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MODELING OF INDIVIDUAL TELERADIOGRAPHIC INDICATORS ACCORDING TO DOWNS METHOD FOR YOUNG MEN AND YOUNG WOMEN WITH DIFFERENT FACE TYPES

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In Ukrainian young men (with a wide face type) and young women (with a wide and very wide face type) with orthognathic occlusion, reliable regression models of individual teleradiographic indicators of the upper and lower jaws were constructed and analyzed by the Downs method (second group) depending on the basic cephalometric parameters (first group) (in young men R^2= 0.856 and 0.902, most often the models include the value of the distances N-S and S-E; only in young women with a wide type of face – R^2=0.778); and indicators that characterize the position of each tooth (third group), depending on the indicators of the first and second groups (in young men R^2= from 0.605 to 0.868, most often the models include the value of the angles NAPog, POr-GnS, AB-NPog and distances N-S and P-PTV; respectively in young women – R^2= from 0.614 to 0.801, most often the models include the value of the angle AB-NPog, and R^2= 0.718 and 0.860, most often the models include the value of the angles NAPog, POr-MeGo, POr-GnS, H and distance S-E).

Keywords: teleradiography, Downs method of cephalometry, young men and young women with orthognathic occlusion, facial types, regression analysis.

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МОДЕЛЮВАННЯ ІНДИВІДУАЛЬНИХ ТЕЛЕРЕНТГЕНОГРАФІЧНИХ ПОКАЗНИКІВ ЗА МЕТОДОМ DOWNS В ЮНАКІВ І ДІВЧАТ ІЗ РІЗНИМИ ТИПАМИ ОБЛИЧЧЯ

В українських юнаків (із широким типом обличчя) і дівчат (із широким і дуже широким типами обличчя) із ортогнатичним прикусом побудовані та проаналізовані достовірні регресійні моделі індивідуальних телерентгеногорафічних показників верхньої та нижньої щелеп за методом Downs (друга група) у залежності від базових цефалометричних параметрів (перша група) (в юнаків R^2= 0,856 і 0,902, найбільш часто до моделей входять величина відстаней N-S і S-□; лише у дівчат із широким обличчям – R^2=0,778); та показників, які характеризують положення кожного окремого зуба (третя група) в залежності від показників першої та другої груп (в юнаків R^2= від 0,605 до 0,868, найбільш часто до моделей входять величина кутів NAPog, POr-GnS, AB-NPog та відстаней N-S і P-PTV; відповідно у дівчат – R^2= від 0,614 до 0,801, найбільш часто до моделей входить величина кута AB-NPog, і R^2= 0,718 і 0,860, найбільш часто до моделей входять величина кутів NAPog, POr-MeGo, POr-GnS, H і відстані S-E).

Ключові слова: телерентгенографія, цефалометрія за методом Downs, юнаки та дівчата з ортогнатичним прикусом, типи обличчя, регресійний аналіз.

The study is a fragment of the research project "Features of teleradiographic indices determined by the methods of Steiner, Ricketts, Downs in persons with orthognathic occlusion depending on the type of face", state registration No. 0121U113159.

The topic of pathology of the dental-jaw system still does not lose its relevance. According to epidemiological studies, the pathology of occlusion, macrodentia, microdentia, adentia and other diseases that require orthodontic treatment cover all segments of the population [4, 12].

Thus, a survey of 700 children in Italy revealed occlusal pathology in 12 % of subjects, temporomandibular joint disorders in 14.7 % of persons, oral parafunctions in 21.3 % [9]. A 21-year analysis of orthodontic pathology in Indonesians found that the most common pathology was mandibular prognathism with open occlusion, which was observed in 46.5 % of people. A decrease in the size of the mandible was observed in 2.3 % of subjects [11].

Effective orthodontic treatment can be provided using a reliable method of planning dental procedures. This can be method of cephalometric analysis according to Downs. However, the lack of normative indicators for the Ukrainian population, taking into account such parameters as sex and face type, significantly limits its use in practical orthodontics.

The purpose of the study was to build and analyze regression models of teleradiographic indicators used in the Downs method for Ukrainian young men and young women with orthognathic occlusion and different face types.

Materials and methods. Using dental cone-beam tomography Veraviewepocs 3D Morita (Japan) in the mode of cephalometric examination conducted teleradiography of 46 young men (aged 17 to 21 years) and 72 young women (aged 16 to 20 years), who had a physiological bite as close as possible to orthognathic. Cephalometric analysis was performed using OnyxCeph³™ software, 3DPro version, Image Instruments GmbH, Germany (software license URSQ-1799).

Committee on Bioethics of National Pirogov Memorial Medical University, Vinnytsya (Minutes No. 9 of November 21, 2019) found that the studies meet the bioethical and moral requirements of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant WHO regulations and the laws of Ukraine according to Order of the Ministry of Health of Ukraine No. 281 of November 1, 2000. Cephalometric points were determined according to the recommendations of Phulari B. S. [10]. To structure a large array of metric characteristics, we used the distribution of teleradiographic indicators into three groups, proposed by Dmitriev M.O. [1]. Because the Downs technique does not contain the cranial parameters included in the first group (metric characteristics of the skull, which usually do not change during surgical and orthodontic treatment), for more informative and scientifically comprehensive of study we added the main most common measurements proposed by other authors (Schwartz A.M., 1960; Jarabak J.R., 1972; Burstone C.J., 1979, 1985; Bjork A., 1966).

The main cephalometric points and measurements belonging to the second group (indicators of the dental system, the definition of which is most often necessary to focus on when performing orthodontic treatment of patients who are in the process of growth, as well as in people with bone skeleton, which can be changed by orthognathic surgery width, length, angles and positions of the upper and lower jaws) indicators according to the method of Downs are shown in figure 1.

The main cephalometric points and measurements in the third group (indicators that actually characterize the position of each individual tooth relative to each other, cranial structures and facial soft tissue profile) indicators according to the method of Downs are shown in figure 2.

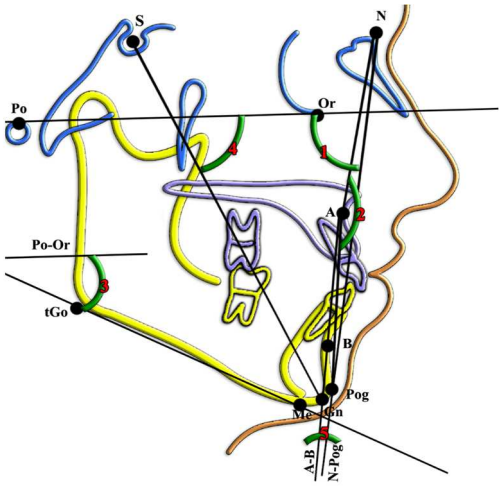

Fig. 1. The main cephalometric points and measurements according to Downs, included into the second group of indicators: 1 – angle POr_NPog (angle NPog-POr according to Ricketts – simulation of which was analyzed in a previous publication [6]) (°); 2 – angle NAPog (°); 3 – angle POr-MeGo (°); 4 – angle POr_GnS (°); 5 – angle AB-NPog (°).

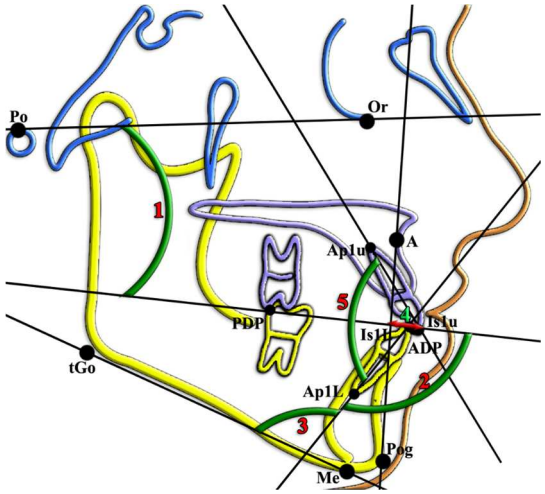

Fig. 2. The main cephalometric points and Downs measurements, which are included into the third group of indicators: 1 – angle POr-DOP (°); 2 – angle 1l-DOP (°); 3 – angle 1l-MeGo (°); 4 – distance 1u-APog (mm); 5 – angle II (angle Steiner II – the simulation of which will be analyzed in the Steiner method) (°).

To divide into facial types, the morphological index of Garson was determined [2]. The following distribution is established: young men – 5 with a very wide face, 22 with a wide face, 11 with a medium face, 8 with a narrow face; young women – 25 with a very wide face, 25 with a wide face, 10 with a medium face, 12 with a narrow face. Therefore, for further correct modeling of teleradiographic parameters by the Downs method, we studied only young men with a wide face and young women with a very wide and wide face.

To build the models, the method of step-by-step regression analysis in the licensed statistical package "Statistica 6.0" was used. The analysis took into account only regression models in which the final version of the obtained equation has a coefficient of determination R^2 not less than 0.60 (thus, the accuracy of the description of the feature being modeled is not less than 60.0 %).

Results of the study and their discussion. In young men with a wide type of face, the model of teleradiographic indicators by the method of Downs, which were included into the second group depending on the indicators of the first group have the form of the following linear equations:

– POr-MeGo (young men with a wide face type) = 106.8 – 0.754×Ar-Go – 0.615×N-S + 0.800×S-E + 0.533×P-PTV (R^2=0.856; $F_{(4.17)}$=25.30; p<0.0000; Std.Error of estimate=2.436);

– POr-GnS (young men with a wide face type) = 86.57 + 0.250×S-ar:ar-Go – 1.534×N-S – 0.665×POr-NBa + 1.512×S-E + 6.641×N-S:S-Ar′ + 0.418×N-CC (R^2=0.902; $F_{(6.15)}$=22.96; p<0.0000; Std.Error of estimate=1.488);

where, here and in the following equations, POr-MeGo – angle POr-MeGo (angle of inclination of the mandibular plane relative to the Frankfurt plane), the angle formed by the lines Po-Or and Me-tGo,

characterizes the angle of the mandibular plane relative to the Frankfurt plane (°); Ar-Go – distance Ar-Go (length of the mandibular branch according to Burstone), the distance from the point Ar to the point tGo (mm); N-S – distance N-S (length of the front part of the skull base according to Roth-Jarabak), the distance from point N to point S (mm); S-E – distance S-E (length of the back of the skull base according to Steiner), the distance from point S to the structural point E, which is located at the intersection of the perpendicular drawn from the point ppCond to the line S-N (mm); P-PTV – distance P-PTV (according to Ricketts), the distance from point Po to point Pt, determined parallel to the Frankfurt plane (mm); POr-GnS – angle POr_GnS (angle of inclination of the Y-axis relative to the Frankfurt plane), the angle formed by the lines Po-Or and S-Gn, characterizes the angle of the Y-axis relative to the Frankfurt plane (°); S-ar:ar-Go – the ratio of S-Ar and Ar-Go distances in Roth-Jarabak cephalometric analysis; POr-NBa – angle POr-NBa (angle of cranial deflection according to Ricketts), angle formed by lines Po-Or and Ba-N (°); N-S:S-Ar′ – the ratio of the distances S-Ar' and N-S in Bjork cephalometric analysis; N-CC – distance N-CC (anterior length of the base of the skull according to Ricketts), the distance from point N to point CC (mm); R^2 – coefficient of determination; $F_{(!.!!)}$=!!.!! – critical $_{(!.!!)}$ and received (!!.!!) the value of the Fisher test; St. Error of estimate – standard error of the standardized regression coefficient.

The coefficients of determination of the regression equations of the magnitude of the angles NAPog (angle of skeletal facial convexity – the angle formed by the lines N-A and A-Pog, characterizes the position of the lower jaw, namely the anterior contour of the bony chin, relative to the upper jaw, in the sagittal plane) and AB-NPog (angle of the plane A-B – the angle formed by the lines A-B and N-Pog, characterizes the position of the plane/line A-B relative to the line N-Pog) in young men with a wide face type are equal to 0.122 and 0.225 and therefore have no practical significance.

Thus, in young men with a wide type of face out of 4 possible built 2 reliable models of teleradiographic indicators by the method of Downs with a coefficient of determination higher than 0.6, which were included in the second group depending on the first group (R^2=0.856 and 0.902). The constructed models in both cases include: the value of the distances N-S (length of the anterior part of the skull base according to Roth-Jarabak) and S-E (length of the posterior part of the skull base according to Steiner).

In young women with a wide type of face among the models of teleradiographic indicators by the method of Downs, which were included in the second group depending on the indicators of the first group with a coefficient of determination above 0.60, built only 1 linear equation:

– POr-MeGo (young women with a wide face type) = 71.09 + 0.476×S-ar:ar-Go + 0.494×N-CC – 1.276×S-Ar – 0.723×H (R^2=0.778; $F_{(4.19)}$=16.69; p<0.0000; Std.Error of estimate=2.285),

where, here and in the following equations, S-Ar – distance S-Ar (length of the lateral cranial base according to Roth-Jarabak), the distance from point S to point Ar (mm); H – angle H (according to Schwartz), the angle formed by the lines Po-Or (Frankfurt plane (Fp)) and Pn (nasal perpendicular, perpendicular to the line from point N' to the line Se-N (°).

Regression equations for the magnitude of the NAPog and AB-NPog angles in young women with a wide face type are not constructed at all. The coefficient of determination of the regression equation of the angle POr-GnS in young women with a wide face type is equal to 0.586 and therefore has no pronounced practical significance.

Young women with a very wide type of face do not have models of teleradiographic indicators by the method of Downs, which were included in the second group depending on the indicators of the first group with a coefficient of determination above 0.60: coefficients of regression equations of angles NAPog, AB-NPog, POr-MeGo and POr-GnS are from 0.279 to 0.483 and therefore have no practical significance.

In young men with a wide face type, the model of teleradiographic indicators by the method of Downs, which were included in the third group depending on the indicators of the first and second groups have the form of the following linear equations:

– POr-DOP (young men with a wide face type) = 24.61 + 0.915×POr-GnS – 0.860×S-Ar – 0.269×Ar-Go – 0.301×H (R^2=0.868; $F_{(4.17)}$=27.94; p<0.0000; Std.Error of estimate=1.948);

– 1l-DOP (young men with a wide face type) = -178.8 + 2.002×N-S – 1.640×P-PTV + 1.373×NAPog + 1.710×AB-NPog (R^2=0.605; $F_{(4.17)}$=6.51; p<0.0023; Std.Error of estimate=4.268);

– 1l-MeGo (young men with a wide face type) = -109.9 – 1.737×POr-MeGo + 0.717×NAPog + 1.501×POr-GnS + 0.893×N-S (R^2=0.797; $F_{(4.17)}$=16.65; p<0.0000; Std.Error of estimate=3.771);

– 1u-APog (young men with a wide face type) = -22.58 + 0.540×NAPog + 0.827×AB-NPog – 0.340×P-PTV + 0.244×N-Se (R^2=0.606; $F_{(4.17)}$=6.53; p<0.0023; Std.Error of estimate=1.041);

where, here and in the following equations, POr-DOP – angle POr-DOP (slope of the closing plane), the angle formed by the Frankfurt plane, namely the Po-Or line and the closing plane according to Downs (OcPD), namely the line ADP-PDP, characterizes the slope of the closing plane by Downs relative to the

Frankfurt plane (°); 1l-DOP – angle 1l-DOP, the angle formed by the central axis of the lower medial incisor, namely the line Ap1L-Is1L and the closing plane by Downs (OcPD), namely the line ADP-PDP with a minus 90°, characterizes the slope of the lower median incisor relative to the closing plane (°); 1l-MeGo – angle 1l-MeGo, the angle formed by the central axis of the lower medial incisor, namely the line Ap1L-Is1L and the mandibular plane, namely the line Me-tGo with a minus 90°, characterizes the inclination of the lower medial incisor relative to the mandibular plane (°); 1u-APog – distance 1u-APog, the distance from the point Is1u, to the line A-Pog, characterizes the position of the cutting edge of the upper medial incisor in the sagittal plane relative to the line A-Pog. Takes a positive value when the cutting edge is in front of the line and negative if behind the line (mm); N-Se – distance N-Se (length of the front part of the skull base according to Schwartz), the distance from point Se to point N (mm).

Thus, in young men with a wide type of face, all 4 possible reliable models of teleradiographic indicators according to the Downs method with a coefficient of determination higher than 0.6 were included in the third group depending on the indicators of the first and second groups (R^2= from 0.605 to 0.868). The constructed models most often include: the value of the angle NAPog (18.8 %), as well as the value of the angles POr-GnS and AB-NPog and the distances N-S (length of the front of the skull base according to Roth-Jarabak) and P-PTV (according to Ricketts) (by 12.5 %).

In young women with a wide type of face models of teleradiographic indicators by the method of Downs, which were included in the third group depending on the indicators of the first and second groups have the form of the following linear equations:

– POr-DOP (young women with a wide face type) = -33.23 – 0.927×P-PTV + 0.457×POr-GnS – 0.550×S-E – 0.212×N-CC (R^2=0.801; $F_{(4.19)}$=19.14; p<0.0000; Std.Error of estimate=1.744);

– 1l-MeGo (young women with a wide face type) = -32.87 + 0.548×N-Se – 0.938×AB-NPog (R^2=0.614; $F_{(2.21)}$=16.67; p<0.0001; Std.Error of estimate=3.445);

– 1u-APog (young women with a wide face type) = 7.043 + 0.478×NAPog + 0.765×AB-NPog (R^2=0.696; $F_{(2.21)}$=24.09; p<0.0000; Std.Error of estimate=1.049).

The coefficient of determination of the regression equation of the angle 1l-DOP in young women with a wide face type is equal to 0.560 and therefore has no practical significance.

Thus, in young women with a wide face type, out of 4 possible, 3 reliable models of teleradiographic indicators were constructed according to the Downs method with a coefficient of determination higher than 0.6, which were included in the third group depending on the indicators of the first and second groups (R^2= from 0.614 to 0.801). The constructed models most often include the value of the angle AB-NPog (25.0 %).

In young women with a very wide face type, the models of teleradiographic indicators by the method of Downs, which were included in the third group depending on the indicators of the first and second groups, have the form of the following linear equations:

– 1l-DOP (young women with a very wide face type) = -195.0 + 0.590×NAPog – 1.552×POr-MeGo + 2.489×POr-GnS – 1.531×S-E + 1.403×H (R^2=0.718; $F_{(5.19)}$=9.66; p<0.0001; Std.Error of estimate=4.305);

– 1l-MeGo (young women with a very wide face type) = -181.1 + 0.778×NAPog – 2.274×POr-MeGo + 2.718×POr-GnS – 1.328×S-E + 1.085×H (R^2=0.860; $F_{(5.19)}$=23.27; p<0.0000; Std.Error of estimate=3.587).

The coefficients for determining the regression equations of the angle POr-DOP and the distance 1u-APog in young women with a very wide face type are 0.457 and 0.441 and therefore have no practical significance.

Thus, young women with a very wide face type out of 4 possible built 2 reliable models of teleradiographic indicators by the method of Downs with a coefficient of determination higher than 0.6, which were included in the third group depending on the indicators of the first and second groups (R^2=0.718 and 0.860). The constructed models in both cases include the magnitude of the angles NAPog, POr-MeGo, POr-GnS and H (according to Schwartz), as well as the distance S-E (the length of the back of the skull base according to Steiner).

It should be understood that the results of this study are part of the foundation for further research, because determining the normative values of various parameters of the dental-jaw and craniofacial areas, identifying the relationships between them allows the dentist to predict the expected outcome of treatment, to distinguish normal from pathology [3]. Adding new variables will further expand the capabilities of the orthodontist. In addition, these results can be used in other related fields, such as forensic dentistry [5].

Thus, because of regression analysis, Ukrainian researchers built reliable models of position characteristics of the central incisors of the upper and lower jaws for Ukrainian boys and girls (coefficient of determination from 0.542 to 0.796 and from 0.503 to 0.622, respectively) according to Steiner cephalometric

analysis. The authors found a relationship between the characteristics of the position of the upper central incisors (as angular, namely the angles Max1_NA, Max1_SN and linear, namely the distance 1u_NA), the angle of the lower central incisors (Mand1_NB) and the angle ANB. These data can be successfully used for the purpose of forensic identification of unidentified persons [5].

In general, the method of cephalometric analysis by Downs has been of interest to researchers for many years and this interest persists. One of the main directions of modern work is the study of ethnic features of cephalometric indicators in accordance with this method and thus its adaptation to local populations.

Vaid S. and co-authors [14] in 2018 surveyed 60 people belonging to the Mongoloid indigenous population of Himachal-Pradesh (India). Statistical analysis of the obtained results revealed that in comparison with the normative indicators for Downs, the local population has a more anterior maxillary part of the face due to the difference in the angle of convexity of the face ($p<0.01$). Regarding the manifestations of sexual dimorphism, the authors found a significant difference only for the parameter of the inclination of the occlusal plane ($p<0.01$).

However, according to various studies [7, 8, 13], taking into account ethnicity or sex alone is not sufficient and cannot meet the current problems of orthodontics, which requires, in particular, to take into account regional affiliation and facial type.

Thus, this work opens wide prospects for the confident implementation of the cephalometric method of analysis of lateral teleradiograms by the method of Downs in the routine practice of Ukrainian orthodontist, complements the theoretical knowledge base of both dentistry and anthropology and forensic dentistry.

Conclusions

1. In young men with a wide type of face by the method of Downs from 4 possible 2 reliable models of teleradiographic indicators with a coefficient of determination higher than 0.6 which entered into the second group depending on indicators of the first group (R^2=0.856 and 0.902) and all 4 models which entered the third group depending on the indicators of the first and second groups (R^2= from 0.605 to 0.868); in young women with a wide type of face – respectively 1 (R^2=0.778) and 3 (R^2= from 0.614 to 0.801) models; young women with a very wide type of face – only 2 (R^2=0.718 and 0.860) models that were included in the third group depending on the indicators of the first and second groups.

2. In young men with a wide type of face among the indicators of the first group included into the models of indicators of the second group according to the method of Downs most often include the value of the distances N-S and S-E (by 20.0 %).

3. In young men with a wide type of face among the indicators of the first and second groups included in the models of indicators of the third group by the Downs method most often include the value of angles NAPog (18.8 %), POr-GnS and AB-NPog and distances N-S and P-PTV (12.5 % each); in young women with a wide type of face – the value of the angle AB-NPog (25.0 %); in young women with a very wide type of face – the value of the angles NAPog, POr-MeGo, POr-GnS, H and the distance S-E (by 20.0 %).

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SCOLIOSIS IN ADULTS AND THE POSSIBILITY OF ITS CORRECTION BY POST-ISOMETRIC RELAXATION

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Negative factors contribute to the progression of scoliosis in adults and complicate its treatment, despite the fact that the disease usually stops developing after puberty. Therefore, it is very important to use physical therapy methods that stabilize the spine and normalize muscle tone. In order to increase the effectiveness of physical rehabilitation of adults with scoliosis, the use of post-isometric relaxation in complex physical therapy was studied. Using pain assessment methods; functional testing of the cardiovascular and respiratory systems were examined 20 patients with scoliosis, which formed the main and control groups of 10 people. It was found that the inclusion of post-isometric relaxation in physical therapy of patients of the main group had a more statistically significant positive effect on pain intensity, static endurance of back and abdominal muscles, the functional state of the cardiovascular and respiratory systems, increased well-being, activity and mood. The obtained results give grounds to recommend the inclusion of this technique in rehabilitation programs aimed at the correction and stabilization of frontal spinal deformity in this group of patients.

Key words: spine deformation, correction and stabilization of the spine, physical therapy, soft hand techniques, quality of life, static endurance of muscles.

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СКОЛІОЗ У ДОРОСЛИХ І МОЖЛИВОСТІ ЙОГО КОРЕКЦІЇ МЕТОДОМ ПОСТІЗОМЕТРИЧНОЇ РЕЛАКСАЦІЇ

Метою дослідження стало використання методу постізометричної релаксації в комплексній фізичній реабілітації дорослих людей з виявленим сколіозом і доведення його терапевтичної ефективності. Обстежено 20 хворих на сколіоз обох статей від 22 до 35 років, з яких сформовані дві групи (основна та контрольна) по 10 осіб. Встановлено**,** що включення постізометричної релаксації в програму фізичної терапії хворих основної групи достовірно знижує інтенсивність та змінює характер болю. Також в основній групі відзначено збільшення статичної витривалості м'язів спини і живота, збільшення рухливості хребта і функціональної активності м'язів тулуба, що формують ортоградну позу. За рахунок зміцнення м'язового корсету та використання постізометричної релаксації і спеціальних дихальних вправ, в основній групі більш достовірно стабілізувались показники функціонального стану серцево-судинної та респіраторної системи. В обох групах у динаміці реєструвались відновлення фізіологічного м'язового балансу, оптимізація рухового стереотипу та покращення психоемоційного стану за показниками – самопочуття, активність, настрій. Проте позитивні зміни були статистично більш виражені у пацієнтів основної групи. Комплексна фізична терапія, з включенням в програму реабілітації методики постізометричної релаксації, достовірно покращує якість життя пацієнтів з фронтальною деформацією хребта

Ключові слова: деформація хребта, корекція та стабілізація хребта, фізична терапія, м'які мануальні техніки, якість життя, статична витривалість м'язів.

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Scoliosis in the adult population is a complex and urgent problem that attracts the attention of both orthopedists, traumatologists and physical therapists. This is due to its prevalence, often severe with a negative impact not only on the functional state of the musculoskeletal system, but also on the chest and the body as a whole, as well as the complexity of treatment [1, 3].

The prevalence of scoliosis ranges from 3.2 % to 30 % of the population in different countries. In the International Classification of Diseases of the 10th revision (ICD-10) scoliosis corresponds to the rubric