 25.6$  U / L) and KF of  $5.58 \pm 1.70$  to  $4.14 \pm 0.80$  U / L ( $p < 0.0001$ ) rate of  $4.10 \pm 0.19$  U / L), the content of glycoproteins from  $0.88 \pm 0.12$  to  $0.63 \pm 0.10$  g / dL ( $p < 0.0001$ ) (rate of  $0.58 \pm 0.02$  g / dL) and LDL of  $0.16 \pm 0.04$  to  $0.07 \pm 0.02$  mmol / l ( $p < 0.0001$ ) (rate of  $0.070 \pm 0.004$  mmol / l) increased the phosphorus from  $1.46 \pm 0.39$  to  $1.53 \pm 0.41$  mmol / l ( $p < 0.0001$ ) (rate of  $1.50 \pm 0.05$  mmol / l) and creatinine from  $75.41 \pm 13.13$  to  $84.10 \pm 14.58$  mmol / L ( $p < 0.0001$ ) (rate of  $84.53 \pm 2.14$  mmol / L) in blood led to a substantial increase in activity of CPK from  $125.81 \pm 21.35$  to  $185.7 \pm 31.62$  U / L ( $p < 0.0001$ ) (rate of  $122.6 \pm 4.57$  U / L), the phosphorus content of  $1.40 \pm 0.31$  to  $1.43 \pm 0.31$  g / day ( $p < 0.0001$ ) (rate of  $1.30 \pm 0.08$  g / day), reduction of oxyproline from  $47.43 \pm 19.60$  to  $31.06 \pm 7.02$  mg / day ( $p < 0.0001$ ) (rule  $27.4 \pm 1.58$  mg / ), UK from  $5.83 \pm 1.74$  to  $5.15 \pm 1.35$  mg / day ( $p < 0.0001$ ) (rate of  $4.30 \pm 0.11$  mg / day) and calcium from  $298.4 \pm 107.4$  to  $210.7 \pm 42.33$  mg / day ( $p < 0.0001$ ) (rate of  $180.3 \pm 9.03$  mg / day) in the urine of children.

Comparing values of the study (a study group) following treatment with their normative values, found that much of it reached the normal range, or significantly closer to them. This includes the value of bending of the spine, the activity of KF, phosphorus, glycoproteins, cholesterol, creatinine in the blood and urine oxyproline children.

Thus, restorative treatment using kinesiotaping children of high school age, patients with idiopathic scoliosis of 1-2 degrees, can significantly improve the clinical and functional status (decrease the angle of curvature, back pain, improve function in all parameters back IFF and reducing all functional limits, improving biomechanics of the spine), a condition of enzyme systems (reducing the activity of enzymes and alkaline phosphatase levels KF) exchange of minerals (increased phosphorus in the blood, decreased urinary calcium) and organic compounds (lowering spare glycoproteins and cholesterol content, increased creatinine levels, reduction of oxyproline UK and urine) on the results of biochemical research. A large number of clinical, functional, instrumental and biochemical parameters after such treatment or achieve much closer to normal values. Compared with standard treatment using renewable kinesiotaping dynamics of the study was more pronounced, and much of it reached normative values.

## Conclusions

1. The use of standardized restorative treatment in children with idiopathic scoliosis, resulting in significantly reduced angle of curvature of the spine on the results of X-ray (from  $7.30 \pm 2.36$  to  $6.70 \pm 2.62$  °,  $p < 0.0001$ ), reduction of "bending the spine" (from  $5.67 \pm 0.90$  to  $5.35 \pm 0.79$  cm,  $p < 0.0001$ ), "rotation of spine"

(from  $43.48 \pm 2.16$  to  $42.29 \pm 2.22$  °,  $p < 0.0001$ ), osteopenia (T-growth criterion densitometry of  $-1.14 \pm 0.84$  to  $-1.26 \pm 0.62$  um. units. SD,  $p < 0.0193$ ), pain VAS (from  $2.06 \pm 1.58$  to  $1.77 \pm 1.23$  points,  $p < 0.0007$ ), improved spinal function parameters for IFF and reduce limitations in training, communication and co touch on social activity and demonstrates the trend towards recovery biochemical parameters. However, most clinical and functional and biochemical parameters after treatment do not reach normal values, and therefore - not to achieve optimal clinical and functional status of patients with idiopathic scoliosis children.

2. Restorative treatment kinesiotaping inclusion of children with idiopathic scoliosis leads to a significant reduction in angle of curvature of the spine on the results of X-ray (from  $7.28 \pm 2.27$  to  $6.10 \pm 2.24$  °,  $p < 0.0001$ ), reduction of "bending" (from  $5.60 \pm 0.81$  to  $4.69 \pm 0.58$  cm,  $p < 0.0001$ ), "extension" (from  $34.13 \pm 1.74$  to  $32.72 \pm 1.34$  °,  $p < 0.0001$ ) and the "rotation of the spine" (from  $43.38 \pm 2.23$  to  $41.56 \pm 1.98$  °,  $p < 0.0001$ ) reduce osteopenia (T-growth criterion densitometry of  $-1.07 \pm 1.09$  to  $\pm 0.76$  cu  $-1.18$  SD,  $p < 0.0001$ ) decrease in pain VAS (from  $2.04 \pm 1.56$  to  $0.38 \pm 0.65$  points,  $p < 0.0001$ ) improvement function back on all counts IFF and reducing restrictions on education, communication and social activity. Restorative treatment to include kinesiotaping significantly reduces the activity of enzymes (LF, CF) and the content of glycoproteins and cholesterol, increases in phosphorus and creatinine in the blood, leading to a significant increase in activity CPK, phosphorus content to reduce the content oxyproline, UK and calcium in the urine of children. A large number of clinical, functional, instrumental and biochemical parameters after such treatment or achieve much closer to normative values.

## References

1. Linkevich K., Mamieieva-Protopopova T., Kovrov Ia. Stan somatychnoho zdorov'ya ditey molodshoho shkil'noho viku, khvorykh na skolioz na etapi adaptatsiyi do navchannya u spetsializovanomu zakladi. [Somatic State of health of the children of junior school age, patients with scoliosis at the stage of adaptation to the training in specialized institution]. Moloda sportyvna nauka Ukrainy. zb. nauk. prats z haluzi fizychnoyi kul'tury ta sportu. Vyp. 9. u 4-kh t. L'viv. NVF «Ukrayins'ki tekhnolohiyi». 2005. T. 2. s. 182–184. (In Ukrainian).
2. Grivas T. B. Suggestions for improvement of school screening for idiopathic scoliosis / T. B. Grivas, E. S. Vasiliadis, J. P. O'brien // Studies in health technology and informatics. 2008. Vol. 140. P. 245–248.
3. Mykhno L. Doslidzhennya problemy poshyrenosti porushen' postavy v ditey molodshoho shkil'noho viku [Investigating the prevalence of disorders of posture in primary school children]. Moloda sportyvna nauka Ukrainy. zb. nauk. pr. z haluzi fiz. vykhovannya, sportu i zdorov'ya lyudyny. za zah. red. Ye. Prystupy. L., 2014. Vyp. 18, t. 3. S. 132–138. (In Ukrainian).
4. Gayduk A. A. Danilenko L. A. Rezul'taty differentsirovannogo primeneniya sredstv ortopedicheskoy i fizicheskoy korrektsii funktsional'nykh narusheniy oporno-dvigatel'nogo apparata u detey i podrostkov. [Results of differentiated use of orthopedic and physical correction of functional disorders of the musculoskeletal system in children and adolescents]. Sovremennyye problemy nauki i obrazovaniya. 2013. № 4. S. 112. (In Ukrainian).
5. Omel'chenko T. M. Metodychna rozrobka zanyattya dlya pidhotovky vykladachiv VMNZ Ukrainy III–IV rivnya na temu: vrodzheni ta nabuti zakhvoryuvannya khrebt. [Methodical development sessions for teachers of higher medical preparation Ukraine III-IV level on: congenital and acquired diseases of the spine]. Litopys travmotolohiyi ta ortopediyi. 2013. № 3–4. S. 168–176. (In Ukrainian).
6. Kenzo Kase. Metodika kineziologicheskogo teypirovaniya. [The method of kinesiological teiping. Introduction and clinical application]. Vvedeniye i klinicheskoye primeneniye. Izd. II. Per. s angl. Moskva. 2013. 218 s. (In Russian).
7. Barulin A. Ye., Kurushina O. V., Kalinchenko B. M. Primeneniye metodiki kinezioteypirovaniya u patsiyentov nevrologicheskogo profilya. [Application of kinesiotherapy in patients with neurological profile]. Russkiy meditsinskiy zhurnal. 2016. № 13. S. 834–837. (In Russian).
7. Mintser O. P., Voronenko Yu. V., Vlasov V. V. Obroblennya klinichnykh i eksperymental'nykh danykh u medytsyni: navch. pos. dlya stud. [Treatment of clinical and experimental data in medicine, teach. Ref. for students]. K. Vyscha shkola, 2003. 350 s. (Informatsiyi tekhnolohiyi v okhoroni zdorov'ya i praktychniy medytsyni : u 10-y kn. kn. 5). (In Ukrainian).