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# **ВІСНИК МОРФОЛОГІЇ REPORTS OF MORPHOLOGY**

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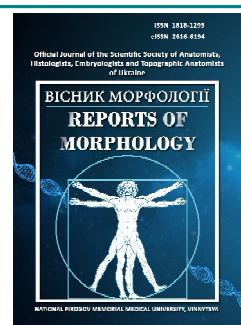




## REPORTS OF MORPHOLOGY

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# Prognostic assessment of constitutional indicators influence on the indicators of personality traits of practically healthy women with different somatotypes

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### CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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*It is known that both genetic factors and environmental influences affect the development of the human body. This statement also applies to a person's personality, in the big five - the main features that make it up. The study of the relationship between physique and personality traits among a healthy population is very relevant and is a promising area for anthropology and psychology. The purpose of the work is to conduct a prognostic assessment of the influence of anthropo-somatotypological indicators on the personality indicators in practically healthy Ukrainian women without and taking into account the somatotype. Primary anthropo-somatotypological (anthropometry according to Bunak's scheme, Heath-Carter somatotype determination, Matiegka and American Institute of Nutrition weight composition) and personality indicators (determination of leading typological characteristics of temperament according to Eysenck, psychodynamic features of personality according to Spielberger and features of accentuated personality traits according to Shmishkek, components of internality according to Rotter) of practically healthy Ukrainian women of the first mature age are selected from the data bank of materials of the research center of National Pirogov Memorial Medical University, Vinnytsya. Factor analysis was performed in the license package "Statistica 6.1". The main factors that indicate the association of personality traits of practically healthy Ukrainian women of different somatotypes with some anthropo-somatotypological indicators: mesomorphs - "the size of the girth and fat size of the body" and "the size of the longitudinal size of the body"; in ectomorphs - "the size of the girth of the body" and "the size of the fat size of the body"; in endo-mesomorphs - "the magnitude of the circumferential size of the body" and "the magnitude of the width of the mandible"; in representatives of the middle intermediate somatotype - "the magnitude of the longitudinal and circumferential dimensions of the body" and "the magnitude of SFT on the posterior surface of the shoulder." In the general group of women, it is impossible to single out the second factor that has a significant load. Analysis of the obtained relationships of interdependence of personality traits, which have the greatest prognostic value in terms of formation of human personality with anthropo-somatotypological indicators showed that women of different somatotypes identified interdependencies have certain features. Thus, the application of factor analysis made it possible to determine the most significant relationships of personality indicators with the constitutional parameters of the body in practically healthy Ukrainian women of different somatotypes.*

**Keywords:** indicators of personality traits, indicators of body structure and sizes, somatotype, practically healthy women, factor analysis.

### Introduction

The relevance of research related to the study of human mental health is growing steadily. Mankind is faced with new and new stressful events that radically change the usual way of life. An example of such an event is the COVID-

19 pandemic. In addition, we should not forget about the usual stressors associated with work, study and other social activities.

Up to 33.7% of the world's population suffers from anxiety

disorders during their lifetime, and among this group of people the most common disorder is agoraphobia [5].

Eating schedules are also widespread, especially in European countries. Anorexia nervosa is found in 1 to 4%, bulimia nervosa in 1 to 2% and subthreshold eating disorders in 2 to 3% of European women. Among these individuals, more than 70% have concomitant anxiety disorder, 40% of mood disorders and more than 20% are engaged in self-harm [12].

According to the WHO, in 2015, there were about 800,000 suicides worldwide, of which 78% occurred in low- and middle-income countries. In general, suicides account for 1.4% of all premature deaths in the world [4].

In total, the cost of treating and overcoming the effects of human depression alone is estimated by researchers at between \$30.1 billion and \$51.5 billion annually [13].

Mental health disorders place a heavy burden not only on the patients themselves but also on their families and the state as a whole. Thus, there is a need to study a person's personality, namely the main features that make it up (the so-called big five), not only in pathological conditions but also in the norm.

Various both external and internal factors affect the development of human personality. Thus, even toxoplasmosis infection has been shown to cause changes in the big five indicators [15]. The most promising, simple and proven method of research for predicting the characteristics of human personality is anthropometric [14, 18, 22, 23].

*The purpose of the study* is to conduct a prognostic assessment of the impact of anthropo-somatotypological indicators on the indicators of personality traits in practically healthy Ukrainian women without and taking into account the somatotype.

## Materials and methods

Primary anthropo-somatotypological and personality indicators of practically healthy Ukrainian women (n=101) of the first mature age (from 21 to 35 years) were selected from the database of materials of the research center of National Pirogov Memorial Medical University, Vinnytsya.

**Committee on Bioethics** of National Pirogov Memorial Medical University, Vinnytsya (protocol № 11 From 03.12.2020) found that the studies do not contradict the basic bioethical standards of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant WHO regulations and laws Of Ukraine.

Anthropometric survey was conducted according to the scheme of V.V. Bunak [6]; somatotype determination - according to the mathematical scheme of J. Carter and B. Heath [7]; determination of fat, bone and muscle components of body weight - according to the formulas of J. Matiegka [16]; in addition, the muscle component of body weight - according to the method of the American Institute of Nutrition (AIN) [19]. The following distribution of women by somatotypes was established: endomorphs - 5;

mesomorphs - 33; ectomorphs - 22; ecto-mesomorphs - 2; endo-mesomorphs - 22; the average intermediate somatotype - 17.

Individual-personal properties of the organism were determined with the help of personality questionnaires [9, 17]. The evaluation of the leading typological characteristics of temperament according to G. Eysenck included the definition (score): the indicator on the scale of extraversion-introversion (AZ\_E), the indicator on the scale of neuroticism (AZ\_N) and the indicator on the scale of insincerity (AZ\_L). Determination of psychodynamic personality traits by C.D. Spielberger in the modification of Y.L. Khanin included the definition (score): situational (reactive) anxiety (SP\_ST) and personal anxiety (SP\_LT). Assessment of the severity and features of accentuated personality traits by G. Shmishek included the definition (score): indicator of accentuation of character of hyperthymic type (SH\_G), indicator of accentuation of character of stuck type (SH\_Z), indicator of accentuation of character of emotional type (SH\_EM), indicator of accentuation of character of pedantic type (SH\_P), anxiety type accentuation index (SH\_T), cyclothymic type character accentuation index (SH\_C), demonstrative type character accentuation index (SH\_DM), excitatory type character accentuation index (SH\_V), dysthymic type character accentuation index (SH\_DC) and character accentuations of the exalted type (SH\_EK). Determination of the components of internality by J. Rotter in the modification of E.F. Bazhin, S.O. Golinkina and O.M. Etkind included the definition (stan): the indicator of the scale of general internality of the level of subjective control (USK\_1), the indicator of the level of subjective control in the field of achievements (USK\_2), the indicator of the level of subjective control in the field of failures (USK\_3), the indicator of the level of subjective control in the field of family relations (USK\_4), the indicator of the level of subjective control in the field of educational (professional) relations (USK\_5), the indicator of the level of subjective control in the field of interpersonal relations (USK\_6) and the indicator of the level of subjective control in the field of health and disease (USK\_7).

To conduct a prognostic assessment of the impact of anthropo-somatotypological indicators on the indicators of personality traits of practically healthy women used factor analysis, which was conducted in the license package "Statistica 6.1".

## Results

For factor analysis, both in women of the general group and in the division into different somatotypes, the analysis included all indicators of personality and anthropo-somatotypological parameters of the body that do not have negative values.

*In the general group of women (without division into somatotypes)*, using the analysis of the "scree plot" [2], identified 3 separate factors (Fig. 1), for which the following main characteristics were established (Table 1).

Given that the eigenvalues of all factors in the general group of women are more than 1, they all have the right to exist according to the first criterion of selection of factors. The total amount of variance is 33.70%, but the second and third "parts" of the variance, which jump from the first, are almost indistinguishable from each other, so they can be abandoned (see Table 1). The calculated loads (correlation coefficients between the initial variables and the values of the factors [2]) confirm the impossibility to identify the second factor that has significant loads in the general group of women.

In women of mesomorphic somatotype using the "scree plot" were identified 3 separate factors (Fig. 2), for which the following main characteristics are established (Table 2).

Since the eigenvalues of all factors in women of mesomorphic somatotype are more than 1, they have the right to exist according to the first criterion of selection of factors. The total amount of variance is 36.92%. Given that the third "part" of the variance by jump differs from the first and second, it can be abandoned (see Table 2).

The calculated loads allowed to identify the most significant for each factor (greater than 0.750). It was found that the *first factor* in women of mesomorphic somatotype includes body weight, shoulder girth in a tense, unstressed state, forearm in the upper part, neck, waist and all chest girth, superficial conjugate, SFT on the thigh, all components of the somatotype, fat component body weight according to Matiegka and muscle component of body weight according to AIN, and the *second* - body length, height of suprasternal, pubic and acromial anthropometric points. To maximize the scatter of load squares, we used the Varimax method for each factor [2]. Comparing the results obtained in women of mesomorphic somatotype with the previous ones, it was found that in the *first factor* in women of mesomorphic somatotype among the most significant loads remained shoulder girths in a tense, unstressed state, neck, waist and all chest girths, thighs on the thigh, all components fat component of body weight according to Matiegka, as well as added SFT on the abdomen and side. In the *second factor* in women of mesomorphic somatotype among the most significant loads remained only the length of the body, the height of the thoracic, pubic and acromial anthropometric points, and the height of the acetabular anthropometric point was added.

Thus, in women of mesomorphic somatotype, the *first factor* can be defined as "the size of the girth and fat size of the body", and the *second factor* - "the size of the longitudinal size of the body".

The obtained results allow to determine and formalize the interdependence of personality indicators with anthropo-somatotypological indicators in *practically healthy women of mesomorphic somatotype* in the form of the following relationships:  $y_{(AZ_E)} = -0.001f_1 + -0.341f_2$ ;  $y_{(AZ_N)} = -0.188f_1 + -0.143f_2$ ;  $y_{(AZ_L)} = 0.464f_1 + 0.185f_2$ ;  $y_{(SP_ST)} = -0.209f_1 + 0.042f_2$ ;  $y_{(SP_LT)} = -0.230f_1 + -0.096f_2$ ;  $y_{(SH_G)} = 0.076f_1 + -0.208f_2$ ;  $y_{(SH_Z)} = 0.205f_1 + 0.010f_2$ ;  $y_{(SH_EM)} = 0.136f_1 + -0.233f_2$ ;  $y_{(SH_P)} = -$

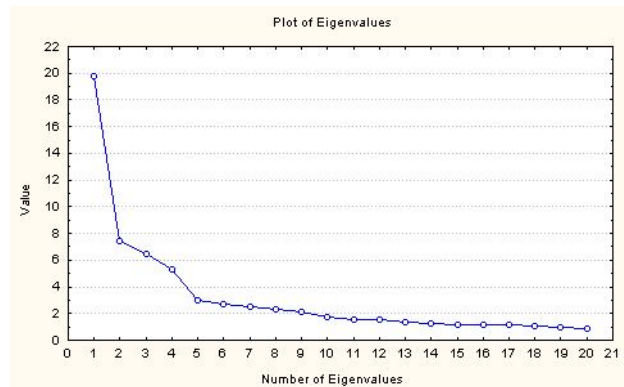


Fig. 1. Graph of selection of the number of factors using the "scree plot" in the general group of women.

Table 1. The results of primary data processing in the general group of women using factor analysis.

	Eigenval	% total Variance	Cumul. Eigenval	Cumul.%
1	19.79	25.05	19.79	25.05
2	7.405	9.374	27.19	34.42
3	6.510	8.241	33.70	42.66

Notes: here and in after: Eigenval - eigenvalues; % total Variance - % of total variance; Cumul. Eigenval - the sum of eigenvalues; Cumul.% - the accumulated percentage of variance.

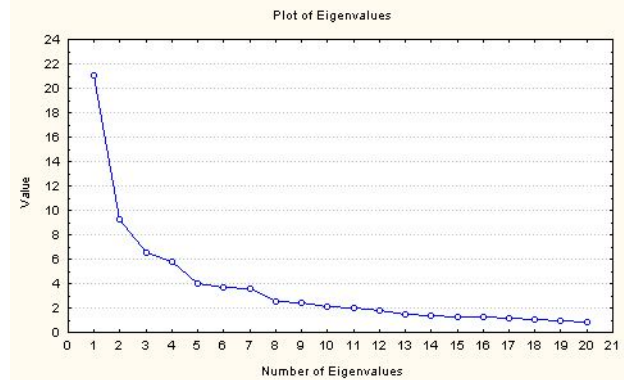
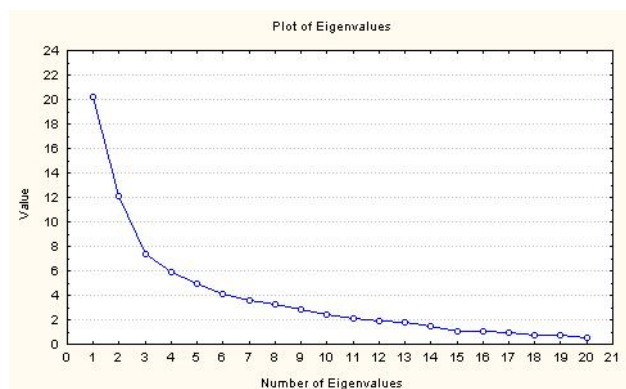


Fig. 2. Selection of the number of factors using the "scree plot" in women of mesomorphic somatotype.

Table 2. The results of primary data processing in women of mesomorphic somatotype using factor analysis.

	Eigenval	% total Variance	Cumul. Eigenval	Cumul.%
1	21.05	26.65	21.05	26.65
2	9.297	11.77	30.35	38.41
3	6.575	8.322	36.92	46.74

$0.180f_1 + -0.061f_2$ ;  $y_{(SH_T)} = -0.184f_1 + -0.282f_2$ ;  $y_{(SH_C)} = -0.250f_1 + 0.037f_2$ ;  $y_{(SH_DM)} = 0.097f_1 + -0.348f_2$ ;  $y_{(SH_V)} = -0.190f_1 + -0.340f_2$ ;  $y_{(SH_DC)} = -0.059f_1 + 0.152f_2$ ;  $y_{(SH_EK)} = -0.417f_1 + -0.248f_2$ ;  $y_{(USK_1)} = 0.087f_1 + 0.023f_2$ ;  $y_{(USK_2)} = 0.137f_1 + 0.282f_2$ ;  $y_{(USK_3)} = 0.008f_1 + 0.236f_2$ ;  $y_{(USK_4)} = 0.031f_1 + 0.310f_2$ ;  $y_{(USK_5)} = -0.065f_1 + 0.041f_2$ ;  $y_{(USK_6)} = -0.261f_1 + 0.042f_2$ ;  $y_{(USK_7)} = -0.263f_1 + -0.089f_2$ ; where, the factor  $f_1$  - should be defined as "the size of the girth and fat size of the body" (the proportion of dispersion - 21.05%) and is associated with the girth of the



**Fig. 3.** Selection of the number of factors using the "scree plot" in women of ectomorphic somatotype.

**Table 3.** The results of primary data processing in women of ectomorphic somatotype using factor analysis.

	Eigenval	% total Variance	Cumul. Eigenval	Cumul.%
1	20.17	25.54	20.17	25.54
2	12.15	15.39	32.33	40.92
3	7.402	9.370	39.73	50.29

shoulder in a tense and unstressed state, neck, waist and all the girth of the chest, abdomen, sides and thighs, all components of the somatotype and fat component of body weight according to Matiegka; factor  $f_2$  - should be defined as "the value of the longitudinal dimensions of the body" (the proportion of variance - 9.30%) and includes in its structure the length of the body, the height of the suprasternum, pubic, acromial and acetabular anthropometric points.

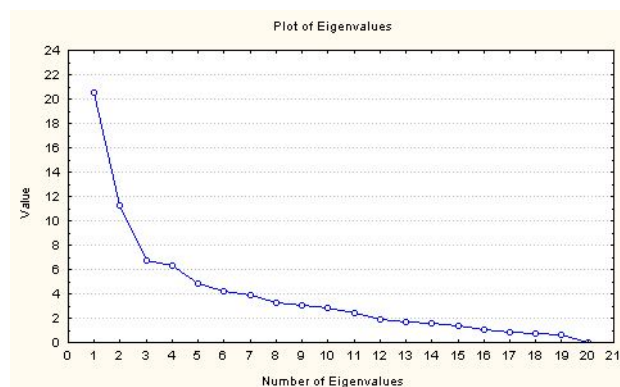
In women of ectomorphic somatotype using the "scree plot" were identified 3 separate factors (Fig. 3), for which the following main characteristics are established (Table 3). According to the first criterion of selection of factors, they all have the right to exist (the eigenvalues of all factors are more than 1). The total amount of variance in women of ectomorphic somatotype is 39.73%. Given that the third "part" of the variance by jump differs from the first and second, it can be abandoned (see Table 3).

The calculated loads allowed to identify the most significant ectomorphic somatotype in women for each factor. It was found that the *first factor* in women of ectomorphic somatotype includes body weight, shoulder girth in a tense and unstressed state, forearms and legs in the upper part, neck, waist and thighs, intertrochanteric distance, muscle component of body weight according to Matiegka and AIN, and the *second* - the height of the acetabular anthropometric point, SFT on the abdomen and the fat component of body weight. The applied Varimax method allowed to maximize the scatter of load squares for each factor. Comparing the obtained results with the previous results, it was found that both in the *first* and in the *second factor* in women of ectomorphic somatotype the magnitude of the load did not change.

Thus, in women of ectomorphic somatotype, the *first factor* can be defined as "the size of the girth of the body", and the *second factor* - "the size of the fat size of the body."

The obtained results allow to determine and formalize the interdependence of personality indicators with anthropo-somatotypological indicators in *practically healthy women of ectomorphic somatotype* in the form of the following relationships:  $y_{(AZ_E)} = 0.282f_1 + -0.445f_2$ ;  $y_{(AZ_N)} = -0.492f_1 + 0.517f_2$ ;  $y_{(AZ_L)} = -0.026f_1 + 0.010f_2$ ;  $y_{(SP_{ST})} = -0.046f_1 + 0.390f_2$ ;  $y_{(SP_{LT})} = -0.038f_1 + 0.600f_2$ ;  $y_{(SH_G)} = 0.103f_1 + -0.651f_2$ ;  $y_{(SH_Z)} = -0.007f_1 + 0.045f_2$ ;  $y_{(SH_{EM})} = -0.112f_1 + 0.326f_2$ ;  $y_{(SH_P)} = -0.436f_1 + -0.018f_2$ ;  $y_{(SH_T)} = -0.582f_1 + 0.306f_2$ ;  $y_{(SH_C)} = -0.181f_1 + 0.559f_2$ ;  $y_{(SH_{DM})} = 0.183f_1 + -0.448f_2$ ;  $y_{(SH_V)} = -0.182f_1 + 0.501f_2$ ;  $y_{(SH_{DC})} = -0.293f_1 + 0.649f_2$ ;  $y_{(SH_{EK})} = -0.224f_1 + 0.474f_2$ ;  $y_{(USK_1)} = -0.369f_1 + -0.534f_2$ ;  $y_{(USK_2)} = -0.269f_1 + -0.475f_2$ ;  $y_{(USK_3)} = -0.127f_1 + -0.375f_2$ ;  $y_{(USK_4)} = -0.481f_1 + -0.317f_2$ ;  $y_{(USK_5)} = -0.450f_1 + -0.303f_2$ ;  $y_{(USK_6)} = 0.430f_1 + -0.132f_2$ ;  $y_{(USK_7)} = -0.358f_1 + -0.024f_2$ , where, factor  $f_1$  - should be defined as "the size of the girth of the body" (the proportion of variance - 20.17%) and is related to body weight, shoulder girth in the tense and unstressed state, forearms and legs in the upper part, neck, waist and thighs, the muscular component of body weight according to Matiegka and according to AIN and intertrochanteric distance; factor  $f_2$  - should be defined as "the value of body fat size" (proportion of dispersion - 12.15%) and includes in its structure SFT on the abdomen, the fat component of body weight and the height of the acetabular anthropometric point.

In women of endo-mesomorphic somatotype using the "scree plot" were identified 3 separate factors (Fig. 4), for which the following main characteristics are established (Table 4). According to the first criterion of selection of factors, they all have the right to exist (the eigenvalues of all factors are more than 1). The total amount of variance in women of



**Fig. 4.** Selection of the number of factors using the "scree plot" in women of endo-mesomorphic somatotype.

**Table 4.** The results of primary data processing in women of endo-mesomorphic somatotype using factor analysis.

	Eigenval	% total Variance	Cumul. Eigenval	Cumul.%
1	20.48	25.92	20.48	25.92
2	11.26	14.25	31.73	40.17
3	6.770	8.569	38.50	48.74



endo-mesomorphic somatotype is 38.50%. Given that the third "part" of the variance by jump differs from the previous ones, it can be abandoned (see Table 4).

The calculated loads allowed to identify the most significant endo-mesomorphic somatotype in women for each factor. It was found that the *first factor* in women of endo-mesomorphic somatotype includes body weight, height of the acromial anthropometric point, width of the distal epiphysis of the shoulder, hip and thigh circumference, SFT at the lower angle of the shoulder blade and shin, endomorphic component of the somatotype, bone and fat components of body weight according to Matejka, and the *second* - the width of the mandible and the superficial conjugate. The applied Varimax method allowed to maximize the scatter of load squares for each factor. Comparing the results with the previous ones, it was found that in the *first factor* in women of endo-mesomorphic somatotype among the most significant loads were body weight, acromial anthropometric point height, hip and thigh girth and fat component of body weight according to Matejka, and added shoulder girth in tension and unstressed state, the forearm at the top and the muscular component of body weight according to Matejka. In the *second factor*, in women of endo-mesomorphic somatotype, only the width of the mandible remained among the most significant loads.

Thus, in women of endo-mesomorphic somatotype, the *first factor* can be defined as "the magnitude of the circumferential size of the body", and the *second factor* - "the magnitude of the width of the mandible."

The obtained results allow to determine and formalize the interdependencies of personality indicators with anthropo-somatotypological indicators in *practically healthy women of endo-mesomorphic somatotype* in the form of the following relationships:  $y_{(AZ_E)} = 0.260f_1 + -0.116f_2$ ;  $y_{(AZ_N)} = -0.159f_1 + -0.286f_2$ ;  $y_{(AZ_L)} = 0.343f_1 + 0.134f_2$ ;  $y_{(SP_ST)} = -0.151f_1 + -0.084f_2$ ;  $y_{(SP_LT)} = 0.174f_1 + -0.433f_2$ ;  $y_{(SH_G)} = 0.125f_1 + -0.295f_2$ ;  $y_{(SH_Z)} = 0.281f_1 + -0.044f_2$ ;  $y_{(SH_EM)} = -0.293f_1 + -0.220f_2$ ;  $y_{(SH_P)} = 0.115f_1 + -0.315f_2$ ;  $y_{(SH_T)} = -0.201f_1 + -0.593f_2$ ;  $y_{(SH_C)} = 0.008f_1 + 0.219f_2$ ;  $y_{(SH_DM)} = 0.007f_1 + -0.169f_2$ ;  $y_{(SH_V)} = 0.423f_1 + 0.263f_2$ ;  $y_{(SH_DC)} = -0.251f_1 + -0.190f_2$ ;  $y_{(SH_EK)} = -0.142f_1 + -0.230f_2$ ;  $y_{(USK_1)} = 0.033f_1 + 0.713f_2$ ;  $y_{(USK_2)} = -0.217f_1 + 0.590f_2$ ;  $y_{(USK_3)} = 0.356f_1 + 0.203f_2$ ;  $y_{(USK_4)} = -0.246f_1 + 0.397f_2$ ;  $y_{(USK_5)} = 0.156f_1 + 0.656f_2$ ;  $y_{(USK_6)} = 0.049f_1 + 0.235f_2$ ;  $y_{(USK_7)} = 0.120f_1 + 0.360f_2$ ; where, the factor  $f_1$  - should be defined as "the size of the circumferential size of the body" (the proportion of variance - 20.48%) and is related to body weight, shoulder girth in a tense and unstressed state, forearms in the upper part, thigh and thighs, muscles and fatty components of body weight according to Matejka and height of acromial anthropometric point; factor  $f_2$  - should be defined as "the value of the width of the mandible" (the proportion of variance - 11.26%).

In women of medium intermediate somatotype using the "scree plot" were identified 3 separate factors (Fig. 5), for which the following main characteristics are established

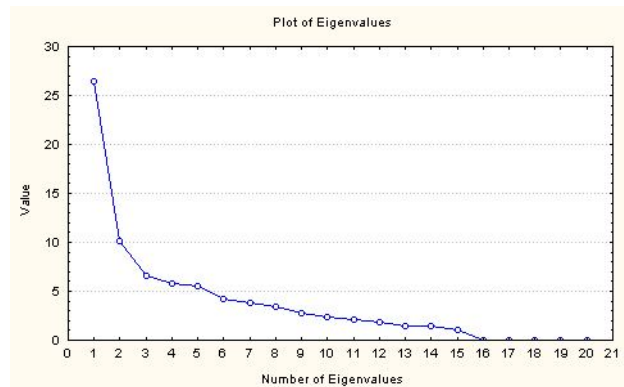


Fig. 5. Selection of the number of factors using the "scree plot" in women of intermediate somatotype.

Table 5. The results of primary data processing in women of intermediate somatotype using factor analysis.

	Eigenval	% total Variance	Cumul. Eigenval	Cumul.%
1	26.45	33.49	26.45	33.49
2	10.12	12.81	36.57	46.30
3	6.578	8.327	43.15	54.62

(Table 5). According to the first criterion of selection of factors, they all have the right to exist (the eigenvalues of all factors are more than 1). The total amount of variance in women of medium intermediate somatotype is 43.15%. Given that the third "part" of the variance by jump differs from the previous ones, it can be abandoned (see Table 5).

The calculated loads allowed to allocate in women of average intermediate somatotype for each factor the most significant. It is established that the *first factor* in women of middle intermediate somatotype includes the smallest width of the head, weight and length of the body, height of the suprasternum, pubic, acromial and acetabular anthropometric points, shoulder girth in a relaxed state, forearm in the upper part, neck, waist, waist on inhalation and at rest, intervertebral distance, superficial conjugate, muscle and bone components of body weight according to Matejka and muscle component of body weight according to AIN, and the *second* - SFT on the back of the shoulder, muscle component of somatotype and an indicator of the accentuation of the character of the exalted type according to Shmishek. The applied Varimax method allowed to maximize the scatter of load squares for each factor. Comparing the obtained results with the previous ones, it was found that in the *first factor* in women of middle intermediate somatotype the magnitude of the load did not change, only the girth of the chest on exhalation was added. In the *second factor* in women of intermediate somatotype among the most significant loads remained only SFT on the posterior surface of the shoulder.

Thus, in women of intermediate somatotype, the *first factor* can be defined as "the magnitude of the longitudinal and circumferential dimensions of the body", and the *second factor* - "the magnitude of SFT on the posterior surface of the shoulder."

The obtained results allow to determine and formalize the interdependence of personality indicators with anthropo-somatotypological indicators in *practically healthy women of average intermediate somatotype* in the form of the following relationships:  $y_{(AZ_E)} = 0.260f_1 + -0.116f_2$ ;  $y_{(AZ_N)} = -0.159f_1 + -0.286f_2$ ;  $y_{(AZ_L)} = 0.343f_1 + 0.134f_2$ ;  $y_{(SP_{ST})} = -0.151f_1 + -0.084f_2$ ;  $y_{(SP_{LT})} = 0.174f_1 + -0.433f_2$ ;  $y_{(SH_G)} = 0.125f_1 + -0.295f_2$ ;  $y_{(SH_Z)} = 0.281f_1 + -0.044f_2$ ;  $y_{(SH_{EM})} = -0.293f_1 + -0.220f_2$ ;  $y_{(SH_P)} = 0.115f_1 + -0.315f_2$ ;  $y_{(SH_T)} = -0.201f_1 + -0.593f_2$ ;  $y_{(SH_C)} = 0.008f_1 + 0.219f_2$ ;  $y_{(SH_{DM})} = 0.007f_1 + -0.169f_2$ ;  $y_{(SH_V)} = 0.423f_1 + 0.263f_2$ ;  $y_{(SH_{DC})} = -0.251f_1 + -0.190f_2$ ;  $y_{(SH_{EK})} = -0.142f_1 + -0.230f_2$ ;  $y_{(USK_1)} = 0.033f_1 + 0.713f_2$ ;  $y_{(USK_2)} = -0.217f_1 + 0.590f_2$ ;  $y_{(USK_3)} = 0.356f_1 + 0.203f_2$ ;  $y_{(USK_4)} = -0.246f_1 + 0.397f_2$ ;  $y_{(USK_5)} = 0.156f_1 + 0.656f_2$ ;  $y_{(USK_6)} = 0.049f_1 + 0.235f_2$ ;  $y_{(USK_7)} = 0.120f_1 + 0.360f_2$ ; where, the factor  $f_1$  - should be defined as "the magnitude of the longitudinal and circumferential dimensions of the body" (the proportion of dispersion - 26.45%) and is related to body weight and length, height of the suprathoracic, pubic, acromial and acetabular anthropometric points, shoulder girths in unstressed waist, upper forearms, neck, waist, thighs and all chest, muscle component of body weight according to Matiegka and AIN, minimum head width, intertrochanteric distance, superficial conjugate and bone component of body weight according to Matiegka; factor  $f_2$  - should be defined as "the value of SFT on the posterior surface of the shoulder" (the proportion of variance - 10.12%).

## Discussion

G. Armon and co-authors [3] surveyed 2664 and 1492 people with an interval of 4 years, during which they assessed sex, age, personality traits and anthropometric indicators. Statistical processing of the obtained results showed that honesty had negative correlations with three indicators of body weight; extraversion and neuroticism had positive correlations with two indicators of body weight. Among all the studied personality traits, neuroticism was most associated with an increase in body weight and openness with a decrease in women.

Examination of 756 children in the dynamics from birth to 2 years revealed the existence of a relationship between the indicators of head circumference and personality traits [8]. Higher head circumferences are associated with lower temperament control, lower speed and extraversion in boys.

Iranian scientists have found a relationship between body mass index, somatotype and temperament among military pilots [1].

After analyzing data from 3712 adults, the researchers found an interdependence between the high ratio of waist circumference to thighs and deficits in episodic memory and executive functions [10].

M. Hintsanen and others [11] using linear regression analysis found that higher search for new and lower dependence on reward are associated with higher values of BMI ( $p < 0.05$ ). In another study, regression analysis found

a significant association between EQ-5D (VAS) scores, harm avoidance and waist-to-height ratio, life event assessment (SRRS), and visceral fat percentage in women, and reward dependence and cooperativeness and ratio. waist circumference and height in men [20].

The study of young people revealed a relationship between neuroticism in women and extraversion in men and increased body weight. These relationships were similar in different racial and ethnic groups of the sample [21].

Using factor analysis, we found that in practically healthy Ukrainian women of different somatypes often associated with indicators of personality are the following constitutional factors: *in mesomorphic somatotype* - "the size of the girth and fat size of the body" (share of variance - 21.05%) and "longitudinal body size" (the share of variance - 9.297%); *in representatives of the ectomorphic somatotype* - "the size of the circumferential size of the body" (the share of dispersion - 20.17%) and "the value of fat body size" (the share of dispersion - 12.15%); *in representatives of the endo-mesomorphic somatotype* - "the value of the circumferential size of the body" (the proportion of variance - 20.48%) and "the value of the width of the mandible" (the proportion of variance - 11.26%); *in the representatives of the middle intermediate somatotype* - "the magnitude of the longitudinal and circumferential dimensions of the body" (the proportion of variance - 26.45%) and "the value of SFT on the posterior surface of the shoulder" (the proportion of variance - 10.12%). In the general group of women (without division into somatypes) it is impossible to single out the second factor which has considerable loadings.

As a result of the factor analysis of the received interrelations of interdependence of personality features indicators which have the greatest prognostic value from the point of view of formation of the person (AZ\_N, SP\_ST, SP\_LT, SH\_EM, SH\_T, SH\_DM, SH\_V, USK\_1, USK\_5 and USK\_7) with anthropo-somatotypological parameters of the body of practically healthy Ukrainian women of different somatypes found:

- *in women of mesomorphic somatotype* - with increasing shoulder girth in a tense, unstressed state, neck, waist and all girth of the chest, SFT on the thigh, abdomen and side, endomorphic component of the somatotype and fat component of body weight according to Matiegka degree of probability SP\_ST, SP\_LT, SH\_T, SH\_V, USK\_5 and USK\_7 decreases, and indicators SH\_EM, SH\_DM and USK\_1 - increases; with increasing body length, height of the suprasternum, pubic, acetabular and acromial anthropometric points, the probability of growth of AZ\_N, SP\_LT, SH\_EM, SH\_T, SH\_DM, SH\_V and USK\_7 decreases, and indicators SP\_ST, USK\_1 and USK\_5 - increases;

- *in women of ectomorphic somatotype* - with increasing body weight, shoulder girth in a tense and unstressed state, forearms and legs in the upper part, neck, waist and thighs, muscle component of body weight according to Matiegka

and AIN degree of probability of growth indicators AZ\_N, SP\_ST, SP\_LT, SH\_EM, SH\_T, SH\_V, USK\_1, USK\_5 and USK\_7 *decreases*, and SH\_DM *increases*; with an increase in SFT on the abdomen and fat component of body weight according to Matiegka, the degree of probability of growth of SH\_DM, USK\_1, USK\_5 and USK\_7 *decreases*, and indicators AZ\_N, SP\_ST, SP\_LT, SH\_EM, SH\_T and SH\_V - *increases*;

- *in women of endo-mesomorphic somatotype* - with *increasing* body weight, shoulder girth in a tense and unstressed state, forearms in the upper part, thighs and thighs, muscle component of body weight according to Matiegka, the degree of probability of increasing AZ\_N, SP\_ST, SH\_EM and SH\_T *decreases*, and indicators SP\_LT, SH\_DM, SH\_V, USK\_1, USK\_5 and USK\_7 - *increases*; with increasing width of the mandible, the degree of probability of growth of AZ\_N, SP\_ST, SP\_LT, SH\_EM, SH\_T and SH\_DM *decreases*, and indicators SH\_V, USK\_1, USK\_5 and USK\_7 - *increases*;

- *in women of intermediate somatotype* - with *increasing* body weight and length, height of the suprasternum, pubic, acromial and acetabular anthropometric points, shoulder girth in a relaxed state, forearm in the upper part, neck, waist, thighs and all chest, muscular and muscular components of body weight according to Matiegka and

muscle component of body weight according to AIN degree of probability of increase of indicators AZ\_N, SP\_ST, SP\_LT, SH\_T, SH\_DM, USK\_1, USK\_5 and USK\_7 *decreases*, and indicators SH\_EM and SH\_V - *increases*; with increasing SFT on the posterior surface of the shoulder, the degree of probability of AZ\_N, SP\_ST, SP\_LT, SH\_EM, SH\_T and USK\_5 growth *decreases*, and indicators SH\_DM, SH\_V, USK\_1 and USK\_7 - *increases*.

Thus, the application of factor analysis made it possible to determine in Ukrainian women of different somatotypes the most significant relationships of personality indicators with the constitutional parameters of the body.

## Conclusions

1. In practically healthy Ukrainian women of different somatotypes, the main constitutional factors that have a significant impact on the indicators of personality traits have been identified during the factor analysis.

2. Analysis of the obtained relationships of interdependence of constitutional parameters of the body in women of different somatotypes with indicators of personality traits that have the greatest prognostic value in terms of formation of human personality showed that the representatives of different somatotypes identified interdependencies have their own characteristics.

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**ПРОГНОСТИЧНА ОЦІНКА ВПЛИВУ КОНСТИТУЦІОНАЛЬНИХ ПОКАЗНИКІВ НА ПОКАЗНИКИ ОСОБЛИВОСТЕЙ ОСОБИСТОСТІ ПРАКТИЧНО ЗДОРОВИХ ЖІНОК РІЗНИХ СОМАТОТИПІВ**

**Андрієвський І.І., Серебреннікова О.А., Бондарь С.А., Шаюк А.В., Гунас І.В.**

Відомо, що як генетичні фактори, так і вплив зовнішнього середовища впливають на розвиток тілобудови людини. Дане твердження так само стосується і особистості людини, тобто великої п'ятірки - основних рис, що її становлять. Дослідження взаємозв'язку між показниками тілобудови та особливостей особистості людини серед здорового населення має значну актуальність і є перспективним напрямком для антропології та психології. Мета роботи - провести прогностичну оцінку впливу антропо-соматотипологічних показників на показники особливостей особистості практично здорових українських жінок без та з урахуванням соматотипу. Первинні антропо-соматотипологічні (антропометрія за схемою Бунака, визначення соматотипу за схемою Heath-Carter, визначення компонентного складу маси тіла за Matiegka та Американським інститутом харчування) та показники особливостей особистості (визначення провідних типологічних характеристик темпераменту за Eysenck, психодинамічних особливостей особистості за Spielberger, вираженості та особливості акцентуованих рис особистості за Shmishkek, складових інтернальності за Rotter) практично здорових українських жінок першого зрілого віку відібрані з банку даних матеріалів науково-дослідного центру Вінницького національного медичного університету ім. М.І.Пирогова. Факторний аналіз проведений в ліцензійному пакеті "Statistica 6.1". Встановлені головні чинники, які свідчать про асоційованість особливостей особистості практично здорових українських жінок різних соматотипів з деякими антропо-соматотипологічними показниками: у мезоморфів - "величина обхватних і жирових розмірів тіла" і "величина поздовжніх розмірів тіла"; у екторморфів - "величина обхватних розмірів тіла" і "величина жирових розмірів тіла"; у ендомезоморфів - "величина обхватних розмірів тіла" і "величина ширини нижньої щелепи"; у представниць середнього проміжного соматотипу - "величина поздовжніх і обхватних розмірів тіла" і "величина ТШЖС на задній поверхні плеча". У загальній групі жінок виділити другий фактор, що має значущі навантаження, неможливо. Аналіз отриманих взаємовідношень взаємозалежності показників особливостей особистості, які мають найбільше прогностичне значення з точки зору формування особистості людини з антропо-соматотипологічними показниками, показав, що у жінок різних соматотипів виявлені взаємозалежності мають певні особливості. Таким чином, застосування факторного аналізу надало можливість визначити найбільш значущі взаємозв'язки показників особливостей особистості з конституціональними параметрами тіла практично здорових українських жінок різних соматотипів.

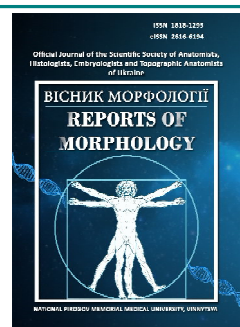
**Ключові слова:** показники особливостей особистості, показники будови та розмірів тіла, соматотип, практично здорові жінки, факторний аналіз.



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# Morphological evaluation of anal canal wound healing after combined operations for combined anorectal pathology

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The authors have no conflicts of interest to declare.

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Not applicable.

*The urgency of the problem of postoperative wound healing after combined operations for combined pathology of the anal canal and rectum is quite high and contributes to the introduction into the practice of coloproctologists of new modern surgical technologies for the treatment of this pathology. The aim of the study was to conduct a comparative morphological assessment of postoperative wound healing in patients with combined pathology of the anal canal and rectum after combined operations using modern high-frequency electrosurgical and radiosurgical technologies. The results of surgical treatment of 689 patients with combined pathology of the anal canal and rectum using high-frequency electrosurgery and radiowave surgery with morphological assessment of wound healing on 3, 5, 7, 14, 21 days of the postoperative period, which were divided into 4 study groups. Using of "Surgitron" and "KLS Martin" devices for the treatment of patients with combined pathology of the anal canal and rectum was accompanied by the formation of the thinnest layers of coagulation necrosis in tissues with a depth of  $0.189 \pm 0.085$  mm and  $0.194 \pm 0.090$  mm respectively and as result patients of the first and fourth study groups had the shortest duration of inpatient treatment, which was 3-5 days and the average time of wound healing, which was 14-15 days. Patients in these study groups had the lowest inflammatory neutrophil reaction in postoperative wounds on day 3, which rapidly disappeared by day 5, on days 7-14 they had active reparative processes with the appearance of fibroblasts and connective tissue fibers, and on 21 day squamous epithelial cells, which indicated the processes of active epithelialization of wounds. The effect on the tissues of the devices "EFA" and "ERBE ICC 200" was deeper than in the above groups, forming a layer of coagulation tissue necrosis with a depth of  $0.208 \pm 0.097$  mm and  $0.302 \pm 0.107$  mm respectively, which was accompanied by patients of the third and second study groups with longer terms of inpatient treatment, which amounted to 5-7 days and increase the duration of wound healing, which amounted to 16-19 days. Patients in the 2nd and 3rd study groups showed a more pronounced inflammatory neutrophilic reaction in postoperative wounds on the 3rd day, which did not disappear until the 5th day and in half of the cases the presence of a significant number of segmental neutrophils and bacterial accumulations persisted. On days 7-14 they had weak reparative processes with the appearance of single fibroblasts and a small number of connective tissue fibers and on the 21st day single squamous epithelial cells, which indicated slow processes of wound epithelization. Using of radio-wave surgery and high-frequency electrosurgery devices promotes active epithelialization of tissues preventing scar strictures of the anal canal and improves the rehabilitation of patients in the postoperative period.*

**Key words:** morphological evaluation, combined anorectal pathology, combined operations, high-frequency electrosurgery devices, radio-wave surgery device, wound healing.

### Introduction

The urgency of the problem of combined pathology of the anal canal and rectum is due to the rapidly growing number of proctological diseases, among which the share of combined pathology of the anal canal and rectum is

constantly growing, ranging from 35 to 65 % [12].

Over the last two decades, there has been a trend towards a significant increase in combined anorectal pathology, which requires surgical treatment. Thus, in 18-

32 % of patients admitted to proctology hospitals, there is a combination of two - three diseases of the anorectal area, which are subject to surgical treatment [2]. The most common combination of hemorrhoids with the following proctological diseases: anal fissure - 12.3-54.3 %, anal fistula - 14.2-40.1 %, anal polyp - 9-18.4 %, anal abscess - 9.9 %, anal fissure and anal polyp - 4.8 %, anal fissure and anal fistula - 1.8 % [2].

The rapid development of the latest surgical technologies has allowed the introduction of new high-tech tools for surgical treatment of various anorectal diseases in coloproctological practice. Thus, Valleylab (USA) has developed a bipolar electrothermal system "Liga Sure" for surgical treatment of hemorrhoids. This method of hemorrhoidectomy is called "closed seamless hemorrhoidectomy" [11]. The depth of thermal impact on the tissues when using this system is 2 mm, which is often accompanied by suppuration of postoperative wounds (2-15 %) [16], as well as the occurrence of strictures of the anal canal (2-9 %) [4, 17].

The ultrasonic harmonic scalpel "Ultra Cision" from Ethicon Endo-Surgery (USA), whose thermal effect on tissues does not exceed 1.5 mm, has become widely used in coloproctology [10]. But this method, according to some authors, is accompanied by prolonged healing of postoperative wounds of the anal canal (6 %) and recurrence of anorectal pathology (9.1 %) [15, 17].

Over the last decade, laser technology has become widely used in the treatment of various anorectal pathology. The advantages of these techniques are: low trauma, laser destruction within the submucosal layer, no intra- and postoperative bleeding, short operations, no inflammatory complications and postoperative scars in the area affected by the laser, reducing the duration of treatment of patients [7]. But, at the same time, according to a number of studies, laser techniques have, unfortunately, a number of disadvantages: postoperative edema in the coagulation zone (6.2-33.1 %), the formation of residual hemorrhoidal skin tags (14.5 %), long-term healing of anal canal wounds (5.6 %) [3, 6, 13].

Prolonged healing of anal canal wounds, which is often accompanied by infection, healing and the occurrence of anal strictures of inflammatory and scar nature has prompted researchers to actively local application a variety of drugs for the treatment of postoperative anal canal wounds. Thus, F. Eshghi and co-authors [5] used aloe vera cream, J.H. Kim and co-authors [8] - sitting baths with ozonated water, U. Rodríguez-Wong and co-authors [14] - topical cream diltiazem, A.K. Vejdani et al. [18] - topical sucralfate for the treatment of anal canal wounds after hemorrhoidectomy, which reduced pain and postoperative wound healing time. A.M. Kuz'minov and co-authors [9] used low-temperature argon plasma for the treatment of postoperative wounds in patients after hemorrhoidectomy, which, according to their data, reduces pain after surgery by reducing microbial contamination of wounds, improving

their healing time.

Thus, the urgency of the problem of postoperative wound healing after combined surgery for combined pathology of the anal canal and rectum is quite high and contributes to the introduction of new modern surgical technologies for the treatment of this pathology, which would have minimal tissue damage, preventing pain syndrome and would promote rapid healing of postoperative wounds, leading to rapid medical and social rehabilitation of patients.

*The aim of the study* was to conduct a comparative morphological assessment of postoperative wound healing in patients with combined pathology of the anal canal and rectum after combined operations using modern high-frequency electrosurgical and radiosurgical technologies.

### **Materials and methods**

In the period from January 2007 to June 2021, 689 patients with combined diseases of the anal canal and rectum were operated on in the proctology department of Public Non-Profit Enterprise "Khmelnitskyi regional hospital" under Khmelnytskyi Regional Council using the radio-wave surgery device "Surgitron" and the high-frequency electrosurgery devices "ERBE ICC 200", "EFA" and "KLS Martin". Among them 382 (55.4 %) patients were male and 307 (44.6 %) were female. The age of patients ranged from 18 to 76 years. All 689 patients, who were divided into 4 study groups, signed a voluntary informed consent for anesthesia and surgery, which were performed under spinal anesthesia.

**Committee on Bioethics** of the National Pirogov Memorial Medical University, Vinnytsya (protocol №3 From 16.03.2017) found that research, clinical trials are planned in accordance with the basic provisions of the GCP (1996), the Council of Europe Convention on Human Rights and Biomedicine (from 04.04.1997), the Helsinki Declaration of the World Medical Association on the ethical principles of scientific medical research with human participation (1964-2000) and the order of the Ministry of Health of Ukraine № 281 from 01.11.2000.

The first study group consisted of 245 patients with combined pathology of the anal canal and rectum, who were operated using a radio-wave surgery device "Surgitron". Of these, 143 (58.4 %) patients were male and 102 (41.6 %) were female. The age of patients ranged from 18 to 74 years.

The second study group consisted of 170 patients with combined pathology of the anal canal and rectum, who were operated using a high-frequency electrosurgery device "ERBE ICC 200". Of these, 105 (61.7 %) patients were male and 65 (38.3 %) were female. The age of patients ranged from 20 to 76 years.

The third study group consisted of 114 patients with combined pathology of the anal canal and rectum, who were operated using a high-frequency electrosurgery device "EFA". Of these, 65 (57 %) patients were male and 49 (43 %) were

female. The age of patients ranged from 24 to 72 years.

The fourth study group consisted of 160 patients with combined pathology of the anal canal and rectum, who were operated using a high-frequency electrosurgery device "KLS Martin". Of these, 64 (40 %) patients were male and 96 patients (60 %) were female. The age of patients ranged from 19 to 65 years.

After surgery using the "Surgitron" radiosurgery device, as well as "ERBE ICC 200", "EFA" and "KLS Martin" high-frequency electrosurgery devices, 30 patients from each study group underwent morphological examination of anal canal and rectal tissues to study depth of their necrosis. Measurement of the thickness of the coagulation necrosis layer was performed using an eyepiece-micrometer scale.

The operating material was fixed in 10 % neutral formalin solution. Next, the material was produced in a carousel histoprocessor type STP-120, for filling paraffin blocks used station EC-350, for cutting paraffin blocks - rotary microtome series HM - 340E, for staining histological specimens - machine Robot-Stainer HMS-740 (all devices from MICROM International GmbH). The drugs were stained with hematoxylin and eosin. An Axioskop 40 microscope with an Axio Cam MRc5 camera (Karl Zeiss) was used.

The dynamics of the wound process was assessed by cytological examination of smears from the surface of postoperative wounds on 3, 5, 7, 14 and 21 days. For this action were used cytological brushes with which the substrate was applied to slides. The material was fixed for 1 minute in the dye-fixative solution of May-Grunwald, then painted for 17 minutes with a solution of paint according to Romanovsky, washed with water and dried. Microscopy was performed with dry and immersion systems. Cytological examination was performed in 30 patients from each study group. The severity and duration of the inflammatory reaction in the wound was assessed by the number of neutrophils, the presence of dystrophic changes, the presence of macrophages, as well as the quantitative composition of the microflora. The timing of reparative signs was assessed by the appearance of cells such as histiocytes, fibroblasts, fibrocytes, as well as connective tissue fibers and squamous epithelial cells.

Statistical analysis of the obtained data was performed using IBM SPSS STATISTICS SUBSCRIPTIONAL TRIAL software. License number: L-CZAA-BHG85V. The normality check was performed using the Kolmogorov-Smirnova criteria, as amended by Lillefors. The critical level of statistical significance was 0.05. The sample size was 120 patients. Descriptive statistics of coagulation necrosis layer depth, inpatient treatment duration and wound healing time were performed using the following indicators: M - arithmetic mean, SD - standard deviation, Median, Q1-Q3 - 1st and 3rd quartiles. The distribution of variables "*Duration of inpatient treatment*" and "*Term of wound healing*" differed from normal at the level of significance  $p < 0.001$  and the distribution of variables "*Depth of coagulation necrosis layer*" did not differ from normal at the level of significance

$p = 0.200$ . The relationship between the variables "*Coagulation necrosis layer depth*" and the variables "*Duration of inpatient treatment*" and "*Wound healing time*" was analyzed using Pearson correlation coefficients ( $r$ ).

## Results

The study revealed 62 variants of combined pathology of the anal canal and rectum, among which in all 4 study groups the most common were the following 10: chronic anal fissure and anal polyp - 118 (17.1 %); chronic anal fissure and combined hemorrhoids - 85 (12.3 %); combined hemorrhoids and anal fistula - 62 (8.9 %); combined hemorrhoids and anal polyp - 61 (8.8 %); chronic anal fissure, anal polyp and hypertrophied perianal skin tags - 41 (5.9 %); combined hemorrhoids, chronic anal fissure and anal polyp - 30 (4.3 %); anal fistula and anal polyp - 24 (3.5 %); external hemorrhoids and anal polyp - 21 (3.1 %); external hemorrhoids and anal fistula - 21 (3.1 %); external hemorrhoids and chronic anal fissure - 20 (2.9 %).

The nature of the performed surgical interventions depended on the variant of combined pathology of the anal canal and rectum. The following types of combined surgical operations were performed on patients: anal fissure excision and polypectomy - 118 (17.1 %); hemorrhoidectomy and excision of the anal fissure - 85 (12.3 %); hemorrhoidectomy and excision of the anal fistula - 62 (8.9 %); hemorrhoidectomy and polypectomy - 61 (8.8 %); excision of the anal fissure, polypectomy and electroexcision of hypertrophied perianal skin label - 41 (5.9 %); hemorrhoidectomy, anal fissure excision and polypectomy - 30 (4.3 %); hemorrhoidectomy and polypectomy - 24 (3.5 %); hemorrhoidectomy and polypectomy - 21 (3.1 %); hemorrhoidectomy and excision of the anal fistula - 21 (3.1 %); hemorrhoidectomy and excision of the anal fissure - 20 (2.9 %) patients.

During the morphological study it was found that the use of radiosurgery device "Surgitron" in patients of the first study group contributed to the preservation of tissue structure with the formation of the thinnest layer of coagulation necrosis among all study groups, the average depth of which was  $0.189 \pm 0.085$  mm. When using the high-frequency electrosurgical device "KLS Martin" in patients of the fourth study group, there is also preservation of tissue structure with the formation of a thin layer of coagulation necrosis along the incision edge, which is slightly deeper than in the first group with thickness  $0.194 \pm 0.090$  mm. After using of high-frequency electrosurgery device "EFA" in patients of the third study group formed a deeper layer of coagulation necrosis than in the first and fourth groups, the average thickness of which was  $0.208 \pm 0.097$  mm. The use of high-frequency electrosurgical device "ERBE ICC 200" in patients of the second study group was accompanied by the formation of the deepest layer of coagulation necrosis among all groups, the average thickness of which was  $0.302 \pm 0.107$  mm.

Comparative characteristics of the depth of coagulation

**Table 1.** Comparative characteristics of using of modern radiosurgical and high-frequency electrosurgical technologies in the treatment of combined diseases of the anal canal and rectum.

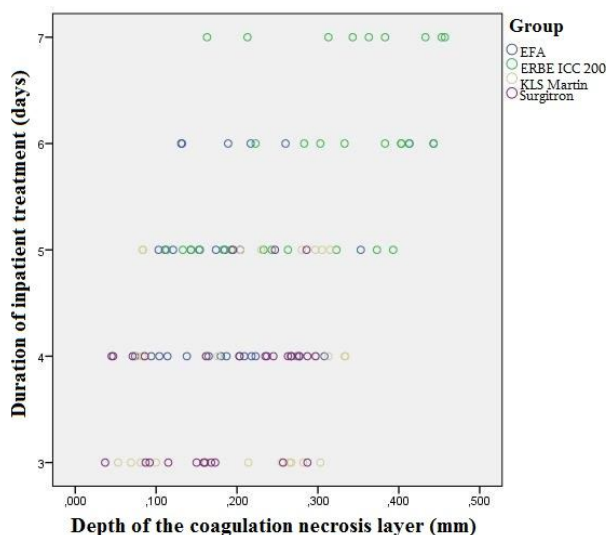
Group	N	Depth of coagulation necrosis layer (mm)		Inpatient treatment duration (days)		Wound healing time (days)	
		M	SD	Me	Q1-Q3	Me	Q1-Q3
EFA	30	0.208	0.097	5	4-5	17	16-17
ERBE ICC 200	30	0.302	0.107	6	5-7	19	18-19
KLS Martin	30	0.194	0.090	4	3-5	15	15-15
Surgitron	30	0.189	0.085	4	3-4	15	14-15
General sample	120	0.223	0.104	5	4-6	16	15-18

**Note:** N - sample volume, M - arithmetic mean, SD - standard deviation, Me - median, Q1-Q3 - 1st and 3rd quartiles.

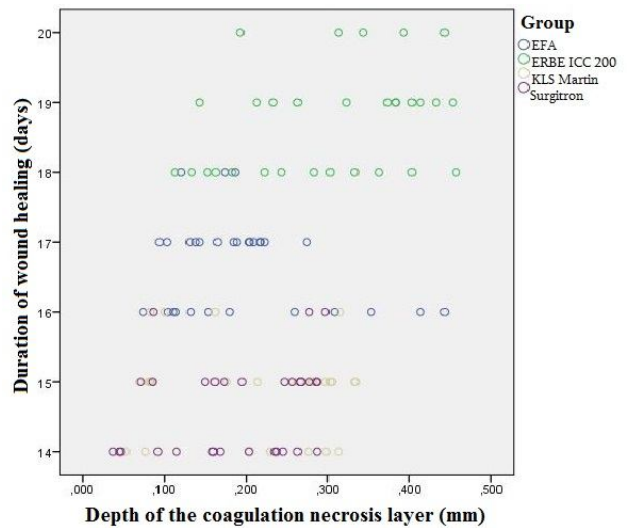
necrosis layer, inpatient treatment duration and wound healing time with using of radiosurgery device "Surgitron", high-frequency electrosurgery devices "ERBE ICC 200", "EFA" and "KLS Martin" in surgical treatment of patients with combined diseases of anal canal and rectum are given in (Table 1).

During the correlation analysis between the variables "Duration of inpatient treatment" and "Depth of coagulation necrosis layer" it was found that the correlation between them is direct (with increasing one variable increases and the second), which is reflected in (Fig. 1). The mean force correlation, Pearson's correlation coefficient  $r=0.485$  (95 % CI: 0.440-0,680), is statistically significantly different from zero ( $p<0.001$ ).

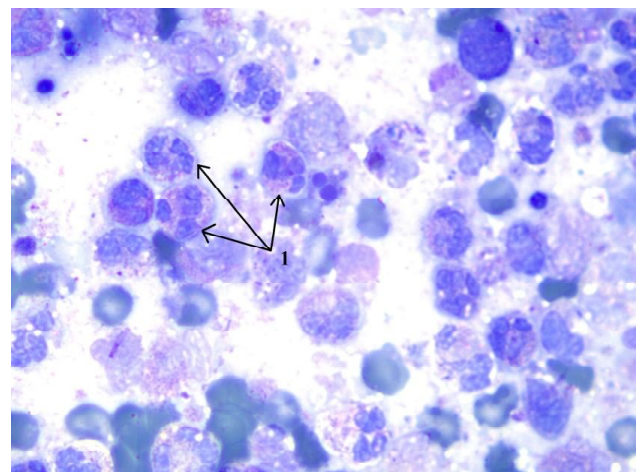
During the correlation analysis between the variables "Duration of wound healing" and "Depth of coagulation



**Fig. 1.** Skaterograms for the entire sample in 120 patients. The color of the dot corresponds to the device used. The line diagrams show a direct linear correlation between the depth of the coagulation necrosis layer and the duration of inpatient treatment.



**Fig. 2.** Skaterograms for the entire sample in 120 patients. The color of the dot corresponds to the device used. The line diagrams show a direct linear correlation between the depth of the coagulation necrosis layer and the duration of wound healing.



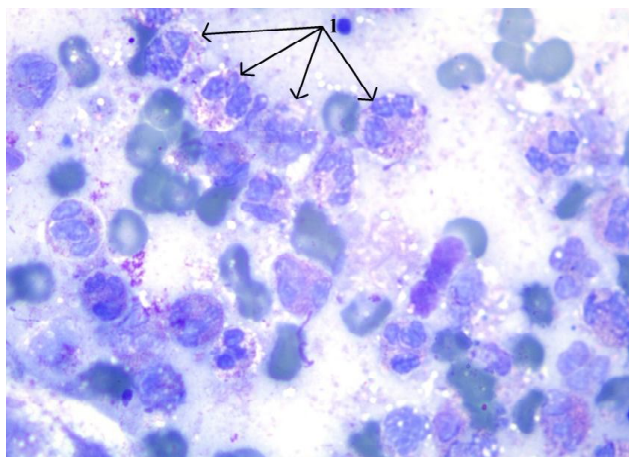
**Fig. 3.** Cytogram of smears from the wound surface for 3 days after surgery using the device "ERBE ICC 200". 1 - a large number of segmental neutrophils, the phenomenon of incomplete phagocytosis. Coloring by Romanovsky. x1000.

necrosis layer" it was found that the correlation between them is also direct (with increasing one variable increases and the second), which is reflected in (Fig. 2). The mean force correlation, Pearson's correlation coefficient  $r=0.376$  (95 % CI: 0.227-0.620), is statistically significantly different from zero ( $p<0.001$ ).

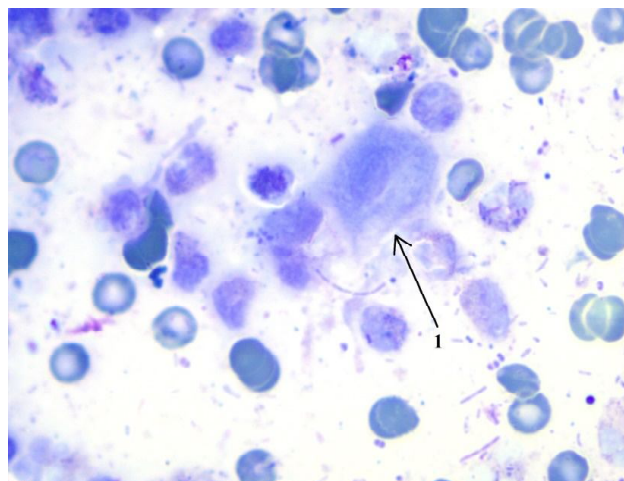
On the 3rd day after surgery, cytological examination of smears from the surface of postoperative wounds showed an inflammatory reaction of neutrophilic nature, which was more pronounced in the study groups, which used for surgical treatment of high-frequency electrosurgery "ERBE ICC 200" and "EFA" than in the study groups using "KLS Martin" high-frequency electrosurgery and "Surgitron" radiosurgery (Fig. 3-5).

During the analysis of smears from postoperative

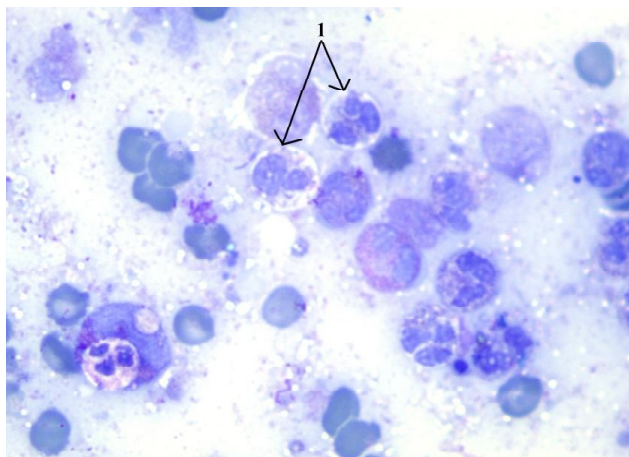




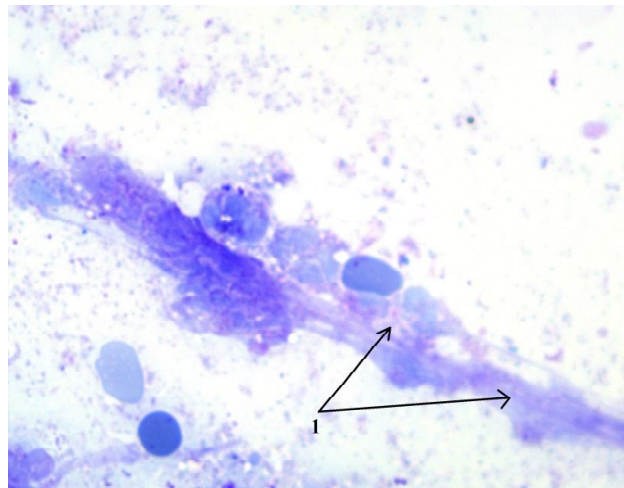
**Fig. 4.** Cytogram of smears from the wound surface for 3 days after surgery using the device "EFA". 1 - a large number of elements of neutrophilic inflammation, the phenomenon of incomplete phagocytosis. Coloring by Romanovsky. x1000.



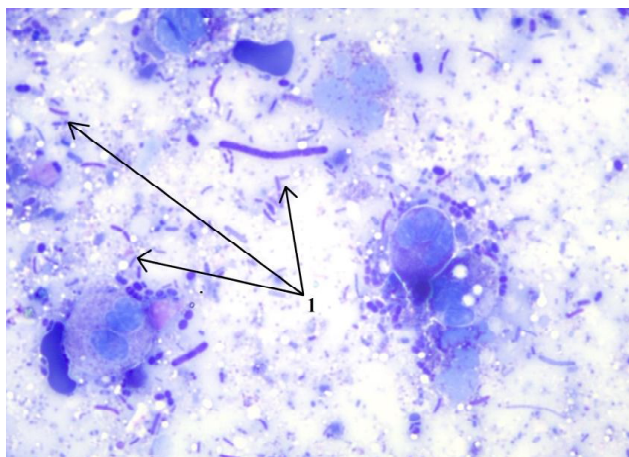
**Fig. 7.** Cytogram of smears from the wound surface for 5 days after surgery using the device "Surgitron". 1 - proliferation of mononuclear histiocytes. Coloring by Romanovsky. x1000.



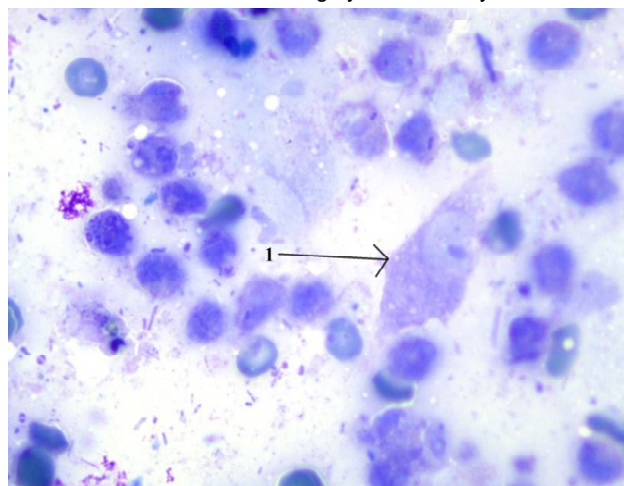
**Fig. 5.** Cytogram of smears from the wound surface for 3 days after surgery using the device "Surgitron". 1 - the presence of segmental neutrophils in smaller numbers (compared to the groups using the devices "ERBE ICC 200" and "EFA"), the phenomenon of incomplete phagocytosis. Coloring by Romanovsky. Coll. x1000.



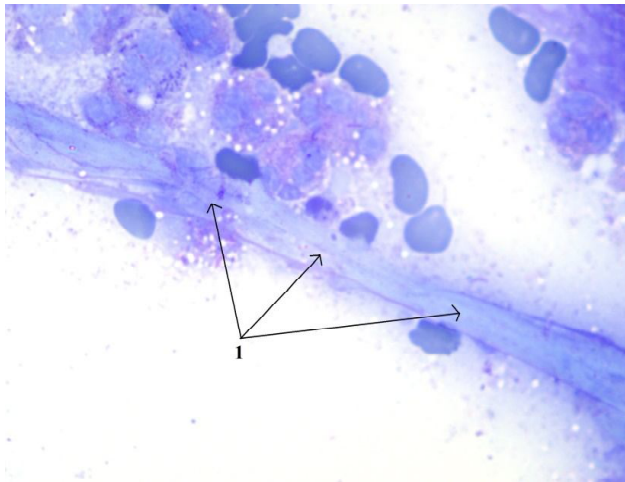
**Fig. 8.** Cytogram of smears from the wound surface on the 7th day after surgery using the device "KLS Martin". 1 - loose connective tissue fibers. Coloring by Romanovsky. x1000.



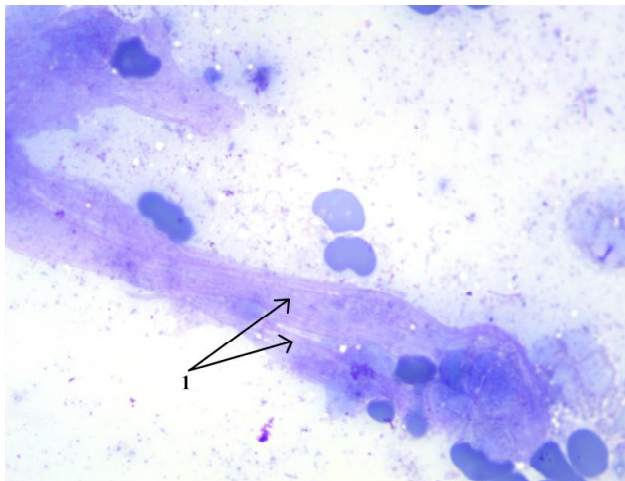
**Fig. 6.** Cytogram of smears from the wound surface for 5 days after surgery using the device "ERBE ICC 200". 1 - the presence of bacterial accumulations. Coloring by Romanovsky. x1000.



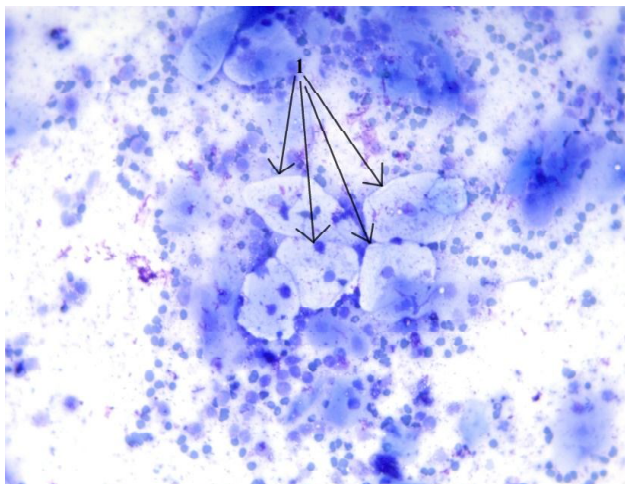
**Fig. 9.** Cytogram of smears from the wound surface on the 14th day after surgery using the device "KLS Martin". 1 - fibroblast. Coloring by Romanovsky. x1000.



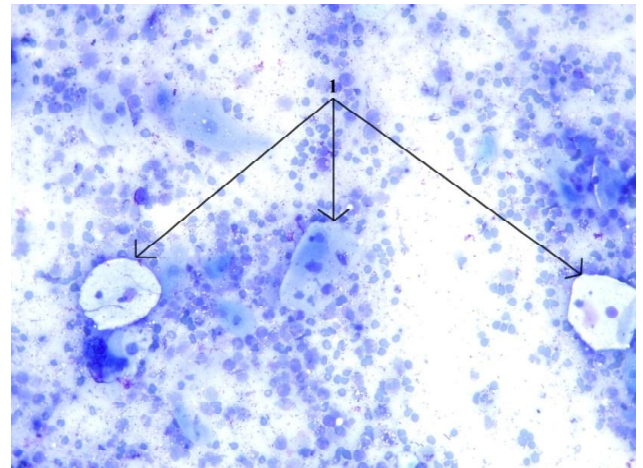
**Fig. 10.** Cytogram of smears from the wound surface on the 14th day after surgery using the device "Surgitron". 1 - connective tissue fibers. Coloring by Romanovsky. x1000.



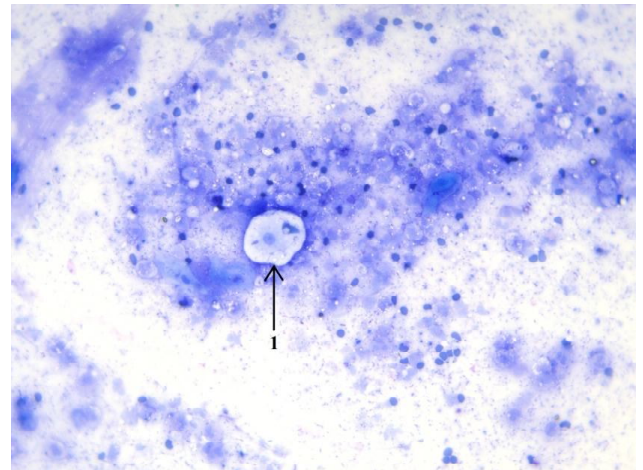
**Fig. 11.** Cytogram of smears from the wound surface on the 14th day after surgery using the device "KLS Martin". 1 - connective tissue fibers. Coloring by Romanovsky. x1000.



**Fig. 12.** Cytogram of smears from the wound surface for 21 days after surgery using the device "KLS Martin". 1 - cells of mature multilayered squamous epithelium. Coloring by Romanovsky. x400.



**Fig. 13.** Cytogram of smears from the wound surface for 21 days after surgery using the device "Surgitron". 1 - cells of mature multilayered squamous epithelium. Coloring by Romanovsky. x400.



**Fig. 14.** Cytogram of smears from the wound surface for 21 days after surgery using the device "ERBE ICC 200". 1 - cells of mature multilayered squamous epithelium. Coloring by Romanovsky. x400.

wounds on the 5th day in patients of the 1st and 4th study groups, which used devices of high-frequency electrosurgery "KLS Martin" and radio-wave surgery "Surgitron" no pronounced inflammatory infiltration was observed, while in the 2nd and the 3rd group of high-frequency electrosurgery devices "ERBE ICC 200" and "EFA" in half of the cases the presence of a significant number of segmental neutrophils and bacterial accumulations was preserved, which caused slower wound healing processes (Fig. 6).

In the 1st and 4th groups of patients who underwent surgery using high-frequency electrosurgery devices "KLS Martin" and radiowave surgery "Surgitron" on the 5th day after surgery, the appearance of mononuclear histiocytes (Fig. 7), and on the 7th day - loose connective tissue fibers (Fig. 8), which indicates the appearance of granulation tissue, which is a sign of reparative changes. In the 2nd and 3rd groups of patients operated with high-frequency electrosurgery devices "ERBE ICC 200" and "EFA",

histiocytes were not observed in smears on the 5th day after surgery and connective tissue fibers were found in isolated cases on the 7th day.

On the 14th day of the postoperative period all patients of the 1st and 4th groups with using of high-frequency electrosurgery "KLS Martin" and radio-wave surgery "Surgitron" appear immature connective tissue elements - fibroblasts with large nuclei and cytoplasmic processes (Fig. 9). Also, in all preparations of patients of these groups on the 14th day there were a number of connective tissue fibers, which are actually synthesized by fibroblasts (Fig. 10, 11). In patients of the 2nd and 3rd groups with the use of high-frequency electrosurgery devices "ERBE ICC 200" and "EFA" on the 14th day of the postoperative period fibroblasts appeared only in isolated cases respectively and connective tissue fibers were found in a much smaller number of drugs.

On the 21st day after surgery epithelial cells with small nuclei and a significant amount of cytoplasm were found in the smears of most patients of the 1st and 4th groups using "KLS Martin" high-frequency electrosurgery and "Surgitron" radiosurgery devices, which was a sign of epithelialization processes (Fig. 12, 13). In patients operated with high-frequency electrosurgery devices "ERBE ICC 200" and "EFA" cells of mature squamous epithelium were found in a small number of cases, often in the form of single cells (Fig. 14).

## Discussion

The use of "Surgitron" radio-frequency surgery and "KLS Martin" high-frequency electrosurgery devices for the treatment of patients with combined pathology of the anal canal and rectum was accompanied by the formation of the thinnest layers of coagulation necrosis in tissues with deepness of  $0.189 \pm 0.085$  mm and  $0.194 \pm 0.090$  mm respectively, resulting the patients of the first and fourth study groups had the shortest duration of inpatient treatment, which was 3-5 days and the average time of wound healing, which was 14-15 days. Patients in these study groups had the lowest inflammatory neutrophil reaction in postoperative wounds on day 3, which rapidly disappeared by day 5, on days 7-14 they had active reparative processes with the appearance of fibroblasts and connective tissue fibers, and on 21 day of squamous epithelial cells, which indicated the processes of active epithelialization of wounds.

The effect on the tissues of high-frequency electrosurgery devices "EFA" and "ERBE ICC 200" was deeper than in the above groups, forming a layer of coagulation tissue necrosis with a depth of  $0.208 \pm 0.097$  mm and  $0.302 \pm 0.107$  mm, respectively, which was accompanied by patients of the third and second study groups with longer terms of inpatient treatment, which amounted to 5-7 days and increasing the time of wound healing, which amounted to 16-19 days. Patients in the 2nd and 3rd study groups showed a more pronounced

inflammatory neutrophilic reaction in postoperative wounds on the 3rd day, which did not disappear until the 5th day and in half of the cases the presence of a significant number of segmental neutrophils and bacterial accumulations persisted, which led to slower wound healing processes. On days 7-14 they had weak reparative processes with the appearance of single fibroblasts and a small number of connective tissue fibers and on the 21st day single squamous epithelial cells, which indicated slow processes of wound epithelialization.

The obtained results indicate that the use of the above modern radiosurgical and high-frequency electrosurgical technologies is accompanied by a much smaller depth of coagulation necrosis than the use of devices "Liga Sure", "Ultra Cision", the depth of which on tissues according to some authors is from 1.5 mm to 2 mm [10, 16], which causes the formation of a delicate elastic scar, preventing the occurrence of scar strictures of the anal canal and improves the rehabilitation of patients in the postoperative period.

Application of radio-wave surgery device "Surgitron" and high-frequency electrosurgery devices "ERBE ICC 200", "EFA" and "KLS Martin" due to the minimal and insignificant depth of coagulation tissue necrosis significantly reduces the inflammatory reaction in postoperative anal canal wounds, which disappears on 3-5 day, helping to reduce the time of their healing, while according to some authors, inflammatory changes in the wounds of the anal canal can last up to 14-15 days [1].

## Conclusions

1. Using of radio-wave surgery device "Surgitron" and high-frequency electrosurgery device "KLS Martin" during combined operations in patients with combined anal and rectal pathology is accompanied by the least damaging effect on tissues, contributing to the formation of a thin layer of coagulation necrosis with deepness of  $0.189 \pm 0.085$  mm and  $0.194 \pm 0.090$  mm respectively, reducing the duration of inpatient treatment of patients to 3-5 days and the average time of wound healing to 14-15 days.

2. Application of high-frequency electrosurgical devices "EFA" and "ERBE ICC 200" during combined operations in patients with combined pathology of the anal canal and rectum is accompanied by a slightly greater damaging effect on tissues, contributing to the formation of a deeper layer of coagulation necrosis with a depth of  $0.208 \pm 0.097$  mm and  $0.302 \pm 0.107$  mm respectively, increasing the duration of inpatient treatment of patients to 5-7 days and the average time of wound healing to 16-19 days.

3. Application of radio-wave surgery device "Surgitron" and high-frequency electrosurgery devices "ERBE ICC 200", "EFA" and "KLS Martin" due to the minimal and insignificant depth of coagulation necrosis of tissues promotes their active epithelialization, preventing the occurrence of scar strictures of the anal canal and improves the rehabilitation of patients in the postoperative period.

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## МОРФОЛОГІЧНА ОЦІНКА ЗАГОЄННЯ РАН АНАЛЬНОГО КАНАЛУ ПІСЛЯ КОМБІНОВАНИХ ОПЕРАЦІЙ З ПРИВОДУ ПОЄДНАНОЇ АНОРЕКТАЛЬНОЇ ПАТОЛОГІЇ

Балицький В.В.

Актуальність проблеми загоєння післяопераційних ран після комбінованих операцій з приводу поєднаної аноректальної патології є досить високою і сприяє впровадженню в практику колопроктологів нових сучасних хірургічних технологій для лікування цієї патології. Метою дослідження було проведення порівняльної морфологічної оцінки загоєння післяопераційних ран у пацієнтів з поєднаною патологією анального каналу і прямої кишки після комбінованих операцій з використанням сучасних високочастотних електрохірургічних та радіохірургічних технологій. Проаналізовані результати хірургічного лікування 689 пацієнтів з поєднаною патологією анального каналу і прямої кишки з використанням апаратів високочастотної електрохірургії та радіохвильової хірургії з морфологічною оцінкою загоєння ран на 3, 5, 7, 14, 21 добу післяопераційного періоду, які були розподілені на 4 досліджувані групи. Застосування апаратів "Surgitron" та "KLS Martin" для лікування хворих на поєднану патологію анального каналу і прямої кишки супроводжувалось утворенням найтонших шарів коагуляційного некрозу в тканинах, глибиною  $0,189 \pm 0,085$  мм та  $0,194 \pm 0,090$  мм відповідно, внаслідок чого у пацієнтів першої та четвертої досліджуваних груп були найменшими терміни стаціонарного лікування, котрі становили 3-5 днів та середні терміни загоєння ран, котрі становили 14-15 днів. У пацієнтів цих досліджуваних груп відмічалась найменша запальна нейтрофільна реакція

в післяопераційних ранах на 3 добу, яка швидко зникла до 5 доби, на 7-14 добу у них відмічались активні репаративні процеси з появою фібробластів та волокон сполучної тканини, а на 21 добу клітин плоского епітелію, що свідчило про активну епітелізацію рани. Вплив на тканини апаратів "ЭФА" та "ERBE ICC 200" був глибшим, ніж у вищенаведених групах, утворюючи шар коагуляційного некрозу тканин глибиною  $0,208 \pm 0,097$  мм та  $0,302 \pm 0,107$  мм відповідно, що супроводжувалось у пацієнтів третьої та другої досліджуваних груп більшими термінами стаціонарного лікування, котрі становили 5-7 діб та збільшенням виражена запальна нейтрофільна реакція в післяопераційних ранах, котра не зникла до 5 доби і у половині випадків зберігалась як наявність значної кількості сегментоядерних нейтрофілів, так і скупчень бактерій. На 7-14 добу у них відмічались слабкі репаративні процеси з появою поодиноких фібробластів та невеликої кількості волокон сполучної тканини, а лише на 21 добу поодинокі клітини плоского епітелію, що свідчило про повільну епітелізацію рани. Застосування апарату радіохвильової хірургії та апаратів високочастотної електрохірургії сприяє активній епітелізації тканин, запобігаючи виникненню рубцевих стриктур анального каналу, і покращує терміни реабілітації пацієнтів у післяопераційному періоді.

**Ключові слова:** морфологічна оцінка, поєднана аноректальна патологія, комбіновані операції, апарати високочастотної електрохірургії, апарат радіохвильової хірургії, загоєння ран.

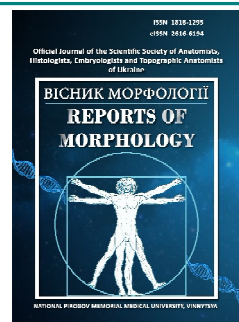
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## Girth body dimensions in men and women with seborrheic dermatitis of varying severity

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Today in modern medicine the study of human health is reoriented to the individual principle, which is based on the identification and study of constitutionally determined patterns of manifestation of certain diseases. The purpose of the study is to establish and analyze the features of the girth body sizes in men and women with generalized fatty form of seborrheic dermatitis of varying severity. The comprehensive body size of 40 men and 40 young women (25–44 years) with generalized fatty seborrheic dermatitis (mild and severe) was determined. The control group consisted of the girth sizes of practically healthy men ( $n=82$ ) and women ( $n=154$ ) of the same age group, which were selected from the database of the research center National Pirogov Memorial Medical University. Statistical processing of body circumference was performed in the licensed package "Statistica 6.0" using non-parametric evaluation methods. As a result of studies in patients with seborrheic dermatitis of varying severity of men, compared with practically healthy men, found only greater values of the girth of the shoulder in a relaxed state and thighs, neck (only mild), shin in the upper part and waist (in both cases only with a severe degree), as well as smaller values of the girth of the shoulder in a tense state; and in patients of varying severity of women - greater values of the girth of the shoulder in a relaxed state, thighs, lower legs, neck, waist and all girths of the chest and both thighs (only severe), as well as smaller values of the girth of the hand (only with mild). In both men and women with seborrheic dermatitis, differences in girth body sizes are more pronounced in people with severe disease. Between men or women with seborrheic dermatitis of varying severity, there are no significant or trends in differences in girth body sizes. In the analysis of the manifestations of sexual dimorphism of the circumferential body size between men and women with seborrheic dermatitis found greater values in men with mild and severe disease of the upper extremities, hands, shin, feet and neck (in most cases more pronounced in representatives with mild severity), as well as only in men with mild severity - greater values of all chest girths. For a more correct understanding of changes in girth body sizes in Ukrainian men or women with seborrheic dermatitis of varying severity, it is necessary to analyze other constitutional parameters of the body.

**Keywords:** seborrheic dermatitis, Ukrainian men and women, girth body sizes, sex differences.

### Introduction

The problem of diseases with a chronic long course is currently quite relevant in both theoretical and practical terms [2, 7].

Seborrheic dermatitis belongs to multifactorial diseases with complex and multifaceted pathogenesis. The work of recent years reflects the participation in the pathogenesis of dermatosis of almost all integrating systems of the body and the main parts of its basic functional systems. Both exogenous (physicochemical,

biological) and endogenous (nervous system, genetic predisposition and immune disorders) factors are involved in the phenotypic manifestation of this disease. The pathogenetic mechanisms of dermatitis are polymorphic and do not contradict, but complement each other [1, 4, 16].

Given the most common manifestation of seborrheic dermatitis in young working age and in a third of cases severe, continuously recurrent course, the presence of

many therapeutic approaches, none of which guarantees the effect of treatment and the absence of recurrence, there is a need to seek prognostic exacerbations [13, 19, 20].

Constitutional diagnosis is an important step in solving the problems of medical anthropology and in the clinic of dermatological diseases in particular. Today it is impossible to predict the possibility of development and features of the pathological processes in a particular patient without taking into account his body type and anthropometric indicators. After all, the somatotype is genetically determined and is characterized by a certain level and feature of metabolism, psychophysiological processes, the predominant development of muscle, bone or adipose tissue, susceptibility to certain diseases [11, 12].

In the literature there are works in which the predisposition to diseases of the skin and its appendages has been studied. The existence of dependence of predisposition to psoriasis, acne, atopic dermatitis on body size indicators has been proved [5, 10, 17]. It is noted that people with overweight are more likely to suffer from seborrheic dermatitis, and men with this pathology have less growth and more pronounced centralization of fat deposits compared to the control group [6].

In the studied literature we did not find the results of anthropological studies of comprehensive body size in men and women with seborrheic dermatitis of varying severity living in Ukraine, and data from other countries are few and often contradictory, indicating the need for research in this area.

*The purpose of the study* is to establish and analyze the features of the girth body sizes in men and women with generalized fatty form of seborrheic dermatitis of varying severity.

### Materials and methods

On the basis of the Department of Dermatology and Venereal Diseases with a postgraduate course in National Pirogov Memorial Medical University and the Military Medical Clinical Center of Central conducted a survey of 40 men and 40 young women (25-44 years according to WHO age periodization, 2015) patients with generalized fatty seborrheic dermatitis (mild and severe).

**Committee on Bioethics** of National Pirogov Memorial

Medical University, Vinnytsya (protocol № 10 From 26.11.2020) found that the studies do not contradict the basic bioethical standards of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant WHO regulations and laws Of Ukraine.

Diagnosis of diabetes was established on the basis of complaints of the subject, life history and illness, examination of the face, scalp, torso and extremities with the assessment of subjective and objective signs of the disease.

Anthropometric survey was conducted according to the scheme of Bunak V. V. [3]. Measurements of the girth dimensions of the body were performed using a centimeter tape with an accuracy of 0.5 cm (after every 100 measurements, the centimeter tape was changed to a new one). Measured: tensile shoulder girth (OBPL1), unstressed shoulder girth (OBPL2), upper forearm girth (OBPR1), lower forearm girth (OBPR2), hand girth (OBK), thigh girth (OBB), both thigh girth (OBBS), shin girth at the top (OBG1), shin girth at the bottom (OBG2), foot girth (OBS), neck girth (OBSh), waist girth (OBT), chest girth on breath (OBGK1), exhalation chest girth (OBGK2), and resting chest girth (OBGK3). During the procedure, certain requirements were observed: control of posture, breathing, muscle relaxation, measurement by the largest or smallest circumference.

The control group consisted of anthropometric data of practically healthy men (n=82) and women (n=154) of the same age group, which were selected from the database of the research center National Pirogov Memorial Medical University.

Statistical processing of body circumference was performed in the licensed package "Statistica 6.0" using non-parametric evaluation methods. The reliability of the difference between the values between the independent quantitative values was determined using the Mann-Whitney U-test.

### Results

Table 1 presents the results of a comparison of the girth body size between healthy and patients with mild and severe seborrheic dermatitis of men and/or women.

**Table 1.** Comparison of girth body sizes between healthy and patients with seborrheic dermatitis of varying severity in men and/or women (M±σ).

Indicators	Healthy men (n=82)	Men suffer from seborrheic dermatitis		P <sub>h-md</sub>	P <sub>h-sd</sub>	P <sub>md-sd</sub>
		MD (n=20)	SD (n=20)			
OBPL1	33.23±2.84***	31.40±2.76t	32.48±4.45*	<0.05	=0.082	>0.05
OBPL2	30.17±2.94***	33.68±2.51**	34.35±4.67*	<0.001	<0.001	>0.05
OBPR1	27.33±2.01***	26.78±1.74***	27.45±2.32***	>0.05	>0.05	>0.05
OBPR2	17.44±1.24***	17.40±0.94***	17.15±1.26**	>0.05	>0.05	>0.05
OBK	21.39±1.22***	21.50±1.49***	21.40±1.19***	>0.05	>0.05	>0.05
OBB	53.25±4.49	56.00±3.87	56.25±6.69	<0.05	=0.081	>0.05

Continuation of table 1.

Indicators	Healthy men (n=82)	Men suffer from seborrheic dermatitis		P <sub>h-md</sub>	P <sub>h-sd</sub>	P <sub>md-sd</sub>
		MD (n=20)	SD (n=20)			
OBBB	95.04±6.39	96.00±5.79	96.80±8.31	>0.05	>0.05	>0.05
OBG1	36.43±2.91***	36.33±3.71	36.63±4.76	>0.05	>0.05	>0.05
OBG2	23.41±1.87***	24.13±2.21*	24.43±2.42*	>0.05	<0.05	>0.05
OBS	24.96±1.46***	24.78±1.04***	24.45±1.34*	>0.05	>0.05	>0.05
OBSH	37.67±1.92***	38.63±1.96***	38.18±2.96***	=0.055	>0.05	>0.05
OBT	79.48±7.32***	80.10±20.14	86.18±14.69	>0.05	=0.093	>0.05
OBGK1	100.0±6.0***	100.3±7.5*	100.8±11.0	>0.05	>0.05	>0.05
OBGK2	93.18±6.39***	93.80±9.26*	94.70±10.62	>0.05	>0.05	>0.05
OBGK3	95.20±6.57***	96.25±8.72*	97.35±11.02	>0.05	>0.05	>0.05
Indicators	Healthy women (n=154)	Women suffer from seborrheic dermatitis		P <sub>h-md</sub>	P <sub>h-sd</sub>	P <sub>md-sd</sub>
		MD (n=20)	SD (n=20)			
OBPL1	27.97±2.82	29.18±4.67	28.98±4.01	>0.05	>0.05	>0.05
OBPL2	26.43±2.80	29.75±4.52	30.63±4.66	<0.01	<0.001	>0.05
OBPR1	23.56±1.88	23.30±2.59	23.88±2.46	>0.05	>0.05	>0.05
OBPR2	15.65±1.58	15.30±1.29	15.78±1.13	>0.05	>0.05	>0.05
OBK	18.68±1.15	18.20±1.03	18.80±1.47	<0.05	>0.05	>0.05
OBB	52.91±4.46	58.20±9.00	58.83±8.02	<0.01	<0.001	>0.05
OBBB	95.40±6.73	97.90±11.18	101.0±12.2	>0.05	=0.080	>0.05
OBG1	34.89±2.83	36.10±4.15	36.65±3.89	>0.05	>0.05	>0.05
OBG2	22.20±1.67	22.85±1.69	23.55±1.32	=0.083	<0.001	>0.05
OBS	22.84±1.51	22.48±1.61	23.23±2.05	>0.05	>0.05	>0.05
OBSH	31.92±1.43	33.55±3.00	34.28±2.81	<0.01	<0.001	>0.05
OBT	68.74±6.18	77.05±11.54	78.00±12.93	<0.001	<0.01	>0.05
OBGK1	89.20±6.08	95.00±9.03	97.30±10.11	<0.01	<0.001	>0.05
OBGK2	82.24±6.31	87.00±7.91	89.15±8.95	<0.05	<0.01	>0.05
OBGK3	84.58±6.34	90.65±8.05	92.95±9.90	<0.001	<0.001	>0.05

**Notes:** MD - mild severity; SD - severe severity; p<sub>h-md</sub> - the significance of the difference between the values of indicators between healthy and patients with mild seborrheic dermatitis; p<sub>h-sd</sub> - reliability of the difference between the values of indicators between healthy and patients with severe seborrheic dermatitis; p<sub>md-sd</sub> - the reliability of the difference between the values of indicators between patients with seborrheic dermatitis of mild and severe severity; \* - the reliability of the difference in the values of the relevant indicators between men and women at the level p<0,05; \*\* - the reliability of the difference in the values of the relevant indicators between men and women at the level p<0,01; \*\*\* - the reliability of the difference in the values of the relevant indicators between men and women at the level p<0,001; † - trends in the difference between the values of the respective indicators between men and women.

## Discussion

The main purpose of screening research is not to detect the disease at an early stage, as is commonly thought, but to prevent unwanted outcomes of the disease. A mass examination of people who do not consider themselves ill is carried out, and the latent course of diseases or other conditions (risk factors for future disease) is revealed. Screening does not diagnose the disease, but identifies people with an increased likelihood of certain conditions. If necessary, these individuals can further undergo an in-depth examination to determine the diagnosis of the disease [8, 15].

In recent decades, increasing attention has been paid to the study of constitutional features and adaptive capabilities of healthy and sick people with various congenital and acquired pathologies. In terms of this, it is advisable to comprehensively assess the morpho-functional systems within the constitutional integrity of the organism, which provides the individual nature of the adaptation process and reveals a range of prenosophical states - from adaptive response to critical stress [14].

Determination of body girth is carried out in the daily practice of various branches of medicine and is of particular interest to physicians of many specialties. The



**Table 2.** Differences in girth body sizes between healthy and patients with seborrheic dermatitis of varying severity in men and/or women.

Indicators	Men			Women		
	H	MD	SD	H	MD	SD
OBPL1	▲	▼	▼			
OBPL2	▼	▲	▲	▼	▲	▲
OBPR1						
OBPR2						
OBK				▲	▼	
OBB	▼	▲	▲	▼	▲	▲
OBBB				▼		▲
OBG1	▼		▲			
OBG2				▼	▲	▲
OBS						
OBSH	▼	▲		▼	▲	▲
OBT	▼		▲	▼	▲	▲
OBGK1				▼	▲	▲
OBGK2				▼	▲	▲
OBGK3						

**Notes:** H - healthy; MD - seborrheic dermatitis of mild severity; SD - severe seborrheic dermatitis; ▲ or ▼ - significant differences between healthy and sick men; ▲ or ▼ - trends in differences between healthy and sick men; ▲ or ▼ - significant differences in indicators between sick women; ▲ or ▼ - tendencies of differences of indicators between sick women; significantly higher indicators are highlighted in green when comparing the respective groups between men and women; tendencies to higher values of indicators are compared in yellow when comparing the respective groups between men and women.

circumferential dimensions of the body and limbs are the perimeters of different parts of the body, which characterize not only the parameters of bone constitution, but also describe the degree of soft tissue development, which contributes to the set of reactivity data [9, 18]. However, these indicators require a balanced assessment, given the possible metabolic changes due to the lifestyle of patients with seborrheic dermatitis with a predominance of negative dynamics in the clinical picture.

A comparative study of body and limb girth between healthy and patients with seborrheic dermatitis is important for assessing the condition and predicting the risk of developing the disease, as well as for developing or adjusting treatments.

As a result of the analysis of the girth body sizes *between healthy and patients with seborrheic dermatitis of varying severity*, Ukrainian men or women found the following differences (Table 2, see Table 1):

- *between healthy and patients of mild and severe severity of the disease in men* - in practically healthy men significantly lower or a tendency to lower values of the girth of the shoulder in a relaxed state (10.4 % and 12.2 %, respectively), thighs (4.9 % and 5.3 %, respectively), shins

in the upper part (only compared to severe by 4.2 %), neck (only compared to mild by 2.5 %) and waist (only compared to severe by 7.8 %), as well as significantly higher or a tendency to higher values shoulder girth in a tense state (by 5.5 % and 2.3 %, respectively);

- *between healthy and patients with mild and severe severity of the disease in women* - in practically healthy women significantly lower or a tendency to lower values of the girth of the shoulder in a relaxed state (11.2 % and 13.7 %, respectively), thighs (9.1 % and 10.1 %, respectively), both thighs (only compared to severe severity by 5.5 %), shin (by 2.8 % and 5.7 %, respectively), neck (by 4.9 % and 6.9 %, respectively), waist (by 10.8 % and 11.9 %, respectively), chest cells on inspiration (by 6.1 % and 8.3 %, respectively), on exhalation (by 5.5 % and 7.8 %, respectively) and at rest (by 6.7 % and 9.0 %, respectively), as well as significantly higher values of hand girth (only compared to light severity by 2.3 %).

In the comparative analysis of anthropometric parameters of the studied sexes with and without seborrheic dermatitis, it was found that this disease occurs against the background of overweight or obesity, characteristic of the hypertensive type of physique. This makes you think about the nature of this disease and regulates further research, taking into account the findings of anthropometry and the physical status of patients with varying degrees of dermatosis.

We did not find any significant or tendencies of differences in body size *between patients with seborrheic dermatitis of varying severity* in Ukrainian men or women (see Tables 1, 2).

The somatic type of a person is a complex morphological assessment focused on the characteristics of physical status and health. In this regard, the physical condition of the organism should be considered comprehensively - as a set of interdependent parameters: sex, age, somatic type, etc., which are inherent in a particular sex [9]. It was found that most of the absolute values of comprehensive values in patients with seborrheic dermatitis are directly dependent on the sex of the individual.

In the analysis of sex differences in girth body sizes *between patients with seborrheic dermatitis of varying severity*, Ukrainian men and women found significantly higher or greater tendencies in men compared to women, shoulder girth in a tense state (respectively 7.1 % and 10.8 %), shoulder unstressed (by 11.7 % and 10.8 %, respectively), forearms in the upper part (by 13.0% and 13.0%, respectively), forearms in the lower part (by 12.1 % and 8.0 %, respectively), hands (by 15.3 % and 12.1 %, respectively), shin (5.3 % and 3.6 %, respectively), feet (9.3 % and 5.0 %, respectively), neck (13.2 % and 10.2 %, respectively), and inhalation thorax (only compared to mild 5.3 %), chest on exhalation (only compared to mild severity by 7.2 %), and chest at rest (only compared to mild severity by 5.8 %) (see Tables 1, 2).

Thus, the comparison of the results of the anthropometric study with the clinical manifestations of seborrheic dermatitis between patients and healthy subjects, as well as between patients of different sexes allowed to formulate some criteria for unfavorable prognosis of seborrheic process.

### Conclusion

1. Patients with seborrheic dermatitis of varying severity of men, compared with practically healthy men, found greater values of the girth of the shoulder in a relaxed state and thighs (more pronounced in representatives with severe severity), neck (only mild), shin in the upper parts and waist (in both cases only severe), as well as smaller values of the shoulder girth in a tense state. Patients of varying severity of women (more pronounced in severe),

compared with practically healthy women, found greater values of the girth of the shoulder in a relaxed state, thighs, shin, neck, waist and all girths of the chest and both thighs (only with a severe degree), as well as smaller values of the girth of the hand (only with a mild degree).

2. There are no significant or trends in differences in body size between men or women with seborrheic dermatitis of varying severity.

3. Among patients with seborrheic dermatitis of varying severity, Ukrainian men and women found pronounced manifestations of sexual dimorphism of the girth sizes of the body - greater values in men (regardless of the severity of the disease) of the upper limb, hand, shin, foot and neck (mostly cases are more pronounced in representatives with mild severity), as well as only in men with mild seborrheic dermatitis greater values of all girths of the chest.

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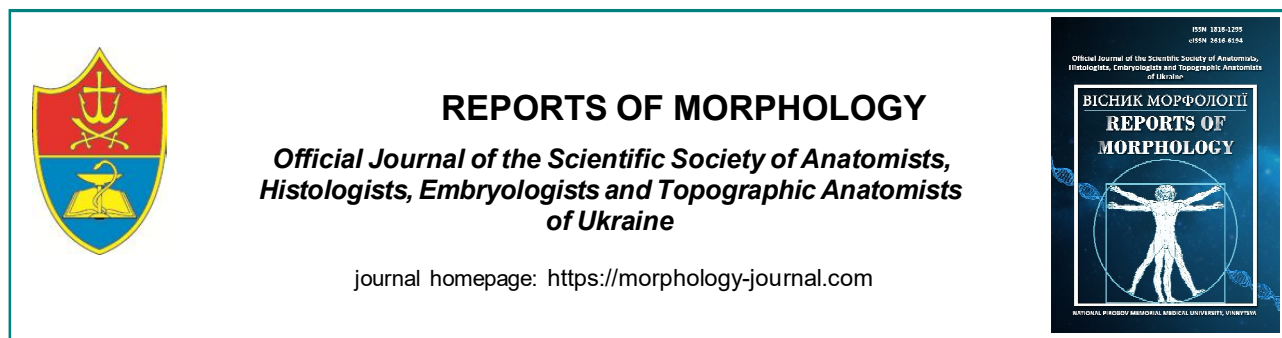
## **ОСОБЛИВОСТІ ОБХВАТНИХ РОЗМІРІВ ТІЛА У ЧОЛОВІКІВ І ЖІНОК ХВОРИХ НА СЕБОРЕЙНИЙ ДЕРМАТИТ РІЗНОГО СТУПЕНЯ ВАЖКОСТІ**

**Хасавнех Ахмад Раед, Сергета І.В., Белік Н.В., Доегань А.О., Жученко І.І.**

На сьогоднішній день в сучасній медицині вивчення стану здоров'я людини переорієнтовано на індивідуальний принцип, в основу якого покладено виявлення і вивчення конституціонально-детермінованих закономірностей прояву певних хвороб. Мета дослідження - встановити та провести аналіз особливостей обхватних розмірів тіла у чоловіків і жінок, хворих на генералізовану жирну форму себорейного дерматиту різного ступеня важкості. Проведено визначення обхватних розмірів тіла у 40 чоловіків і 40 жінок молодого віку (25-44 роки) хворих на генералізовану жирну форму себорейного дерматиту (легкого та важкого ступеня важкості). Контрольну групу склали обхватні розміри практично здорових чоловіків (n=82) і жінок (n=154) аналогічної вікової групи, що були відібрані з банку даних науково-дослідного центру Вінницького національного медичного університету ім. М.І. Пирогова. Статистична обробка обхватних розмірів тіла проведена в ліцензійному пакеті "Statistica 6.0" із використанням непараметричних методів оцінки. В результаті проведених досліджень у хворих на себорейний дерматит різного ступеня важкості чоловіків, порівняно з практично здоровими чоловіками, встановлені лише більші значення обхватів плеча у ненапруженому стані та стегна, шиї (лише з легким ступенем), гомілки у верхній частині та талії (в обох випадках лише з тяжким ступенем), а також менші значення обхвату плеча у напруженому стані; а у хворих різного ступеня важкості жінок - більші значення обхватів плеча у ненапруженому стані, стегна, гомілки у нижній частині, шиї, талії і усіх обхватів грудної клітки та обох стегон (лише з тяжким ступенем), а також менші значення обхвату кисті (лише з легким ступенем). Як у хворих на себорейний дерматит чоловіків, так і у жінок, відмінності обхватних розмірів тіла більш виражені у представників із тяжким ступенем важкості захворювання. Між чоловіками або жінками, хворими на себорейний дерматит різного ступеня важкості не встановлено достовірних або тенденцій розбіжностей обхватних розмірів тіла. При аналізі проявів статевого диморфізму обхватних розмірів тіла між хворими на себорейний дерматит чоловіками та жінками встановлені більші значення у чоловіків із легким і тяжким ступенем важкості захворювання обхватів верхньої кінцівки, кисті, гомілки у нижній частині, стопи та шиї (у більшості випадків більш виражено у представників із легким ступенем важкості), а також лише у чоловіків із легким ступенем важкості - більші значення усіх обхватів грудної клітки. Для більш коректного розуміння змін обхватних розмірів тіла в українських чоловіків або жінок, хворих на себорейний дерматит різного ступеня важкості необхідно провести аналіз інших конституціональних параметрів тіла.

**Ключові слова:** себорейний дерматит, українські чоловіки та жінки, обхватні розміри тіла, статеві розбіжності.

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# Fractal analysis as a method of morphometric study of linear anatomical objects: modified Caliper method

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### CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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Not applicable.

The purpose of the study was to develop an original modification of the Caliper method of image fractal analysis to determine the fractal dimension of linear anatomical objects. To develop the method, the linear contour of the outer surface of the cerebral cortex was chosen as the object of study. Magnetic resonance brain images in coronal projection were used. The original modification of the Caliper method includes image analysis using Adobe Photoshop CS5 software or its analogues. The linear contour of the studied object is selected, followed by stepwise smoothing of the contour with different smoothing radius. At the 1st stage of fractal analysis smoothing is not applied, at the 2nd stage the smoothing radius is 2 pixels, the 3rd - 4 pixels, the 4th - 8 pixels, the 5th - 16 pixels. At each stage, the contour length in pixels is measured (P). The size of the fractal measurement unit (G) at the 1st stage of fractal analysis is 1 pixel, the 2nd stage - 2 pixels, the 3rd stage - 4 pixels, the 4th stage - 8 pixels, the 5th stage - 16 pixels. The contour smoothing radius, the size of the fractal measurement units and the number of stages of fractal analysis can be changed depending on the characteristics of the studied structure, size, scale and image resolution. Based on the values of the perimeter and the size of the fractal measurement units, the number of fractal measurement units covering the studied object (N) is calculated:  $N=P/G$ . The fractal dimension value is calculated based on the N and G values. The modification of the Caliper method described in this paper is automatized and does not require much time required for manual calculation. In addition, compared to the classic Caliper method, this modification is more accurate because the measurement is performed automatically. The main limitation of the developed modification is the ability to determine the fractal dimension of only closed contours of studied structures or closed linear structures, because this method involves determining the length of the closed perimeter of the selected image area. The modified Caliper method of image fractal analysis described in this paper can be used in morphology and other fields of medicine for fractal analysis of linear objects: external and internal linear contours of different anatomical structures (cerebellum, cerebral hemispheres) and pathological foci (tumors, foci of necrosis, fibrosis, etc.).

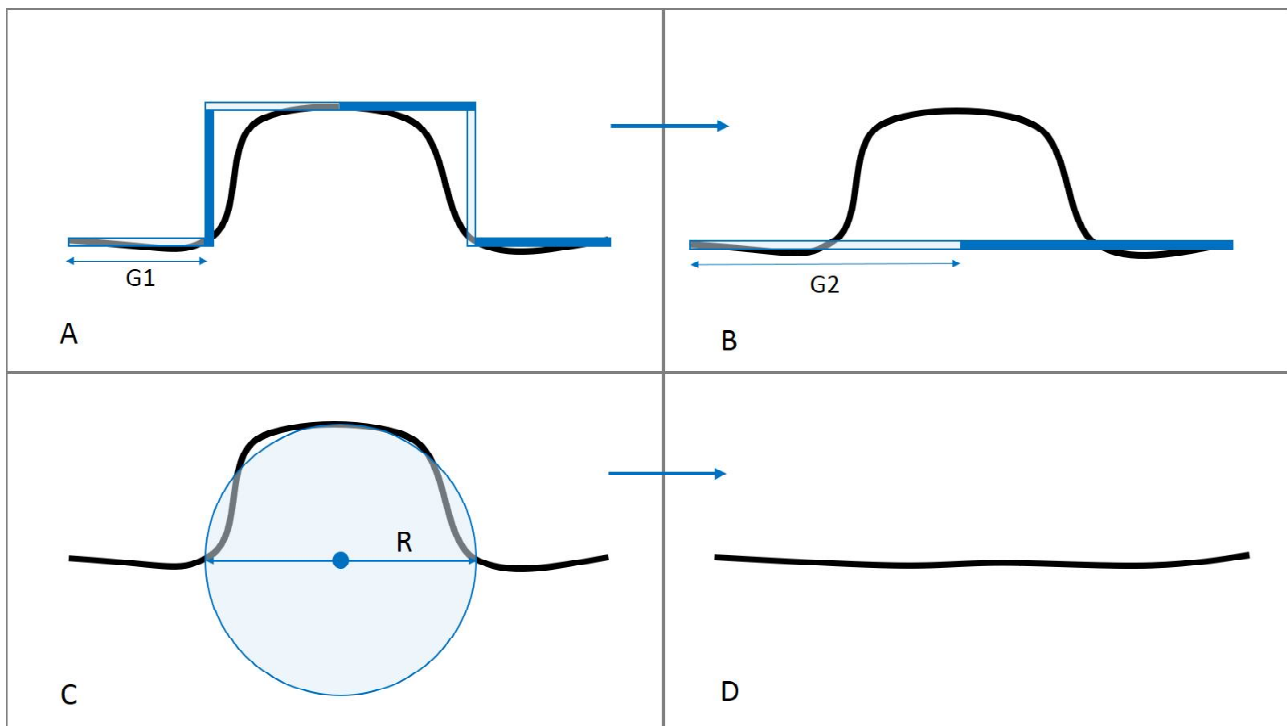
**Keywords:** fractal analysis, fractal dimension, morphometry, Caliper method, Richardson's method.

### Introduction

Fractal analysis is a method of mathematical analysis that in recent decades is increasingly used as a morphometric method in morphology and in medicine in general. Fractal analysis involves determining the fractal dimension, which is an indicator of the complexity of the spatial configuration and the degree of filling of space with a particular object. Among the anatomical structures that can be visualized on medical images, there are often linear objects - linear contours of various anatomical structures

and formations (eg, outer linear contour of the cerebral cortex, outer contour of pathological foci, inner contour of hollow organs, etc.) and linear anatomical structures (membranes, vessels, nerves, fibers, etc.). Fractal analysis can be used for complex morphometric study of such objects.

For fractal analysis in medicine, various methods are used - box counting [1, 8, 9, 16, 18, 21], pixel dilatation [12, 15], Caliper method [11, 17, 19, 22] and others [3, 4, 6, 7]. Different methods of fractal analysis can take into account



**Fig. 1.** The principle of fractal analysis using the Caliper method. A, B - classical method, overlapping fractal measures of different sizes ( $G_1$ ,  $G_2$ ). C, D - contour modification by smoothing, used in the author's modification of the Caliper method: from a contour containing bends (A), bends with a radius equal to or less than  $R$  are removed - the specified value of the smoothing radius (D).

one linear size of the studied objects (length), two linear dimensions (length and width) or three linear dimensions (length, width and height). Linear objects have one linear dimension, namely length, so for their fractal analysis it is advisable to use fractal analysis methods that take into account only one linear dimension. This method of fractal analysis is the *Caliper* method [13].

The Caliper method also has the following names: Richardson's method, perimeter stepping method, ruler method, divider dimension, compass dimension, yard stick method [6, 7, 13]. Historically, the Caliper method was one of the first methods of fractal analysis. In 1951, the English mathematician Lewis Fry Richardson, while studying the relationship between the length of a border and the number of conflicts between neighboring states, described the paradox of the coastline, which was later called the Richardson Effect. Contradictory data were obtained in determining the length of state borders and the length of the coastline. A compass was used to measure the length of the shoreline: first, a segment of a certain length was measured, which was recorded in a compass, and then the length of the contour was measured step by step on a map (similar to how distances are measured with a surveyor). The length of the shoreline ( $L$ ) was determined by the number of segments ( $N$ ) multiplied by their length ( $G$ ):  $L = N \times G$ . L. Richardson noticed that when using segments of different lengths, the total length of the shoreline differed: the smaller (shorter) were the segments used for measurement, the greater the total length of the shoreline. Richardson initially assumed that when using even shorter segments, the length

of the shoreline would reach a certain fixed length and later cease to change as the measure decreased, but it turned out that when the length of the segment used for measurement approaches zero, the length of the shoreline goes to infinity. With this in mind, Richardson based on empirical data suggested that the length of the shoreline contour ( $L$ ) and the size of measure ( $G$ ) are related by the equation  $L(G) = MG^{(1-D)}$ , where  $M$  is the calculated constant and  $D$  (dimension) - a certain quantity that quantifies the dependence of the size of the measure and the measured object and is called dimension. This value ranged from 1 to 2 and corresponded to the metric dimension of the shoreline [5, 14, 20].

Benoit Mandelbrot later took up the issue, publishing in 1967 "How Long Is the Coast of Britain? Statistical Self-Similarity and Fractional Dimension" [14], which examines the mathematical aspects of self-similar curves. In this paper, Mandelbrot analyzed the regularities of the organization of self-similar mathematical curves (which are essentially linear mathematical fractals) and determined how the metric dimension of such curves is calculated. The approximation of the length of the self-similar line ( $L$ ) corresponded to  $G^{(1-D)}$ , where  $G$  is the length of the segment used to measure the length, and  $D$  is the metric dimension. The metric dimension of such self-similar objects can have not only integer but also fractional values, so it was called fractional dimension (FD) [5, 13, 14, 20].

The classic *Caliper* method conducted as follows. A linear object is covered by a broken line consisting of linear segments that have a certain fixed length ( $G_1=1$ ), and count

$N_1$  - the number of such segments that can be completely placed on this linear object (Fig. 1, A, B). This linear segment is called a fractal measurement unit. The length of the segments is halved and  $N_2$  is counted - the number of segments of length  $G_2=1/2$  that can be placed on this object. Then this procedure is repeated several times, iteratively reducing the length of the segments by half ( $G_3=1/4$ ,  $G_4=1/8$ ,  $G_5=1/16$ , etc.) and at each stage count the number of segments with the appropriate length (respectively  $N_3$ ,  $N_4$ ,  $N_5$  and so on). Then, taking into account the values of  $G$  and  $N$ , the fractal dimension (FD) is calculated. For the classical Caliper method, measurements with a caliper (or compass, surveyor, ruler, etc. - depending on the field of use, scale and characteristics of the object) are most often used, which determines the name of the method [6, 7, 13].

However, the Caliper method in the classic version and known modifications is routine and, due to manual calculation, is not accurate enough to use it as a morphometric method in medicine for diagnostic purposes. Therefore, the search for a fractal analysis method that would be an automated and more accurate analogue of the classical Caliper method prompted the authors to develop their own modification of the fractal analysis of linear objects.

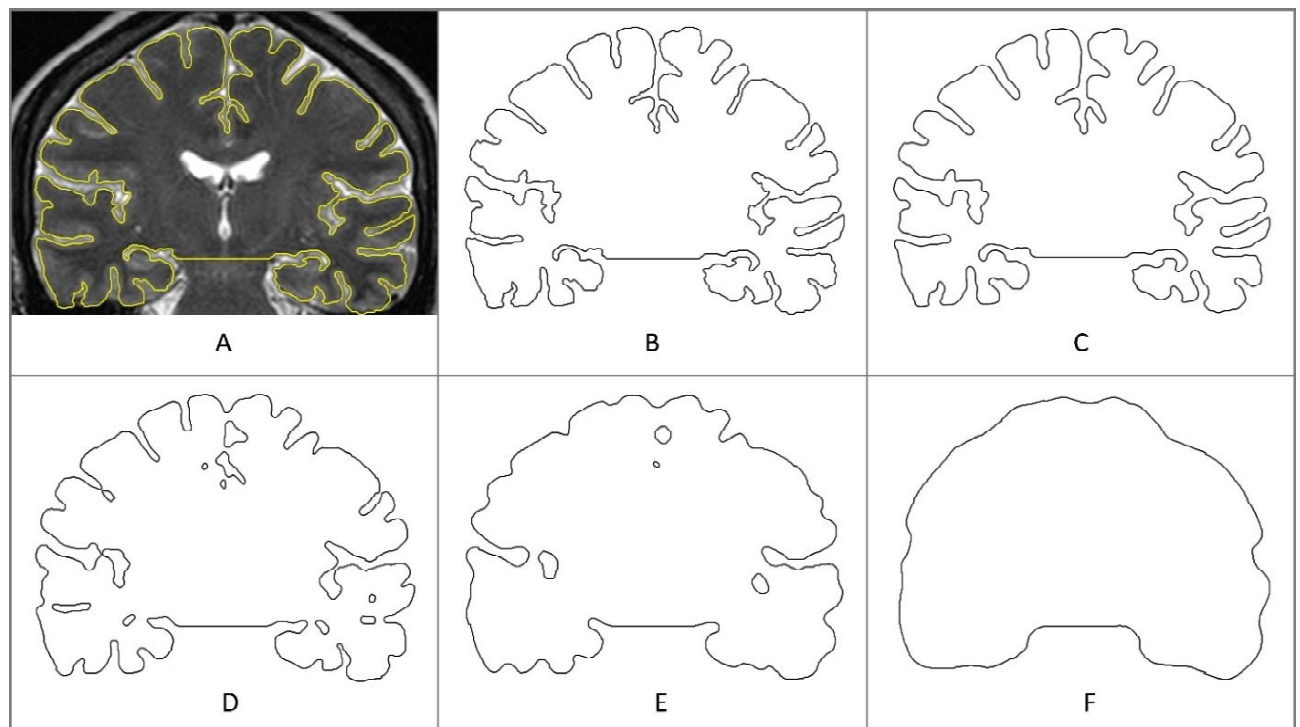
*The purpose of the study* is to develop an original modification of the Caliper method to determine the fractal dimension of linear anatomical objects.

## Materials and methods

The study was conducted in compliance with the basic bioethical provisions of the Council of Europe Convention on Human Rights and Biomedicine (04.04.1997), the Helsinki Declaration of the World Medical Association on ethical principles of scientific medical research with human participation (1964-2008), and the Ministry of Health of Ukraine № 690 dated September 23, 2009. **The conclusion of the Ethics and Bioethics** Commission of Kharkiv National Medical University confirms that the study was conducted in compliance with human rights in accordance with current legislation in Ukraine, meets international ethical requirements and does not violate ethical norms in science and standards of biomedical research (Minutes of the meeting of the Commission on Ethics and Bioethics of KhNMU № 10 dated November 7, 2018).

In order to develop our own modification of the fractal analysis technique using the Caliper method, we chose the outer linear contour of the cerebral cortex as the object of study. First, the linear contour of the cortex has fractal properties and can be considered as a natural linear fractal [10]. Secondly, the study of this structure is of great clinical importance, as it allows to quantify the degree of complexity of the spatial configuration of the surface of the cerebral cortex, which in the future can be used for diagnostic purposes [8, 9].

Magnetic resonance imaging of the brain in coronal



**Fig. 2.** Method of fractal analysis using the author's modification of the Caliper method. A - the original image (magnetic resonance imaging of the brain in the coronal projection), the stroke of the studied contour with a yellow line used. B-F - stages of fractal analysis: B - 1st stage of fractal analysis, contour smoothing not applied, C - 2nd stage, contour smoothing radius 2 pixels, D - 3rd stage, contour smoothing radius 4 pixels, E - 4th stage, radius of smoothing of a contour of 8 pixels, F - 5th stage, radius of smoothing of a contour of 16 pixels.

projection, obtained with the help of magnetic resonance imaging with a value of magnetic induction of 1.5 T, was used to develop our own method (Fig. 2). Digital T1 and T2 weighted images of magnetic resonance (MR) tomograms with a resolution of 72 pixels per inch were used (the most common value of resolution for digital MR tomograms).

Image analysis was performed using the graphic editor Adobe Photoshop CS5.

## Results

*The technique is performed as follows.* Image analysis is performed using an Adobe Photoshop CS5 graphics editor (or other graphics editor with similar parameters). Using the "selection tool", select the area of the digital image that corresponds to the area delineated by a specific linear object - the outer or inner contour of the anatomical structure or formation or the linear anatomical structure as a whole (membrane, vessel wall in cross section, etc.). In this case, the contour of the area of selection should coincide with the studied linear object (in this case - the outer linear contour of the pial surface of the cortex of the cerebral hemispheres). Selection is performed using visual inspection and manual correction (if necessary) (Fig. 2).

Next, you need to measure the length of a linear object using fractal measurement units - linear segments of a certain length. If you use the classic Caliper method, a linear object is covered by a broken line consisting of segments of a certain fixed length; then the number of these segments is counted. In contrast to the classical method, this modification performs an automated calculation of the number of fractal measures placed on the linear contour of the selected area. First, use the "analysis" tool of the Adobe Photoshop CS5 graphics editor to measure the length of the perimeter of the selected area (contour length) in pixels (P). Then determine the size of the fractal measure (G) (size of fractal measurement unit (G)) - the length in pixels of the segments covering the linear object. Based on these data, calculate N - the number of fractal measures covering the object under study:  $N=P/G$ . The calculation data are entered in the table (Table 1).

*In the first stage of fractal analysis, the smallest possible*

**Table 1.** Fractal analysis of a linear object. Counting data at 1-5 stages of fractal analysis.

Stage of fractal analysis	G - fractal measure, absolute values (number of pixels)	P - length of linear contour (perimeter) (number of pixels)	N - the number of fractal measures of length L, placed on the perimeter of the contour ( $N=P/G$ )	R - contour smoothing radius (number of pixels)
1	1	3867	3867	-
2	2	3646	1823	2
3	4	2505	626.25	4
4	8	1739	217.375	8
5	16	1253	78.3125	16

value of G is used. The length of the shortest linear segments of a broken line, which can cover a linear object in a digital image and measure its length (similar to the classic Caliper method), is 1 pixel. In subsequent calculations, 1 pixel can be considered the smallest possible size of the fractal measure G. On the MR image of the brain used as an example of the calculation (Fig. 2), the length of the contour ( $P_1$ ) was 3867 pixels (Table 1). Since  $G_1$  is equal to 1 pixel, the number of fractal measures covering the object under study in the first stage of fractal analysis ( $N_1$ ) is:  $N_1 = P_1 / G_1 = 3867 \text{ pixels} / 1 \text{ pixel} = 3867$ .

After that it is necessary to *double the size of the fractal measure G*, in the second stage of fractal analysis G should be equal to 2 pixels, in the third - 4, fourth - 8, fifth - 16. In order to automatically increase the size of the fractal measure, a gradual modification of the contour: using the "selection-modification-smoothing tool", the Adobe Photoshop CS5 graphics editor smoothes a contour with different smoothing radius (R) values. This allows you to automatically replicate the algorithm of the classic Caliper method, which involves the use of linear segments that cover a linear fractal object in the form of a broken line.

If a linear object has bends, then depending on the radius of these bends, the linear fractal segments will cover them differently. If the bends of a linear object have a radius greater than the length of the linear fractal segment, the segments will be placed on the curved sections of the linear object, covering this bend with a broken line (Fig. 1A). But fractal linear segments cannot repeat with a broken line bends that have a radius smaller than the length of this segment (Fig. 1B). Therefore, in such areas fractal segments are placed without repeating the small curves of the contour - "smoothing" the contour.

Adobe Photoshop "smoothing tool" modifies a selected area of an image as follows: add or subtract selection areas that lie on the outline and have a radius smaller than the anti-aliasing radius to the selected area. In this case, all bends of the linear contour with a radius less than or equal to the specified value of the smoothing radius are removed from the contour, replacing the smooth line ("smoothed") (Fig. 1C, 1D). For example, if the line has bends with a radius of less than 2 pixels, when smoothing with a radius of 2 pixels, they will be replaced by linear segments that do not have these bends. Thus, automated contour smoothing removes small curves from the line and allows you to measure the length of the contour in the same way as using the classic Caliper method, but more accurately and automatically.

*At the first stage of fractal analysis, the length of the fractal segment was 1 pixel, which allowed to fully cover all the smallest curves of the linear contour, so the smoothing of the contour was not necessary. But in order to increase the length of the linear fractal segment, in the second or fifth stages of fractal analysis, a gradual smoothing of the contour is performed.*

*In the second stage of fractal analysis, the contour*

**Table 2.** Fractal analysis of a linear object. Data used to calculate fractal dimension.

Stage of fractal analysis	G - fractal measure				N	
	G - absolute values (number of pixels)	g - fractional values	1/g	ln(1/g)	N - number of fractal measures of length L placed on the perimeter of the contour (N=P/G)	ln(N)
1	1	1/16	16	2.77	3867	8.26
2	2	1/8	8	2.08	1823	7.51
3	4	1/4	4	1.39	626.25	6.44
4	8	1/2	2	0.69	217.375	5.38
5	16	1	1	0.00	78.3125	4.36

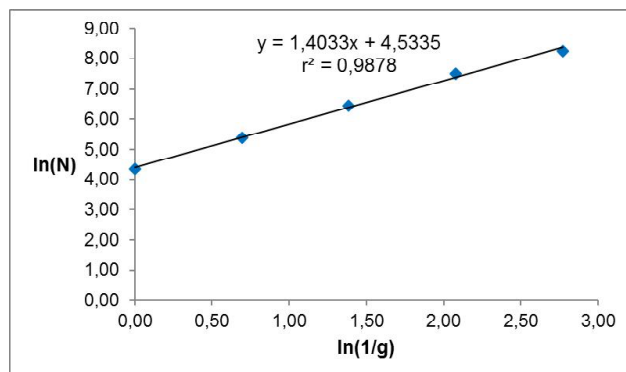
smoothing radius is 2 pixels. Accordingly,  $G_2$  is equal to 2 pixels. Then re-measure the length of the contour in pixels ( $P_2$ ). The length of the contour in Fig. 2 at this stage was 3646 pixels. Then determine the number of fractal measures G that cover the object under study. This amount for the image in Fig. 2 is:  $N_2 = P_2 / G_2 = 3646 \text{ pixels} / 2 \text{ pixels} = 1823$ .

In the third stage of fractal analysis, the contour smoothing is repeated, but with a smoothing radius of 4 pixels. Therefore,  $G_3$  is equal to 4 pixels. After smoothing, re-measure the length of the contour ( $P_3$ ). The length of the contour in Fig. 2 at this stage was 2505 pixels. Therefore, the number of fractal measures covering the object under study is  $N_3 = P_3 / G_3 = 2505 \text{ pixels} / 4 \text{ pixels} = 626,25$ .

In the fourth and fifth stages of fractal analysis, the contour is smoothed with radii of 8 and 16 pixels, respectively.  $G_4$  and  $G_5$  are 8 and 16 pixels respectively. After each smoothing, measure the length of the contour in pixels ( $P_4, P_5$ ).  $N_4$  and  $N_5$  are calculated similarly to the previous stages of fractal analysis and entered in the table (Table 1).

After the fifth modification of the contour by smoothing it, an almost smooth linear contour is obtained (Fig. 2).

To calculate the fractal dimension, you also need to determine the fractional values of the fractal measure G. If the largest value of G ( $G_5$ ) is 16 pixels, the fractional value of g (measure of iterative division G) is at the first stage of fractal analysis  $g_1=1/16$ , the second -  $g_2=1/8$ , the third -  $g_3=1/4$ , the fourth -  $g_4=1/2$ , the fifth -  $g_5=1$  (Table 2).



**Fig. 3.** Graph of linear dependence when calculating the fractal dimension of the linear contour of the cortex of the cerebral hemispheres.

Thus, if when using the classical Caliper method, the value of g in the first stage is the largest and in the following stages it decreases again (often divided in half), then this modification uses the inverse iterative change of fractal measure: in the first stage of fractal analysis measure g is the smallest, and in the second or fifth stages this measure is iteratively doubled.

The contour smoothing radius, the size of the fractal measure and the number of stages of fractal analysis can be changed depending on the characteristics of the studied structure, size, scale and image resolution.

To determine the fractal dimension, the natural logarithms of two numbers are calculated: N and numbers inverse to the value of g (1/g) (Table 2). Then the linear dependence of ln (N) on ln (1/g) is determined by the linear regression equation. The fractal dimension is equal to the slope of the direct regression relative to the abscissa axis (Fig. 3).

The linear regression equation in Fig. 3 has the form  $y=1.4033x + 4.5335$ , thus, the fractal dimension of the outer linear contour of the cortex of the cerebral hemispheres (Fig. 2) is 1.4033.

### Discussion

Currently, the Caliper method is used to determine the fractal dimension of the linear contour of various objects in geology [2], and this method is sometimes used in medicine [11, 17, 19, 22]. In studies [17, 22], the authors developed an original modification of this method, adapted for the study of tree-like structures - dendritic neurons tree (in the classical version, the Caliper method is used to study contours). To do this, the researchers divided the dendritic tree into linear continuous and unbranched segments. Each of the linear segments was then measured with a compass, and the fractal dimension was calculated from the total length of all linear segments that were part of the branched dendritic tree.

The original modification of the Caliper method described in this paper has its advantages when used as a morphometric method for the study of linear objects compared to the classical Caliper method. The classic method involves overlapping segments of different lengths on a linear object. Most often this is done manually with a caliper (compass, surveyor, ruler, etc.). However, this



measurement is routine and inaccurate, as the way the segments are superimposed on the contour can be influenced by subjective factors: the segments can be superimposed on the contour in different ways, which may cause differences in the fractal dimension values obtained when repeating the measurements. In addition, the vast majority of medical images are now digital (such as magnetic resonance imaging), which limits the use of the classical method using a caliper for digital images without pre-printing. These factors cause insufficient accuracy and convenience of this method and limit its use in the medical field for diagnostic purposes.

The modification described in this paper is automated and does not require a lot of time required for manual calculation. In addition, compared to the classical method, this modification is more accurate because the measurement is performed automatically. Changing the fractal measure is not done by changing the length of the fractal segment, as in the classical method, but automatically - by changing the radius of smoothing the contour. This modification of the contour eliminates the influence of subjective factors in the calculation and greatly simplifies the study.

The described technique is a methodologically simple algorithm that does not require additional programs for complex image segmentation and skills in working with these programs. Outline selection and modification is performed using Adobe Photoshop CS5 (or later versions of Adobe Photoshop), which is quite accessible and common in use. In addition to this program, you can use other graphics editors that have options comparable to or better than the version of the graphics editor we used. Thus, it allows to widely use the developed modification of the Caliper method for fractal analysis of linear anatomical structures as a morphometric method in morphology and other fields of medicine for diagnostic purposes.

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**ФРАКТАЛЬНИЙ АНАЛІЗ ЯК МЕТОД МОРФОМЕТРИЧНОГО ДОСЛІДЖЕННЯ ЛІНІЙНИХ АНАТОМІЧНИХ ОБ'ЄКТІВ:  
АВТОРСЬКА МОДИФІКАЦІЯ СПОСОБУ CALIPER**

**Мар'єнко Н.І., Степаненко О.Ю.**

*Мета дослідження - розробка оригінальної модифікації способу Caliper для визначення фрактальної розмірності лінійних анатомічних об'єктів. Для розробки методики у якості об'єкта дослідження обрано лінійний контур зовнішньої поверхні кори великих півкуль головного мозку. Були використані магнітно-резонансні томограми головного мозку у корональній проекції. Оригінальна модифікація способу Caliper включає аналіз зображення за допомогою програми Adobe Photoshop CS5 або її аналогів. Проводиться виділення лінійного контуру досліджуваного об'єкта із наступним поетапним згладжуванням контуру із різним радіусом згладжування. На 1-му етапі фрактального аналізу згладжування не застосовується, на 2-му етапі радіус згладжування складає 2 пікселі, 3-му - 4 пікселі, 4-му - 8 пікселів, 5-му - 16 пікселів. На кожному етапі проводиться вимірювання довжини контуру у пікселях (P). Розмір фрактальної міри (G) складає на 1-му етапі фрактального аналізу 1 піксель, на 2-му етапі - 2 пікселі, 3-му - 4 пікселі, 4-му - 8 пікселів, 5-му - 16 пікселів. Радіус згладжування контуру, розмір фрактальної міри та кількість етапів фрактального аналізу можуть бути змінені у залежності від особливостей досліджуваної структури, розміру, масштабу та роздільної здатності зображення. На основі значень периметра та розміру фрактальної міри розраховують N - кількість фрактальних мір, що покривають досліджуваний об'єкт:  $N=P/G$ . Значення фрактальної розмірності розраховується на основі значень N та G. Модифікація способу Caliper, описана у цій роботі, є автоматизованою та не потребує великих затрат часу, необхідних для ручного підрахунку. Крім цього, у порівнянні з класичним способом Caliper, ця модифікація є більш точною, оскільки вимірювання проводиться автоматизовано. Основним обмеженням у використанні розробленої модифікації є можливість визначення фрактальної розмірності лише замкнених контурів певних структур або замкнених лінійних структур, оскільки цей спосіб передбачає визначення довжини периметра ділянки, виділеної на зображенні. Методика визначення фрактальної розмірності за допомогою оригінальної модифікації способу Caliper, описана у даній роботі, може бути використана у морфології та інших галузях медицини для фрактального аналізу лінійних об'єктів: зовнішніх та внутрішніх лінійних контурів різних анатомічних структур (мозочка, великих півкуль головного мозку) та патологічних осередків (пухлин, осередків некрозу, фіброзу тощо).*

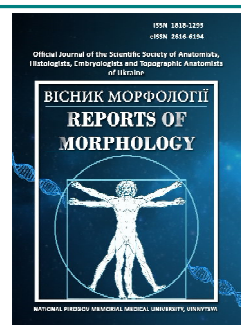
**Ключові слова:** фрактальний аналіз, фрактальна розмірність, морфометрія, спосіб Caliper, спосіб Річардсона.



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# Total, longitudinal and transverse body sizes in men with psoriasis of different somatotypes

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### CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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Using a constitutional approach to predict the onset of a disease can be key not only to solving the problem of late-stage lifestyle modification therapy but also to understanding the deep, seemingly incomprehensible links between organs and body structure. The aim of the study was to establish and analyze the differences in total, longitudinal and transverse body sizes between healthy and/or psoriatic men of different somatotypes depending on the severity of the disease. Anthro-somatotypological examination was performed on Ukrainian men (aged 22 to 35 years) with psoriasis (n=100, including 32 with mild and 68 with severe). A clinical assessment of the severity and area of psoriatic lesions was performed using the PASI index. Anthropometric data of 82 practically healthy men of the same age group was taken from the data bank of the research center of National Pirogov Memorial Medical University, Vinnytsya. Statistical processing of the obtained results was performed in the license package "Statistica 5.5" using non-parametric evaluation methods. In patients with mild and severe psoriasis, men of mesomorphic and endo-mesomorphic somatotypes in comparison with healthy men of the corresponding somatotypes, higher values of almost all total (in the endo-mesomorphs with severe disease), transverse (except for shoulder width) and lateral body size (except endo-mesomorphs with severe disease) was found. In patients with psoriasis, men of endo-mesomorphic somatotype with a mild course of the disease found greater than in patients with a similar course men of mesomorphic somatotype, body weight, length and surface area, height of acromial and finger anthropometric points, and transverse middle thoracic diameters and anteroposterior middle thoracic diameter; and in patients with psoriasis men of endo-mesomorphic somatotype with a severe course of the disease - only greater values than in patients with a similar course of the disease men of mesomorphic somatotype, interspinous distance. When comparing the total, longitudinal and transverse dimensions of the body between men with psoriasis of the corresponding somatotypes, in representatives of the mesomorphic somatotype with a mild course of the disease found greater than with severe course, body length values and lower - posterior middle thoracic diameter. The revealed differences in total, longitudinal and transverse body sizes between healthy and/or patients with mild or severe psoriasis Ukrainian men of mesomorphic and endo-mesomorphic somatotypes provide an opportunity to increase the effectiveness of the use of body structure and size to identify risk groups psoriasis.

**Keywords:** psoriasis, total, longitudinal and transverse body sizes, somatotype, men.

### Introduction

Psoriasis may seem like a simple skin condition at first glance. However, in reality, this nosology hides one of the most common pathologies that can be found in all parts of the world, with a complex, unexplored process of pathogenesis, which affects mostly able-bodied people and has huge consequences for the psychological sphere of human life [2, 14, 17, 23].

When focusing on the pathogenesis of this disease, scientists ultimately agree that a key element in the development of psoriasis is the inflammatory component. Systemic inflammation that occurs in psoriasis causes an increase in a number of inflammatory cytokines, including IL-6, IL-17, IL-20, IL-22 and IL-23. In addition, there is ample evidence of the association of psoriasis with other systemic

inflammatory diseases of the human body [14].

An analysis of population data conducted in the United States from 2011 to 2014 revealed that the prevalence of psoriasis in the adult population is 3.0 % (95 % CI, 2.6 %-3.4 %). Moreover, the prevalence was the same for both men and women (2.8 % (95 % CI, 2.4 %-3.3 %) and 3.2 % (95 % CI, 2.6 %-3.8 %) in accordance). The highest prevalence was observed among the white population 3.6 % (95 % CI, 2.9 %-4.2 %), and the lowest among blacks 1.5 % (95 % CI, 1.0 %-2.0 %) [2]. Data from previous years, namely 1999-2013, indicate a lower prevalence of psoriasis in the United States during this period. Thus, in 1999 the prevalence rate was only 2.3 % [25].

A similar study conducted in China found the following data: the prevalence of psoriasis was 0.47 %; prevalence in men 0.54 %; prevalence in women 0.44 % [11].

A long-term study of the prevalence of psoriasis was conducted in Denmark and covered the years 2003-2012. In this Scandinavian country, the prevalence of the disease is 2.2 %. Researchers have noted an increase in the incidence rate over time, which peaked in 2010. In addition, higher levels of the disease were found in women and in the age group of 60-69 years [13]. In Brazil, there are also gender differences and the prevalence of psoriasis. In women, this figure is 1.15 % (CI 95 % 0.90-1.43 %) and 1.47 % (CI 95 % 1.11-1.82 %) in men ( $p=0.22$ ), and in the country as a whole the prevalence rate is 1.31 %. As in Denmark, the highest incidence is observed in the age group after 60 years - 2.29 % (CI 95 % 1.71-2.84 %) [22].

However, the question remains - can we confidently say about the increase in the incidence of psoriasis? A longer-term assessment is needed to answer this question. Norwegian scientists have estimated the prevalence of psoriasis in the local population for 30 years (from 1979 to 2008). If in 1979 the prevalence of psoriasis was 4.8 %, in 2008 this figure was already 11.4 % [9].

The versatility of psoriasis is manifested in a large number of complications and concomitant diseases that accompany it. According to Lakshmy S. and co-authors [17], the prevalence of depression in patients with this disease is 78.9 %, and anxiety - 76.7 %. In addition, patients have problems with frequent feelings of shame, anger, anxiety and irritation (most of them are more common in women than men), problems at work and other social difficulties in life [23].

Predicting the occurrence and severity of the disease in this regard is an important topic for research that requires a simple and elegant solution. The way to solve this problem can be the application of a constitutional approach - the study of certain anthropometric indicators. This method is successfully used in various fields and has shown a wide range of applications and the ability to identify the relationship between the various components of the human body [19].

The aim of the study was to establish and analyze the differences in total, longitudinal and transverse body sizes between healthy and/or psoriatic men of different somatotypes depending on the severity of the disease.

## Materials and methods

An anthropometric examination, according to the scheme of V.V. Bunak [6], men (aged 22 to 35 years) with psoriasis ( $n=100$ , including 32 with mild and 68 with severe), who were examined on base of the Military Medical Clinical Center of the Central Region and the Department of Dermatology and Venereal Diseases with a course of postgraduate education National Pirogov Memorial Medical University, Vinnytsya have been done. Assessment of somatotype was performed according to the method of Heath Carter [7].

**Committee on Bioethics** of National Pirogov Memorial Medical University, Vinnytsya (protocol № 2 From 20.02.2020) found that the studies do not contradict the basic bioethical standards of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant WHO regulations and laws of Ukraine.

Clinical assessment of the severity and area of psoriatic lesions was performed using the PASI index (Psoriasis Area and Severity Index) [3, 16].

As a control from the database of the research center of the National Pirogov Memorial Medical University, Vinnytsya selected anthropometric data of 82 practically healthy men of the same age group.

Statistical processing of the obtained results was performed in the license package "Statistica 5.5" using non-parametric evaluation methods. The reliability of the difference between the values between the independent quantitative values was determined using the U-Mann-Whitney test.

## Results

Significant or trends in differences in total, longitudinal and transverse body sizes between healthy and/or psoriatic men of mesomorphic and endo-mesomorphic somatotypes are shown in tables 1 and 2.

## Discussion

Thus, *when comparing men with psoriasis of different somatotypes with healthy men of the corresponding somatotypes*, it was found:

- in patients with psoriasis men of *mesomorphic somatotype* - higher values of body weight by 17.0 % and 18.3 % (in the future, respectively, for mild and severe); body length by 1.9 % (only for mild course); body surface area by 8.3 % and 7.6 %; heights of the supra thoracic anthropometric point by 3.6 % and 2.0 %; heights of acromial anthropometric point by 3.0 % and 1.4 %; heights of the finger anthropometric point by 6.3 % and 4.6 %; transverse middle thoracic diameter by 16.2 % and 19.1 %; transverse lower thoracic diameter by 15.9 % and 17.6 %; anteroposterior middle thoracic diameter by 16.4 % and 24.7 %; interspinous distance by 13.6 % and 14.3 %; intercrystal distance by 14.8 % and 13.3 %; intertrochanteric distance by 10.8 % and 10.4 %; and lower values of pubic

**Table 1.** Comparison of total and longitudinal body sizes between healthy and psoriatic men of mesomorphic and endo-mesomorphic somatotypes (M±σ).

Indicators	Healthy		p	Psoriasis MC		p	Psoriasis SC		p
	mes.	en-mes.		mes.	en-mes.		mes.	en-mes.	
W	76.43±9.78	79.92±7.47	>0.05	89.48±14.68#	111.5±16.3&	<0.01	90.38±13.20#	90.51±25.28	>0.05
H	175.8±6.9	177.8±5.9	>0.05	179.2±4.9*	185.5±3.1*	<0.05	176.4±4.6	179.2±8.9	>0.05
S	1.923±0.149	1.977±0.116	>0.05	2.082±0.157#	2.346±0.164&	<0.01	2.069±0.144#	2.087±0.313	>0.05
ATND	142.5±6.5	144.5±5.7	>0.05	147.6±4.4#	152.5±6.4t	>0.05	145.4±4.0*	147.3±8.2	>0.05
ATL	89.21±5.46&	90.82±4.54	>0.05	87.46±3.86	90.05±1.42	>0.05	85.66±4.36	87.13±4.06	>0.05
ATPL	145.2±7.3	147.6±6.6	>0.05	149.5±4.7*	156.0±3.5*	<0.05	147.2±4.0t	151.0±6.1	>0.05
ATP	65.61±5.49	66.31±4.74	>0.05	69.77±2.94#	72.50±3.00*	<0.05	68.63±3.00#	69.67±3.94	>0.05
ATV	92.38±5.96&#	95.92±3.75*&	<0.05	86.21±11.29	91.75±2.63	>0.05	87.59±4.96	89.44±3.71	>0.05

**Notes:** in this and the following table, MC - mild course; SC - severe course; mes. - representatives of the mesomorphic somatotype; en-mes. - representatives of the endo-mesomorphic somatotype; p - significance of differences in indicators in groups of healthy or sick men between mesomorphs and endo-mesomorphs; \*, &, # - significant differences (respectively <0.05, <0.01 or <0.001) between the corresponding indicators in the groups of healthy and patients with mild psoriasis mesomorphs or endo-mesomorphs (higher values are noted); \*, &, # - significant differences (respectively <0.05, <0.01 or <0.001) between the corresponding indicators in the groups of healthy and patients with severe psoriasis mesomorphs or endo-mesomorphs (higher values are noted); t - the tendency of differences between the corresponding indicators in the groups of healthy and patients with mild psoriasis of mesomorphs or endo-mesomorphs (higher indicators are noted); t - the tendency of differences between the corresponding indicators in groups of healthy and patients with psoriasis of severe mesomorphs or endo-mesomorphs (higher indicators are noted); significantly higher values of indicators were noted in yellow (<0.05) when comparing between the corresponding somatotypes of patients with mild and severe psoriasis; significantly (<0.01) higher values of indicators were noted in green when comparing patients with mild and severe psoriasis according to the corresponding somatotypes; W - body weight (kg); H - body length (cm); S - body surface area (m<sup>2</sup>); ATND - height of the thoracic anthropometric point (cm); ATL - height of the pubic anthropometric point (cm); ATPL - height of acromial anthropometric point (cm); ATP - height of the finger anthropometric point (cm); ATV - height of trochanteric anthropometric point (cm).

**Table 2.** Comparison of transverse body sizes between healthy and psoriatic men of mesomorphic and endo-mesomorphic somatotypes (M±σ).

Indicators	Healthy		p	Psoriasis MC		p	Psoriasis SC		p
	mes.	en-mes.		mes.	en-mes.		mes.	en-mes.	
W	76.43±9.78	79.92±7.47	>0.05	89.48±14.68#	111.5±16.3&	<0.01	90.38±13.20#	90.51±25.28	>0.05
H	175.8±6.9	177.8±5.9	>0.05	179.2±4.9*	185.5±3.1*	<0.05	176.4±4.6	179.2±8.9	>0.05
S	1.923±0.149	1.977±0.116	>0.05	2.082±0.157#	2.346±0.164&	<0.01	2.069±0.144#	2.087±0.313	>0.05
ATND	142.5±6.5	144.5±5.7	>0.05	147.6±4.4#	152.5±6.4t	>0.05	145.4±4.0*	147.3±8.2	>0.05
ATL	89.21±5.46&	90.82±4.54	>0.05	87.46±3.86	90.05±1.42	>0.05	85.66±4.36	87.13±4.06	>0.05
ATPL	145.2±7.3	147.6±6.6	>0.05	149.5±4.7*	156.0±3.5*	<0.05	147.2±4.0t	151.0±6.1	>0.05
ATP	65.61±5.49	66.31±4.74	>0.05	69.77±2.94#	72.50±3.00*	<0.05	68.63±3.00#	69.67±3.94	>0.05
ATV	92.38±5.96&#	95.92±3.75*&	<0.05	86.21±11.29	91.75±2.63	>0.05	87.59±4.96	89.44±3.71	>0.05

**Notes:** PSG - transverse middle thoracic diameter (cm); PNG - transverse lower thoracic diameter (cm); SGK - anterior-posterior middle thoracic diameter (cm); ACR - shoulder width (cm); SPIN - interspinous distance (cm); CRIS - intercrystal distance (cm); TROCH - intertrochanteric distance (cm).

anthropometric point height by 4.2 % (only for severe); the height of the trochanteric anthropometric point by 7.2 % and 5.5 %; shoulder widths by 21.0 % and 18.4 %;

- in patients with psoriasis men of *endo-mesomorphic somatotype* - higher values of body weight by 39.5 % (only for mild course); body length by 4.3 % (only for mild course); body surface area by 18.7 % (only for mild course); height of the thoracic anthropometric point by 5.5 % (only for mild course); height of acromial anthropometric point by 5.7 % (only for mild course); height of the finger anthropometric point by 9.3 % (only for mild course); transverse middle

thoracic diameter by 30.9 % and 17.1 %; transverse lower thoracic diameter by 31.2 % and 18.8 %; anterior-posterior middle thoracic diameter by 38.6 % and 18.0 %; interspinous distance by 17.2 % and 15.3 %; intercrystal distance by 15.1 % and 11.0 %; intertrochanteric distance by 12.8 % and 9.6 %; and lower values of the height of the trochanteric anthropometric point by 9.5 % and 7.2 %; shoulder width by 19.7 % and 23.4 %.

It should be noted that in most cases (more pronounced for mesomorphic somatotype) similar differences between healthy and psoriatic men were found by us in a study of

Ukrainian men without division into different somatotypes [12]. The only thing that attracts attention is, in most cases, the lack of significant or tendencies of differences between total and longitudinal body sizes between healthy and patients with severe psoriasis of endo-mesomorphic somatotype.

When comparing the total, longitudinal and transverse dimensions of the body between men with psoriasis of different somatotypes, it was found:

- in men with mild psoriasis - higher values in endo-mesomorphs of body weight by 24.6 %; body length by 3.5 %; body surface area by 12.7 %; height of acromial anthropometric point by 4.3 %; the height of the finger anthropometric point by 3.9 %; transverse middle thoracic diameter of 15.5 %; transverse lower thoracic diameter by 13.2 %; anterior-posterior middle thoracic diameter by 27.0 %;

- in patients with severe psoriasis - greater values in endo-mesomorphs only for interspinous distance by 4.3 %.

It should be noted that in most cases, we found significant somatotypological differences in total, longitudinal and transverse body size in patients with mild psoriasis in men are not present between practically healthy men (see Tables 1, 2).

When comparing the total, longitudinal and transverse dimensions of the body between men with psoriasis of the corresponding somatotypes, higher values of body length by 1.6 %, height of the thoracic anthropometric point by 1.5 % and height of the acromial anthropometric point by 1.6 % in mesomorphic somatotype with a mild course of the disease, as well as anterior-posterior middle thoracic diameter by 7.2 % in mesomorphic somatotype with a severe course of the disease.

In an anthropometric survey of 113 children with psoriasis and 113 healthy children in Kabul (Afghanistan), researchers found that children with psoriasis had higher body weight and central obesity than children in the control group (27.4 % vs. 12.4 %, OR=2.67; p=0.005 and 23 % vs. 9.7 %, OR=2.77; p=0.007, respectively). In addition, sick children had higher family history of skin diseases (23.0 % vs. 13.7 %; p<0.001) [1]. The importance of such a factor in the development of psoriasis as body weight and the presence of obesity in children is emphasized by the results of other studies [21]. In a sample of 27 children who developed psoriasis within 1 or 2 years, 25 were overweight or obese [4].

At the same time, anthropometric examination of children with different forms of psoriasis did not reveal any relationship between weight and the presence of obesity and some form of psoriasis [18].

In adults, the relationship between psoriasis and the presence of overweight has also been found. According to the data of multifactor logistic regression analysis, with an increase in body mass index to 28 kg/m<sup>2</sup> the chances of

psoriasis increase to 43 %, and with  $\geq 30$  kg/m<sup>2</sup> to 71 % [10].

If we take into account such an indicator as waist circumference, the increase in waist circumference by 1.20 (95 % CI 1.16, 1.23) at S.D. 13.5 cm increased the chances of psoriasis and 1.30 (95 % CI 1.21, 1.39) - psoriatic arthritis [15].

The meta-analysis of 19 publications on the relationship between anthropometric indicators and psoriasis provided strong evidence that indicators such as the percentage of total body fat, the percentage of visceral fat, the percentage of muscle mass should be used to assess the risk of psoriasis [5]. A similar analysis by Chahoud J. and co-authors [8] of 14 publications also indicated the appropriateness of using the ratio of waist to human height to predict the occurrence of this pathology.

The results of a study of the Turkish population showed a link between the presence of psoriasis and waist circumference. In addition, it was found that the risk of psoriasis increases for women compared to men by 1.26 times [20]. Similarly, various groups of Norwegian scientists have found a connection with increased waist circumference [24, 26].

The analysis of foreign literary scientific sources revealed that most of the works used mostly homogeneous and few anthropometric indicators, such as waist circumference, hips, weight and body height. At the same time, work on a complex variety of anthropometric data or type of somatotype has not been identified, which indicates a fundamentally new and atypical nature of the study, which could potentially open a new branch of research to study the relationship between anthropometric indicators and psoriasis.

## Conclusions

1. In patients with mild and severe psoriasis men of mesomorphic somatotype, almost all total, transverse (except shoulder width) and more than half of the longitudinal body sizes is larger than in healthy men; and in patients with psoriasis, men of endo-mesomorphic somatotype larger than in healthy men - all total (only with a mild course), more than half of the longitudinal (only with a mild course) and almost all transverse (except shoulder width) body sizes.

2. In men of endomorph somatotype of patients with mild psoriasis, higher values of all total, almost half of the longitudinal dimensions of the body and almost all diameters of the torso; and in patients with severe psoriasis - only interspinous distance.

3. Only in men of mesomorphic somatotype with mild psoriasis, compared with severe psoriasis, greater values of body length, height of suprathoracic and acromial anthropometric points and lower values of anterior-posterior middle thoracic diameter are found.

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#### ТОТАЛЬНІ, ПОЗДОВЖНІ І ПОПЕРЕЧНІ РОЗМІРИ ТІЛА У ХВОРИХ НА ПСОРИАЗ ЧОЛОВІКІВ РІЗНИХ СОМАТОТИПІВ

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Використання конституціонального підходу з метою передбачення виникнення того чи іншого захворювання може стати ключем не тільки до вирішення проблеми пізнього початку терапії модифікації образу життя але і розуміння глибоких, не зрозумілих на перший погляд зв'язків між органами і будовою тіла людини. Мета дослідження - встановити та провести аналіз відмінностей тотальних, поздовжніх і поперечних розмірів тіла між здоровими та/або хворими на псоріаз чоловіками

різних соматотипів в залежності від тяжкості перебігу захворювання. Українським чоловікам (віком від 22 до 35 років) хворим на псоріаз (n=100, серед яких 32 із легким перебігом і 68 із тяжким перебігом) проведено антропо-соматотипологічне обстеження. За допомогою індексу PASI проведено клінічну оцінку важкості перебігу та площі псоріатичних уражень. Контролем слугували антропометричні дані 82 практично здорових чоловіків аналогічної вікової групи з банку даних науково-дослідного центру Вінницького національного медичного університету ім. М.І. Пирогова. Статистична обробка отриманих результатів проведена в ліцензійному пакеті "Statistica 5.5" із використанням непараметричних методів оцінки. У хворих на псоріаз легкого і тяжкого перебігу чоловіків мезоморфного та ендо-мезоморфного соматотипів порівняно зі здоровими чоловіками відповідних соматотипів встановлені більші значення практично всіх тотальних (окрім ендо-мезоморфів із тяжким перебігом захворювання), поперечних (окрім, ширини плечей) та більш ніж половини поздовжніх розмірів тіла (окрім ендо-мезоморфів із тяжким перебігом захворювання). У хворих на псоріаз чоловіків ендо-мезоморфного соматотипу з легким перебігом захворювання встановлені більші, ніж у хворих із аналогічним перебігом захворювання чоловіків мезоморфного соматотипу, маса тіла, довжина та площа поверхні тіла, висота акроміальної та пальцевої антропометричних точок, а також поперечний середньогруднинний, нижньогруднинний діаметри та передньо-задній середньогруднинний діаметр; а у хворих на псоріаз чоловіків ендо-мезоморфного соматотипу з тяжким перебігом захворювання - лише більші значення, ніж у хворих із аналогічним перебігом захворювання чоловіків мезоморфного соматотипу, міжостової відстані. При порівнянні тотальних, поздовжніх і поперечних розмірів тіла між хворими на псоріаз чоловіками відповідних соматотипів, у представників мезоморфного соматотипу з легким перебігом захворювання встановлені більші, ніж із тяжким перебігом, значення довжини тіла, висоти надгруднинної та акроміальної антропометричних точок, а також менші значення передньо-заднього середньогруднинного діаметра. Виявлені виражені відмінності тотальних, поздовжніх і поперечних розмірів тіла між здоровими та/або хворими на псоріаз легкого або тяжкого перебігу українськими чоловіками мезоморфного та ендо-мезоморфного соматотипів надають можливість підвищити ефективність застосування показників будови та розмірів тіла для виявлення груп ризику, щодо виникнення та особливостей перебігу псоріазу.

**Ключові слова:** псоріаз, тотальні, поздовжні та поперечні розміри тіла, соматотип, чоловіки.

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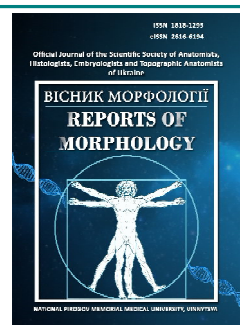




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## Normal values of coronary arteries branching height in women

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### CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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*Morphometric analysis of the structures of the aortic bulb and coronary arteries is necessary for the planning of cardiac surgery and endovascular interventions. The aim of the study was to determine the height of the coronary arteries branching in healthy women of Lviv city and Lviv region and to determine the relationship between the height of the location of the orifice of the coronary artery with anthropometric indicators. Fifteen computed tomography images with contrast of female thorax without heart and ascending aortic lesions (normal) were selected for the study. The height of the upper and lower edges of the coronary arteries was measured; height of Valsalva sinuses. The comparison of the mean values was performed according to the Student's t-test. The correlation between the observed variables (age, height, body weight, body mass index, body surface area, height of the sinuses of Valsalva) was calculated using the Pearson linear correlation method (r). According to the study, the population group consisted of persons of the second period of adulthood (46.67 %) and the elderly (53.33 %). According to the body mass index, 80 % were overweight or obese I-II degree. The mean height of the coronary artery orifice in women without structural changes of the heart and ascending aorta was: 11.19±1.96 mm for the left and 11.68±1.80 mm for the right. The height of the orifice of the right and left coronary arteries were almost the same, without statistical significance (p=0.26). Analysis of the correlation between the values of the height of the orifice of the coronary artery did not show a probable dependence on height, weight, age, body mass index and body surface area. There is a direct relationship between the parameters of the height of the lower edge of the right coronary artery and the height of the upper edge of the right coronary artery (r=+0.75, p=0.001) and between the value of the lower edge of the left coronary artery and the upper edge of the left coronary artery (r=+0.63, p=0.01). Thus, the analysis of the correlation between the values of the height of the orifice of the coronary artery in women in norm and anthropometric indicators did not show a significant relationship. There was no statistical significance between the indicators of the height of the orifice of the right and left coronary arteries in women.*

**Keywords:** orifice of the coronary artery, anatomy, computed tomography, aorta, measurements.

### Introduction

The risk of cardiovascular disease is associated with anthropometric and sex indicators [10, 14]. Short stature is considered a factor in the development of coronary heart disease [8], which is closely associated with the risk of sudden coronary death [6]. Coronary arteries are a target for coronary heart disease. The right and left coronary arteries depart from the corresponding sinuses of Valsalva, which are part of the aortic bulb. Adequate assessment of aortic bulb anatomy is important in preoperative planning of cardiac surgery and endovascular interventions. The development of the latter, in particular

transcatheter aortic valve implantation (TAVI), requires morphometric analysis of the structures of the aortic bulb and the orifice of the coronary artery [1].

Data on the height of coronary arteries in populations are quite variable [7, 9, 13], which emphasizes the difficulty of unifying the range of aortic sizes in the norm [4]. Analysis of morphometric parameters of orifice of the coronary artery among the population of Ukraine in the professional scientific literature is not covered.

*The aim of the study* was to determine the height of the coronary arteries branching in healthy women of Lviv city

and Lviv region and to determine the relationship between the height of the location of the orifice of the coronary artery with anthropometric indicators.

### Materials and methods

The materials of the study are represented by computed tomography (CT) images with contrast of the thoracic organs of women without damage to the heart and ascending aorta (norm). Patients of the Lviv Regional Clinical Hospital (Lviv, Ukraine) were involved in the study. CT scans were performed at the Ukrainian-Polish Heart Center "Lviv" (Lviv, Ukraine). The studies were performed on a 64-slice multidetector computed tomograph LightSpeed VCT XT, GE (General Electric, USA). The survey was conducted in 3 stages: planning topograms, phase without contrast (native) and phase with contrast. Scanning type - helical. Introduction of contrast Ultravist 470 (Bayer Healthcare, Germany) at a rate of 4 ml/s, followed by the introduction of sodium chloride solution (Arterium, Ukraine). Contrast volume was calculated for each patient individually, kVp and mAs/rotation were adjusted automatically depending on the patient's parameters. The survey protocol was performed according to the manufacturer's standards. CT analysis of angiography was performed at an appropriate station with licensed software (General Electric, USA) by two independent physicians.

Criteria for inclusion: CT of the chest with contrast; female patients; persons of the second period of mature age and old age; no complaints from the cardiovascular system; no history of cardiac surgery and endovascular interventions.

Exclusion criteria: patients with congenital malformations or abnormalities of the heart, coronary arteries and ascending aorta; inadequate visualization of the studied structures, incomplete clinical data.

The research was conducted in accordance with the Declaration of Helsinki and the approval of the **Bioethics Committee of LNMU named after D. Halytsky**, №5 dated July 22, 2020, with the informed consent of patients signed.

Of the 173 images analyzed, the study included data from 15 CT scans of the chest. The study used the following indicators: age, height, body weight, body mass index (BMI), body surface area. Body surface area was calculated by the formula of R. D. Mosteller [11]. All persons involved in the study were further divided into 2 groups depending on height: group 1 - females less than 1.6 meters tall (n=6), group 2 - with a height of more than 1.61 m (n=9). The average age of the surveyed persons was  $57.37 \pm 14.33$  years, including persons of the second period of mature age (age limits 36-55 years) and the elderly (elderly) age (age limits 56-74 years).

Image analysis was performed in horizontal (axial), sagittal and frontal (coronal) planes and 3D reconstruction. The height of the location of the upper and lower edges of

both coronary arteries was measured; the height of the right, left and posterior sinuses of Valsalva. Measurements of the height of the left coronary artery were measured in the oblique frontal reformation, the right coronary artery - in the oblique sagittal reformation. The height of the lower edge of the coronary artery was measured as the distance from the ring of the aortic valve to the lower edge of the coronary artery. Height of the location of the upper edge of the coronary artery - the distance from the ring of the aortic valve to the upper edge of the coronary artery. The height of the sinuses of Valsalva is the distance from the ring of the aortic valve to the sinus-tubular junction. All measurements were made according to the step-by-step instructions in the appropriate planes and are given in millimeters [3].

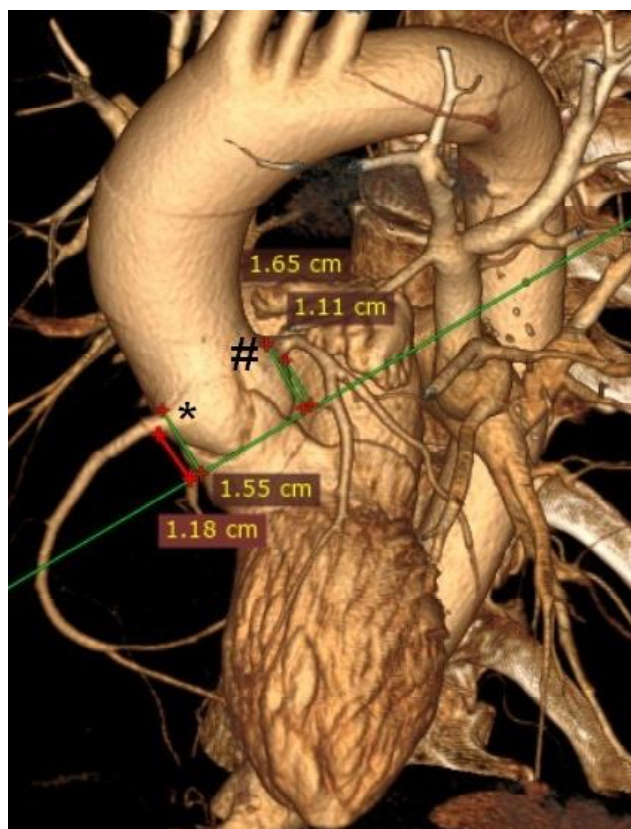
Statistical analysis was performed using R version 4.0.5 software (R Core Team, 2021) based on the Windows XP operating system using a personal computer [16]. The Shapiro-Francia test was used for correct distribution. The comparison of the mean values was performed according to the Student's t-test. The correlation between the observed variables was calculated using the Pearson linear correlation method (r). Values are presented as arithmetic mean  $\pm$  standard deviation (M $\pm$ SD) and in absolute numbers. The level of reliability  $p < 0.05$  was considered reliable.

### Results

According to clinical characteristics, the age of the persons was  $57.37 \pm 14.33$  years, height  $1.640 \pm 0.030$  m, body weight  $77.40 \pm 14.47$  kg and BMI  $29.78 \pm 6.18$  kg/m<sup>2</sup>. According to age periodization: 7 persons of the second period of mature age (46.67 %) and 8 persons of elderly (elderly) age (53.33 %). According to the BMI classification:



**Fig. 1.** Contrast-enhanced computed tomography of the chest. CT image visualizes the ascending aorta (Ao), aortic valve (red arrow), sinuses of Valsalva (white arrow), right coronary artery orifice (\*), left coronary artery (#).



**Fig. 2.** Contrast-enhanced computed tomography of the chest. 3D-reconstruction visualizes the measurement of the height of the divergence of the right (\*) and left (#) coronary arteries.

3 people with normal weight (20 %), 6 people with overweight (40 %), 4 people with grade I obesity (26.67 %) and 2 people with grade II obesity (13.33 %).

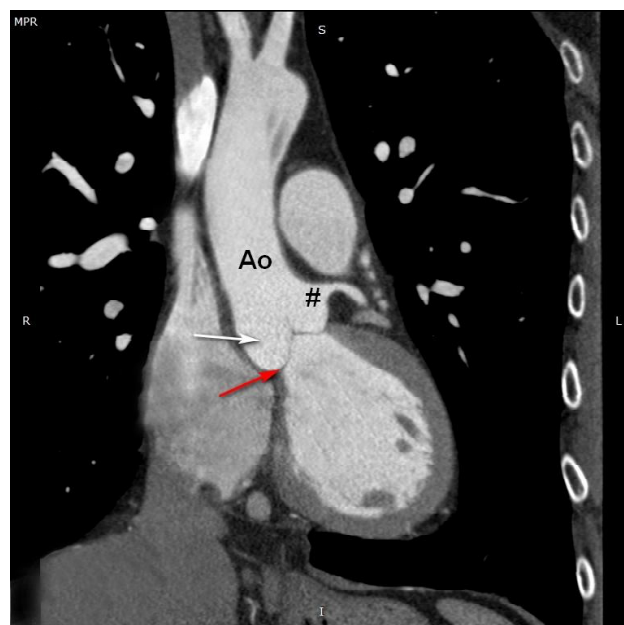
In women without structural changes in the heart and ascending aorta, the mean height of the left coronary artery was  $11.19 \pm 1.96$  mm. The measured distance from the aortic valve ring to the lower and upper edge of the right coronary artery (Fig. 1, 2) and to the lower and upper edge of the left coronary artery (Fig. 2, 3) differed between the studied groups: in the first group this figure was  $10.57 \pm 2.03$  mm, in the second group  $11.80 \pm 1.88$  mm,  $p=0.25$  (Table 1).

The mean height of the right coronary artery orifice in women was  $11.68 \pm 1.80$  mm. According to the distribution

by groups was  $11.43 \pm 1.62$  mm in the first group and  $11.97 \pm 2.03$  mm in the second,  $p=0.57$ . The height of the orifice of the right and left coronary arteries (Fig. 4) were almost the same, without statistical significance ( $p=0.26$ ).

The analysis of the correlation between the values of the height of the orifice of the coronary artery and anthropometric indicators did not show a significant dependence on height, which is actually explained by the above data of the highest values of the height of the orifice of the coronary artery in women of the second group. Data on the correlation between the height of the orifice of the coronary artery and height, weight, body mass index, body surface area and height of the sinuses of Valsalva are presented in Table 2.

It is logical to establish a direct relationship between the parameters of the height of the lower edge of the right coronary artery and the height of the upper edge of the right coronary artery ( $r=+0.75$ ,  $p=0.001$ ) and between the value

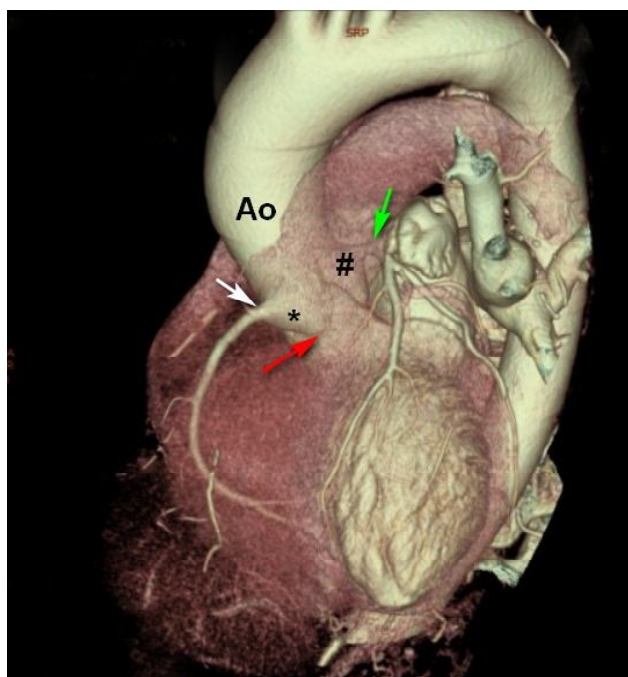


**Fig. 3.** Contrast-enhanced computed tomography of the chest. CT image visualizes the ascending aorta (Ao), aortic valve (red arrow), sinuses of Valsalva (white arrow), left coronary artery orifice (#).

**Table 1.** Indicators of the height of the orifice of the coronary artery in women without structural damage to the heart and ascending aorta.

Parameters (mm)	Total	n=15	Group 1	n=6	Group 2	n=9
	M±SD	Me[Q1;Q3]	M±SD	Me[Q1;Q3]	M±SD	Me[Q1;Q3]
LCAI	11.19±1.96	10.8 [9.9; 12.3]	10.57±2.03	10.3 [9.0; 12.3]	11.80±1.88	10.9 [10.4; 12.2]
LCAu	14.77±2.50	14.9 [13.5; 16.4]	13.45±3.02	13.5 [12.0; 15.8]	15.73±1.89	15.2 [14.7; 17.2]
RCAI	11.68±1.80	11.3 [10.4; 12.8]	11.43±1.62	11.3 [10.1; 12.4]	11.97±2.03	12.4 [10.4; 13.2]
RCAu	14.83±1.50	14.8 [13.9; 15.6]	14.45±1.30	14.7 [13.3; 15.6]	15.21±1.65	15 [14.5; 15.6]

**Notes:** LCAI - the height of the lower edge of the orifice of the left coronary artery; LCAu - the height of the upper edge of the orifice of the left coronary artery; RCAI - the height of the lower edge of the orifice of the right coronary artery; RCAu - the height of the upper edge of the orifice of the right coronary artery.



**Fig. 4.** Contrast-enhanced computed tomography of the chest. The 3D reconstruction visualizes the right sinuses of Valsalva (\*), the left sinuses of Valsalva (#), the aortic valve (red arrow), the right coronary artery (white arrow) and the left coronary artery (green arrow).

**Table 2.** Data on the correlation (r) between the indicators of the height of the location of the orifice of the coronary artery and other studied indicators in women without structural damage to the heart and ascending aorta (norm).

Indicators	Height of discharge of the left coronary artery		Height of discharge of the right coronary artery	
	r	p	r	p
Age	-0.04	0.89	0.44	0.09
Height	0.03	0.90	0.17	0.54
Weight	0.26	0.32	0.05	0.85
Body mass index	0.25	0.35	0.00	1.00
Body surface area	0.25	0.36	0.08	0.78
Height of the right sinuses of Valsalva	0.07	0.80	0.30	0.25
Height of the left sinuses of Valsalva	0.48	0.06	0.45	0.08
Height of the posterior sinuses of Valsalva	0.10	0.72	0.43	0.10
The height of the upper edge of the orifice of the right coronary artery	0.54	0.03	0.75	0.001
The height of the upper edge of the orifice of the left coronary artery	0.63	0.01	0.44	0.09

of the lower edge of the left coronary artery and an indicator of the height of the upper edge of the left coronary artery ( $r=+0.63$ ,  $p=0.01$ ).

### Discussion

The height of the orifice of the coronary artery discharge is an important parameter when planning cardiac surgery in pathology of the aortic valve and ascending aorta [2]. The high location of the right coronary artery at the appropriate height of the right sinuses of Valsalva is a frequent site of air embolism in cardiac surgery. Modern technique of transcatheter aortic valve implantation (TAVI) in the preoperative protocol requires measuring the height of the right and left coronary arteries [3, 6]. Underestimation of height can cause obstruction of the coronary artery [5].

The study measured the discharge of coronary arteries in women of Lviv city and Lviv region in the norm, aged over 18 years using computed tomography with contrast. It is valuable to analyze these data in the norm, which is not easy to carry out, given several points. First, contrast-enhanced computed tomography is performed according to clear indications under the direction of a physician. Second, creatinine and urea levels should be constant before the test. As a result, out of the large number of women surveyed (173 surveys), the images of 15 people corresponded to the norm. The study group consisted of persons of the second period of adulthood (ages 36-55 years) and the elderly (elderly) (ages 56-74). According to the body mass index, only 20 % of people corresponded to the level of normal weight. 80 % (12 people) were overweight or obese I-II degree.

According to the results of the study, in women there was no statistically significant relationship between the values of the height of the orifice of the coronary artery and indicators of age, height, weight, body mass index and body surface area. These data are consistent with the results published by Stolzmann [15], according to which age and BMI do not affect the height orifice of the coronary artery in women ( $p>0.05$ ). According to a retrospective analysis conducted in Italy, biometric parameters are low correlated with the size of the aorta [4]. Instead, H. Wang and co-authors (2021) report that age affects the size of the aorta. It is important to note that in women, in contrast to men, age does not correlate with the height of the discharge orifice of the coronary artery [17].

Data on the relationship between the height of the right and left coronary arteries differ significantly. In a study conducted by Swiss radiologists and cardiac surgeons, a statistically significant difference ( $p<0.001$ ) between the orifice height of the right and left coronary arteries was confirmed in the general population [15]. In contrast, data from the African continent indicate a slightly higher location of the eye of the left coronary artery than the right [12]. According to the results of our study, in females the height of the orifice of the right and left coronary arteries were almost the same, without statistical significance ( $p=0.26$ ).

Measuring the distance from the aortic valve ring to the lower edge of the coronary artery, we found that in women without structural changes in the heart and ascending aorta, the average height of the left coronary artery orifice is

11.19±1.96 mm, the average height of the right coronary arteries orifice - 11.68±1.80 mm. Drawing a parallel with previously published studies, we found that the distances are very variable [7, 9, 12, 15, 17]. The reasons for this are: geographical, racial, demographic and sex differences; use of various diagnostic methods for assessment (CT angiography, coronary angiography, esophageal ECHO, autopsy); difference in measurement technique. It would be rational to compare the data obtained by us with other regions of Ukraine. Unfortunately, the analysis of the professional literature showed that such studies have not been conducted.

The obtained results create prospects for the implementation of morphometric data in clinical practice. Globally, the study will complement world data, taking into account the peculiarities of anthropometric data of females

in Ukraine. The data will be useful for both morphologists and interventional cardiologists and cardiac surgeons for use in clinical practice.

### Conclusions

1. The analysis of the correlation between the values of the height of the location of the orifice of the coronary artery in women in norm and anthropometric indicators did not show a significant relationship.

2. Statistically significant differences between the height of the location of the orifice of the right and left coronary arteries in women were not found.

3. The measured distance from the ring of the aortic valve to the lower and upper edge of the right coronary artery and to the lower and upper edge of the left coronary artery ( $p=0.25$ ) differed between the studied groups.

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### ВИСОТА ВІДХОДЖЕННЯ ВІНЦЕВИХ АРТЕРІЙ В ЖІНОК У НОРМІ

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Морфометричний аналіз структур цибулини аорти та вінцевих артерій необхідний для планування кардіохірургічних та ендovasкулярних втручань. Мета дослідження - встановити висоту розташування відходження вінцевих артерій у здорових

жінок Львова та Львівської області та з'ясувати взаємозалежність показника висоти розташування вічок вінцевих артерій з антропометричними показниками. Для дослідження відібрані 15 зображень комп'ютерної томографії з контрастуванням органів грудної клітки осіб жіночої статі без ураження серця та висхідної аорти (норма). Проведено вимірювання висоти верхнього та нижнього краю вінцевих артерій; висоти пазух Вальсальви. Порівняння середніх величин здійснено за t-критерієм Стьюдента. Кореляцію між спостережуваними змінними (вік, зріст, маса тіла, індекс маси тіла, площа поверхні тіла, висота пазух Вальсальви) розраховано за допомогою методу лінійної кореляції Пірсона ( $r$ ). За результатами дослідження, популяційну групу склали особи другого періоду зрілого віку (46,67 %) та похилого віку (53,33 %). За показником індекса маси тіла 80 % з них страждали надлишковою вагою чи ожирінням I-II ступеня. Середнє значення висоти розташування вічка вінцевих артерій у жінок без структурних змін серця та висхідної аорти становило:  $11,19 \pm 1,96$  мм для лівої та  $11,68 \pm 1,80$  мм для правої. Висота відходження вічок правої та лівої вінцевих артерій були практично однаковими, без статистичної значущості ( $p=0,26$ ). Аналіз кореляційного зв'язку між значеннями висоти розташування вічок вінцевих артерій не показав вірогідної залежності від зросту, маси, віку, індексу маси тіла та площі поверхні тіла. Встановлено прямий взаємозв'язок між параметрами висоти нижнього краю вічка правої вінцевої артерії та показником висоти верхнього краю правої вінцевої артерії ( $r=+0,75$ ,  $p=0,001$ ) і між значенням висоти нижнього краю вічка лівої вінцевої артерії та показником висоти верхнього краю лівої вінцевої артерії ( $r=+0,63$ ,  $p=0,01$ ). Таким чином, аналіз кореляційного зв'язку між значеннями висоти вічок вінцевих артерій у жінок в нормі та антропометричними показниками не показав суттєвої залежності. Статистичної значущості різниці між показниками висоти відходження вічок правої та лівої вінцевих артерій у жінок не виявлено.

**Ключові слова:** вічка вінцевих артерій, анатомія, комп'ютерна томографія, аорта, вимірювання.

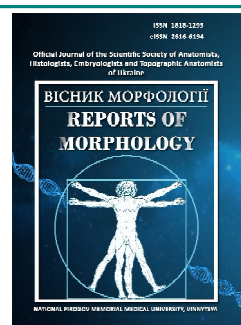
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# Determination of normative cephalometric parameters according to the Downs method for Ukrainian young men and young women with different face types

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### CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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*Orthodontics is a rapidly evolving branch of dentistry in both theoretical and practical areas. Modern instrumental research methods used in it organically coexist with the already classical ones, perfectly complementing each other. It is such a classic method that is actively used in the practice of orthodontics is cephalometric analysis, which nevertheless requires updates over time and the emergence of new scientific data. The aim of the study was to establish the limits of percentile range and features of cephalometric parameters according to the Downs method in Ukrainian young men and young women with orthognathic occlusion depending on the type of face. 49 young men and 76 young women with orthognathic occlusion underwent a cephalometric study using the Downs method in OnyxCeph<sup>3</sup>™ software, 3DPro version, Image Instruments GmbH, Germany (license № URSQ-1799). The division into facial types was performed using the Garson index. The licensed statistical package "Statistica 6.0" using non-parametric assessment methods analyzed the second (characteristics of the jaws by the method of Downs) and the third (indicators by the method of Downs that characterize the position of the teeth) groups of indicators. Studies have shown that most of the reliable or tendencies of differences in cephalometric parameters by the method of Downs in both young men and young women (more pronounced) with orthognathic occlusion, between different types of faces belong to the second group of indicators (dental characteristics of which surgical methods you can change the length, width, angles and positions of the upper and lower jaws). Manifestations of sexual dimorphism of cephalometric parameters by the method of Downs between young men and young women with appropriate facial types are insignificant and also, in almost all cases, belong to the second group of indicators. The established limits of percentile scope and features of cephalometric parameters according to the Downs method in Ukrainian young men and young women with orthognathic occlusion depending on the type of face will improve the existing methods of treatment of dental patients.*

**Keywords:** cephalometry according to the Downs method, young men and young women with orthognathic occlusion, face types, sex differences.

### Introduction

The development of a particular branch of medicine directly depends on the "demand" created by certain diseases in it, what socio-economic resonance they create, how they affect the quality of life and their prevalence. If we talk about orthodontics, the pathology of the dental and tooth-jaw system is extremely multisystemic and affects several systems of the human body and areas of activity. It can be a violation of the digestive and respiratory systems and a violation of speech and the overall beauty of the face, which in turn will negatively affect a person's social life.

If we are talking about such a component as prevalence, the data of researchers in different parts of the world are quite unanimous - the pathology of the dental and tooth-jaw system is a common phenomenon with a tendency to increase the number of cases. The global analysis of studies on the prevalence of occlusal pathology covered 53 studies. Among persons with permanent dentition, the prevalence of occlusion pathology of class III was 5.93 %, pathology of class II - 19.56 %, and pathology of class I - 74.7 %. In younger age groups with mixed type of dentition,

the distribution was 73 % for class III pathology, 23 % for class II pathology and 4 % for class I pathology. The most common pathologies were deep bite - 21.98 %, cross bite - 9.39 %, and open bite - 4.93 %. If we take into account the ethnic component, the highest prevalence of bite pathology of the first class was found in Africans, class II - in Europeans, and class III among the Mongoloids [4].

In a similar study, which included an analysis of 20 publications, the pathology of malocclusion class III ranged from 0 to 26.7 % depending on the region and ethnic group [13]. These findings already indicate a significant role of the constitutional component in the formation of the dental system.

An analysis of 25 articles on the prevalence of occlusal pathology among Iranian children (covering a total of 28,693 persons aged 3-18 years) revealed the prevalence of occlusion pathology of class I in 54.6 % of respondents, class II in 24.7 % and class III in 6.01 %. There was a greater prevalence of occlusion pathologies of III and I class among girls compared to boys (48.8 % and 44.6 % and 5.5 % and 4.5 %, respectively) [2].

The population of western Nepal is dominated by dental pathologies such as tooth accumulation, deep occlusion and the presence of increased gaps between teeth (61.3 %, 29.5 % and 10.5 %, respectively) [6].

In people with permanent dentition, residents of Brazil, the prevalence of occlusal pathology is 45.6 % [7]. The prevalence of cross-bite among schoolchildren in Italy is 3.7 % [12].

If we talk about the quality of life, and how the pathology of the bite affects it, then we can also note the unidirectional findings of research. Brazilian researchers in a study of 451 children aged 3 to 5 years found a relationship between the type of bite pathology and its impact on the quality of life of the child. A statistically significant association was found between anterior open occlusion and OHRQoL ( $p < 0.001$ ) [19]. The same data were obtained by Turkish scientists in a survey of preschool children [20].

At the same time, Dimberg L. and co-authors [8] obtained rather heterogeneous data - in some studies, the fact of the influence of occlusal anomalies on quality of life was found, in other cases, such a relationship was not found.

However, regardless of this, it is already clear that the pathology of the dental and maxillofacial system is a great challenge for modern orthodontics and finding solutions to this problem is an urgent issue today. The use of cephalometric research with the most individual approach to each patient, taking into account all his data can be the answer to this question, provided that adequate in volume and quality of research.

The aim of the study was to establish the limits of percentile range and features of cephalometric parameters according to the Downs method in Ukrainian young men and young women with orthognathic occlusion depending on the type of face.

## Materials and methods

According to the Downs method, cephalometry was performed for 49 young men and 76 young women with orthognathic occlusion in the software OnyxCeph<sup>3™</sup>, 3DPro version, Image Instruments GmbH, Germany (license № URSQ-1799).

**Committee on Bioethics** of National Pirogov Memorial Medical University, Vinnytsya (protocol № 9 From 21.11.2019) found that the studies do not contradict the basic bioethical standards of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant WHO regulations and laws of Ukraine.

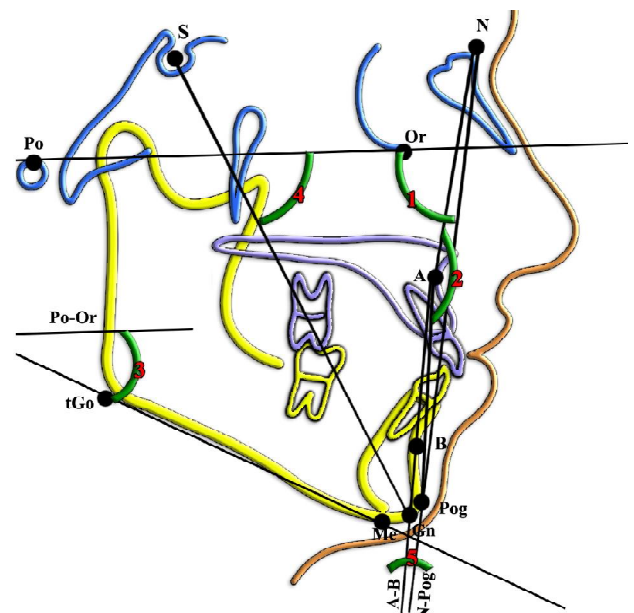
According to Dmitriev M. O. [9], all cephalometric indicators were divided into three groups. The first group includes indicators that usually do not change during surgical and orthodontic treatment, used in modern cephalometric analyzes of Schwartz, Ricketts, Steiner, Roth-Jarabak, Burstone and Bjork and were described by us in previous studies [11].

The main cephalometric points and measurements included to the second group of indicators according to the Downs method are shown in Figure 1.

The main cephalometric points and measurements included to the third group of indicators according to the Downs method are shown in Figure 2.

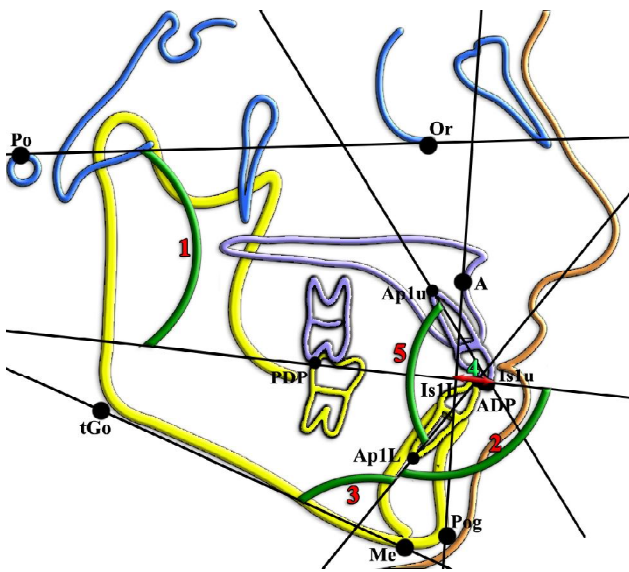
The division of young men and young women into facial types was performed using the Garson index [18].

The results were processed in the licensed statistical package "Statistica 6.0" using non-parametric evaluation



**Fig. 1.** The main cephalometric points and measurements according to Downs, which are in the second group of indicators: **1** - angle **POr\_NPog** (angle NPog-POr according to Ricketts, changes have been described in previous studies [10]) (°); **2** - angle **NAPog** (°); **3** - angle **POr\_MeGo** (°); **4** - angle **POr\_GnS** (°); **5** - angle **AB\_NPog** (°).





**Fig. 2.** The main cephalometric points and measurements according to Downs which are in the third group of indicators: 1 - angle **POR-DOP** (°); 2 - angle **1I-DOP** (°); 3 - angle **1I-MeGo** (°); 4 - distance **1u-APog** (mm); 5 - angle **II** (angle II according to Steiner, the changes are described in another article submitted for publication)

methods. The nature of the distributions for each of the variation series was estimated, the averages for each trait, the standard deviation and the percentile range limits were determined. The reliability of the difference between the values between the independent quantitative values was determined using the U-Mann-Whitney test.

**Results**

As a result of our research, we established the limits of the percentile range of cephalometric parameters according to the Downs method, which are included in the second and third groups of indicators, in Ukrainian young men and young women with orthognathic occlusion depending on facial type (Table 1).

Peculiarities and sex differences of cephalometric parameters according to the Downs method, which are included in the second and third groups of indicators, in Ukrainian young men and young women with orthognathic occlusion with different face types are shown in Table 2.

**Table 1.** Percentage scope limits (25,0<sup>th</sup>-75,0<sup>th</sup> percentl) of cephalometric parameters by the method of Downs in Ukrainian young men and young women with orthognathic occlusion depending on the type of face.

Indicator	Face type	Young men		Young women	
		25,0 <sup>th</sup> percentl	75,0 <sup>th</sup> percentl	25,0 <sup>th</sup> percentl	75,0 <sup>th</sup> percentl
<b>NAPog</b> (°)	Very wide	2.7	2.9	-4.5	1.3
	Wide	-3.2	5.5	0.2	5.8
	Average	-4.5	6.1	-0.1	4.7
	Narrow	-4.6	1.6	1.1	6.8

**Continuation of table 1.**

Indicator	Face type	Young men		Young women	
		25,0 <sup>th</sup> percentl	75,0 <sup>th</sup> percentl	25,0 <sup>th</sup> percentl	75,0 <sup>th</sup> percentl
<b>AB-NPog</b> (°)	Very wide	-7.1	-6.1	-5.2	-0.6
	Wide	-7.2	-2.8	-6.4	-2.1
	Average	-8.5	-2.6	-6.5	-1.7
	Narrow	-5.8	-2.9	-9.3	-2.7
<b>POR-MeGo</b> (°)	Very wide	7.5	19.6	16.1	20.9
	Wide	15.5	22.9	17.9	23.1
	Average	19.1	23.4	19.7	26.2
	Narrow	15.8	21.45	21.1	28.2
<b>POR-GnS</b> (°)	Very wide	52.6	57.4	53.8	58.1
	Wide	56.5	60.3	56.0	60.5
	Average	57.4	59.9	58.2	60.5
	Narrow	56.8	59.6	57.7	61.2
<b>POR-DOP</b> (°)	Very wide	2.7	4.3	4.4	7.0
	Wide	3.3	8.0	4.6	10.1
	Average	4.7	8.8	6.9	10.3
	Narrow	4.2	9.5	6.8	10.1
<b>1I-DOP</b> (°)	Very wide	15.6	25.9	13.1	23.0
	Wide	17.7	26.8	16.9	24.8
	Average	15.7	23.3	15.6	26.5
	Narrow	14.5	23.6	15.8	23.2
<b>1I-MeGo</b> (°)	Very wide	3.2	16.1	-1.3	11.1
	Wide	3.9	13.7	2.1	10.1
	Average	-1.1	10.2	-0.3	10.3
	Narrow	2.0	9.6	-2.0	9.3
<b>1u-APog</b> (mm)	Very wide	1.2	5.9	2.8	5.1
	Wide	3.6	5.5	3.8	6.2
	Average	2.7	5.0	2.8	6.7
	Narrow	2.0	4.5	3.2	5.5

**Table 2.** Peculiarities and sexual differences of cephalometric parameters according to the Downs method in Ukrainian young men and young women with orthognathic occlusion with different face types (M±σ)

Indicator	Face type	Young men	Young women	p
<b>NAPog</b> (°)	Very wide	2.400±4.881	-1.192±4.721	<b>=0.090</b>
	Wide	1.659±5.202	2.628±6.163*	>0.05
	Average	1.691±6.019	2.090±3.168*	>0.05
	Narrow	-1.538±4.378	3.858±3.487&	<b>&lt;0.05</b>
<b>AB-NPog</b> (°)	Very wide	-6.480±1.439	-3.156±3.246	<b>&lt;0.01</b>
	Wide	-5.032±3.058	-4.200±3.232	>0.05
	Average	-5.100±3.440	-3.870±2.647	>0.05
	Narrow	-4.550±2.636t	-5.483±3.479	>0.05

Continuation of table 2.

Indicator	Face type	Young men	Young women	p
<b>POr-MeGo</b> (°)	Very wide	13.44±6.23	18.52±3.63	>0.05
	Wide	18.90±5.78t	21.00±4.43*	>0.05
	Average	20.93±3.73*	23.35±4.30&t	>0.05
	Narrow	18.45±3.22	24.13±4.33##*	<0.01
<b>POr-GnS</b> (°)	Very wide	54.60±2.79	56.20±2.58	>0.05
	Wide	57.54±4.01t	58.22±3.15*	>0.05
	Average	58.35±2.17*	59.36±1.72&	>0.05
	Narrow	58.11±2.12t	59.51±2.29&	>0.05
<b>POr-DOP</b> (°)	Very wide	4.180±5.691	5.552±2.912	>0.05
	Wide	4.845±4.824	6.696±3.620	>0.05
	Average	6.900±2.832	8.230±2.445*	>0.05
	Narrow	6.225±4.407	8.275±2.621*	>0.05
<b>1I-DOP</b> (°)	Very wide	20.36±8.79	18.57±7.21	>0.05
	Wide	21.69±6.11	21.13±5.55	>0.05
	Average	18.73±7.34	19.32±5.62	>0.05
	Narrow	18.19±5.67	19.33±4.81	>0.05
<b>1I-MeGo</b> (°)	Very wide	11.12±9.10	5.612±8.518	>0.05
	Wide	7.645±7.524	6.820±5.422	>0.05
	Average	4.682±7.524	4.220±5.907	>0.05
	Narrow	5.963±4.836	3.458±6.040	>0.05
<b>1u-APog</b> (mm)	Very wide	3.360±2.686	4.064±1.903	>0.05
	Wide	4.641±1.491*	5.040±1.791	>0.05
	Average	3.718±2.356	5.140±2.386	>0.05
	Narrow	3.050±1.310	4.400±1.741	=0.097

**Notes:** p - the significance of the difference in the values of the respective indicators between young men and young women with the same face types; \*, &, # - significant differences (\* - p<0.05, & - p<0.01, # - p<0.001) relevant indicators between very wide and other types of faces in young men and young women (higher values are noted); t - tendency of discrepancies of the corresponding indicators between very wide and other types of the face in young men or young women (higher values are noted); \* - significant differences (\* - p<0.05) relevant indicators between wide and medium, or wide and narrow face types in young men or young women (higher values are noted); t - tendency of discrepancies of the corresponding indicators between wide and average, or wide and narrow types of the person in young men or young women (higher values are noted).

### Discussion

Thus, when comparing the cephalometric parameters by the method of Downs, belonging to the *second group* of indicators, between *young men or young women* with different facial types found both similar differences: both young men or young women with a very wide face type - significantly lower (p<0.05-0.001) or tendency (p=0.057-0.098) to lower values of *POr-MeGo* angles, which characterizes the angle of the mandibular plane relative to the Frankfurt plane (except for young men with a narrow face) and *POr-GnS*, which characterizes the angle the position of the *U-axis* relative to the Frankfurt plane than

that of representatives with other face types; only in young women with a very wide face type - significantly (p<0.05-0.01) smaller values of the angle **NAPog**, which characterizes the position of the lower jaw, namely the anterior contour of the chin relative to the upper jaw in the sagittal plane than in women with other face types; only in *young women* with a wide face type - significantly lower (p<0.05) or a slight tendency (p=0.093) to smaller values of the angle **POr-MeGo** than in women with narrow and medium face types; *only in young men* with a very wide face type there is a tendency (p=0.079) to smaller values of the angle **AB-NPog**, which characterizes the position of the plane/line AB relative to the N-Pog line, than in representatives of a narrow face.

When comparing the cephalometric parameters by the method of Downs, belonging to the *third group* of indicators, between young men and young women with different face types almost no significant differences were found: *only in young women* with a very wide face type found significantly (p<0.05) smaller values of **POr-DOP**, which characterizes the slope of the closing plane on the Downs relative to the Frankfurt plane than in young women with medium and narrow face types; and *only in young men* with a very wide face type there is a significantly (p<0.05) smaller value of the distance **1u-APog**, which characterizes the position of the cutting edge of the upper medial incisor in the sagittal plane relative to the A-Pog line (takes a positive value when the cutting edge and negative if behind the line) than in representatives with a very wide type of face.

Minor manifestations of sexual dimorphism of cephalometric parameters by the Downs method were also found, namely: significantly (p<0.05-0.01) greater or insignificant tendency (p=0.097) to greater values *in young women with narrow face type* **NAPog** and **POr-MeGo** angles and distances **1u-APog**, as well as significantly (p<0.01) greater value of the angle **AB-NPog** *in young women with a very wide face type* than in young men with the corresponding face types; in young men with a very wide face type showed only a slight tendency (p=0.090) to higher **NAPog** angle values than young women with the corresponding face type.

Authors from various scientific institutions are actively addressing the topic of studying the peculiarities of cephalometric indicators according to the Downs method.

The team of authors established the features of cephalometric indicators for the population of the state of Maharashtra (India). Among the indicators that were statistically significantly different from the normative indicators according to Downs, researchers distinguish the facial angle (average difference compared to the normative indicators -1.10), convexity angle (4.70), incisor angle (-13.54), angle of the lower incisor plane jaws (5.61), FMIA (-7.91) and the angle for protrusion of the lower incisors (5.40) (in all cases p<0.001) [1].

There were also differences in the cephalometric

parameters of the Downs method for residents of North India. These data showed statistically significant differences in the indicators of the facial angle and the angle of inclination of the occlusal plane [16].

An analysis of 238 telerradiograms of ethnic Iranians with a balanced face and no history of any surgery or pathology of the dental and tooth-jaw system revealed differences in cephalometric parameters for Iranians compared to Downs. Thus, Iranians have a greater angle of convexity of the face and the angle of IMPA [5]. In addition, these data are confirmed by a study conducted on the ethnic population of the city of Zanjan, which is also located in Iran [15].

In a study of a sample of ethnic Bangladeshis, the researchers found statistically significant differences from Downs data for facial angle, facial convexity angle, mandibular angle, Y-axis, and tilt of occlusal plane. In addition, the authors of the study identified manifestations of sexual dimorphism - higher values were observed in men [3].

Data from another study, also conducted on a sample of Bangladeshi residents, confirmed significant differences between cephalometric indicators of the local population and normative indicators for Downs. This study, in addition to the above results, also found that Bangladeshis have higher rates of AB plane, incisor angle, distances L1 to the mandibular plane, to the closing plane, U1 to the AB plane [14].

Pin-pin X. U. and Yan L. I. N. [17] found differences in cephalometric indices according to the Downs for the She and Han nationalities living in China. Statistically significant differences were found for MP-FH, U1-L1 and facial convexity ( $p < 0.05$ ).

In a Downs cephalometric examination of individuals belonging to the Mongoloid tribes of the state of Himachal

Pradesh (India), scientists found a significant difference compared to the normative indicators for the convexity angle, inclination of the occlusal plane and incisor angle [21].

Summarizing the above data on the study of cephalometric and odontological indicators according to the method of analysis by Downs among different ethnic groups and nationalities, we can see a common tendency of authors to identify differences with normative indicators obtained by Downs methodology.

The data obtained by foreign scientists are fully consistent with the data obtained during our study, which in turn emphasizes the relevance and necessity of research aimed at identifying the constitutional features of cephalometric indicators among, above all, healthy population, which in turn will serve basis for further research, however, on pathological conditions.

### Conclusions

1. In Ukrainian young men and young women with orthognathic occlusion, the limits of the percentile range of cephalometric parameters according to the Downs method depending on the type of face are found.

2. Practically all significant or trends in differences in cephalometric parameters by the method of Downs, both young men and young women (more pronounced), between different types of faces belong to the second group of indicators (dental characteristics of which surgical methods can change length, width, angles and positions of the upper and lower jaws).

3. Insignificant manifestations of sexual dimorphism of cephalometric parameters according to the Downs method have been found between young men and young women with appropriate facial types, which also, in almost all cases, belong to the second group of indicators.

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#### ВИЗНАЧЕННЯ НОРМАТИВНИХ ЦЕФАЛОМЕТРИЧНИХ ПАРАМЕТРІВ ЗА МЕТОДОМ DOWNS ДЛЯ УКРАЇНСЬКИХ ЮНАКІВ І ДІВЧАТ ІЗ РІЗНИМИ ТИПАМИ ОБЛИЧЧЯ

*Драчевська І.Ю., Дмитрієв М.О., Ліхницький О.М., Перлова А.В., Гунас І.В.*

Ортодонція є розділом стоматології, що швидко розвивається як в теоретичному так і в практичному напрямках. Сучасні інструментальні методи дослідження, що використовуються у ній, органічно співіснують з вже класичними, ідеально доповнюючи одне одного. Саме таким класичним методом, що активно використовується у практиці ортодонта, є цефалометричний аналіз, котрий, тим не менш, вимагає оновлень відповідно до плину часу і появи нових наукових даних. Мета дослідження - встановити межі процентильного розмаху та особливості цефалометричних параметрів за методом Downs в українських юнаків і дівчат з ортогнатичним прикусом в залежності від типу обличчя. 49 юнакам і 76 дівчатам з ортогнатичним прикусом у програмному забезпеченні OluxCeph<sup>3</sup>™, версії 3DPro, компанії Image Instruments GmbH, Німеччина (ліцензія № URSQ-1799) проведено цефалометричне дослідження за методикою Downs. Розподіл на типи обличчя проводили за допомогою індексу Гарсона. В ліцензійному статистичному пакеті "Statistica 6.0" з використанням непараметричних методів оцінки проведено аналіз другої (характеристики щелеп за методом Downs) та третьої (показники за методом Downs які характеризують положення зубів) груп показників. В результаті проведених досліджень встановлено, що більшість достовірних або тенденцій розбіжностей цефалометричних параметрів за методом Downs як в юнаків, так і у дівчат (більш виражено) з ортогнатичним прикусом, між різними типами обличчя відносяться до другої групи показників (зубо-щелепні характеристики, котрим хірургічними методами можна змінити довжину, ширину, кути та положення верхньої та нижньої щелеп). Прояви статевого диморфізму цефалометричних параметрів за методом Downs між юнаками та дівчатами з відповідними типами обличчя незначні і також, практично в усіх випадках, відносяться до другої групи показників. Встановлені межі процентильного розмаху та особливості цефалометричних параметрів за методом Downs в українських юнаків і дівчат з ортогнатичним прикусом у залежності від типу обличчя дозволять удосконалити існуючі методи лікування стоматологічних пацієнтів.

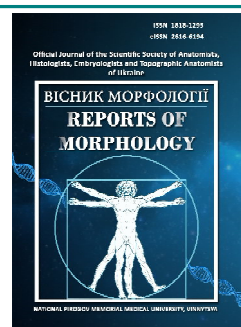
**Ключові слова:** цефалометрія за методом Downs, юнаки та дівчата з ортогнатичним прикусом, типи обличчя, статеві розбіжності.



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# Morphological changes in the white rats' thyroid gland 14 days after simulated thermal trauma of the skin on the background of the administration of 0.9 % NaCl solution

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### CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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According to the World Health Organization (WHO), there are about 11 million burns in the world each year, of which 180,000 are fatal. One of the systemic consequences of burn injuries is the so-called burn-associated hypermetabolism, the clinical picture of which includes immunological dysfunction, loss of bone mineral density, endocrine disorders, including thyroid dysfunction. The aim of the study was to establish histological and ultrastructural changes of the thyroid gland of experimental animals 14 days after the simulated thermal trauma of the skin on the background of using first 7 days 0.9 % NaCl solution. At the optical and ultrastructural levels of the study 14 days after thermal skin burn on the background of 0.9 % NaCl solution in the thyroid gland of experimental animals found: follicles - mostly large, overstretched (epithelium flat, with desquamation); cytoplasm of thyrocytes is poor in organelles, part of mitochondria with damaged cristae and enlightened matrix, available electron-dense lysosomes, apical surface smoothed; there is swelling of the capsule and trabeculae, leukocyte infiltration; components of the arterial and venous bed are dilated, there is a deformation of the lumen of blood vessels; hemocapillaries are dilated with numerous erythrocytes and perivascular edema. The detected changes cause a violation of the secretory cycle of thyrocytes, transendothelial metabolism and lead to an imbalance in the production and excretion of thyroid hormones.

**Keywords:** thyroid gland, structural changes, skin burn, 0.9 % NaCl solution.

### Introduction

Despite the modernization of working and living conditions in the XXI century, burn injuries and their long-term consequences remain a pressing problem in modern medicine and create a significant burden on the health care system in Ukraine and around the world. Thus, according to the World Health Organization (WHO), about 11 million burns are registered worldwide each year, of which 180,000 are fatal [11, 20]. At the same time, 90 % of burn injuries occur in developing countries [5, 17]. According to the American Burn Association, the majority of burn injuries (41 %) are thermal burns [1].

Modern combustiology recognizes that, due to the body's systemic response, severe skin burns to some extent affect the condition of all human organs. This is confirmed by the fact that during the autopsy of the dead due to severe burns in more than 70 % of cases the direct cause of death is multiple organ failure [9].

One of the systemic consequences of burn injuries is

the so-called burn-associated hypermetabolism, the clinical picture of which includes immunological dysfunction, loss of bone mineral density, endocrine disorders, including thyroid dysfunction [8]. A series of our studies is devoted to the study of morpho-functional changes of the latter in different periods after thermal skin burns. One of the most important steps in providing medical care to patients with burns is fluid resuscitation, the main purpose of which is to maintain adequate perfusion of distant organs. Discussions are still underway to determine the "drug of choice" for the treatment of burn shock, which is usually accompanied by massive loss of protein, electrolytes and plasma [10, 12, 15, 19].

Thus, the urgent task is not only to describe the morphological changes of the thyroid gland on the background of burn injury, but also to find the optimal solution for infusion therapy, the use of which would minimize the impact of burn shock on the functioning of

this endocrine gland.

*The aim of the study* was to establish histological and ultrastructural changes of the thyroid gland of experimental animals 14 days after the simulated thermal trauma of the skin on the background of using first 7 days 0.9% NaCl solution.

### Materials and methods

All research was conducted under the agreement on scientific cooperation between the research center of National Pirogov Memorial Medical University, Vinnytsya and the Department of Histology, Cytology and Embryology of Odessa National Medical University (from 01.01.2018), as well as between the Department of Histology and Embryology of Ternopil National Medical University named after I. Gorbachevsky and the Department of Histology, Cytology and Embryology of Odessa National Medical University (from 01.01.2019).

Experimental studies were conducted on 90 white male rats weighing 160-180 g (obtained from the vivarium of the Institute of Pharmacology and Toxicology of the National Academy of Medical Sciences of Ukraine), conducted on the basis of the Research Center of National Pirogov Memorial Medical University, Vinnytsya. The keeping and manipulation of animals was carried out in accordance with the "General Ethical Principles of Animal Experiments" adopted by the First National Congress on Bioethics (Kyiv, 2001), and was guided by the recommendations of the European Convention for the Protection of Vertebrate Animals for Experimental and Other Scientific Purposes. (Strasbourg, 1985), guidelines of the State Pharmacological Center of the Ministry of Health of Ukraine on "Preclinical studies of drugs" (2001), as well as rules of humane treatment of experimental animals and conditions approved by the **Committee on Bioethics** of National Pirogov Memorial Medical University, Vinnytsya (Minutes № 1 dated 14.01.2010).

Thermal skin burns of 2-3 degrees were performed by applying four copper plates (each with a surface area of 13.86 cm<sup>2</sup>) to pre-depilated side surfaces of the body of rats for 10 seconds, which were preheated for 6 minutes in water with a temperature of 100°C [6]. The total area of skin lesions was 21-23 %. The first 7 days, rats were infused with 0.9 % NaCl solution into the inferior vena cava. Animals were removed from the experiment by decapitation (after 1, 3, 7, 14, 21 and 30 days). Shaving, venous catheterization, skin burns, and decapitation of rats were performed under intravenous propofol anesthesia (60 mg/kg body weight).

Collection of material for microscopic examinations was performed according to generally accepted methods [7]. Pieces of the thyroid gland were fixed in 10 % neutral formalin solution, dehydrated in alcohols of increasing concentration, poured into paraffin blocks. The sections, 5-6 µm thick, were stained with hematoxylin-eosin [7]. Histological specimens were studied using a MIROMED SEO SCAN light microscope and photo-documented using

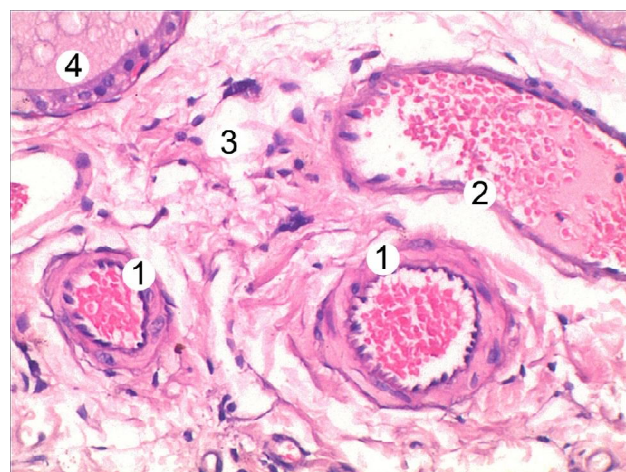
a Vision CCD Camera with a histological specimen image output system.

For electron microscopic examinations, pieces of the thyroid gland were removed, fixed in 2.5 % glutaraldehyde solution, and fixed with 1 % osmium tetroxide solution on phosphate buffer. Further processing was performed according to the generally accepted method [7]. Semi-thin sections were stained with methylene blue. Ultrathin sections made on an LKB-3 ultramicrotome were contrasted with uranyl acetate, lead citrate according to the Reynolds method [14] and studied under a PEM-125K electron microscope.

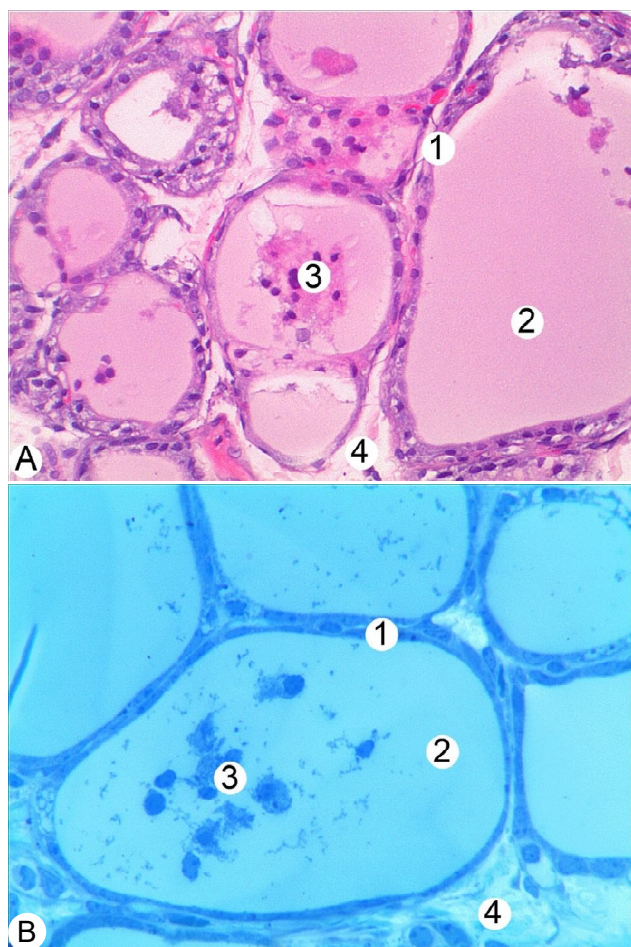
### Results

14 days after skin burn on the background of the introduction of 0.9 % NaCl solution at the microscopic level in the thyroid gland of experimental animals, significant changes in its structural elements were observed. Swollen trabeculae departed from the slightly thickened connective tissue capsule, which went deep into the organ, dividing it into lobes. In the layers, sometimes with leukocyte infiltration, loose connective tissue, there were numerous vessels that supply blood to the body. It should be noted that the components of the arterial and venous channels were dilated, there was a significant blood supply, protrusion of endothelial cells into the lumen, deformation of the lumen, which is often associated with changes in the media (Fig. 1).

The lobe itself consisted of follicles of different sizes and shapes. Among small, medium and large round and oval follicles, large ones were dominant. They looked significantly overstretched, limited by thinned, squamous epithelium and filled with homogeneous oxyphilic colloid. The epithelial cells were intensely basophilic, largely due to elongated, pyknotic nuclei with large amounts of



**Fig. 1.** Histological changes in the thyroid gland of the animal 14 days after skin burn on the background of the introduction of 0.9 % NaCl solution. 1 - arterioles 2 - venules, 3 - swollen interparticle loose connective tissue, 4 - a fragment of the follicle. Staining with hematoxylin and eosin. Magnification x400.



**Fig. 2.** Microscopic condition of the animal's thyroid gland 14 days after skin burn on the background of 0.9 % NaCl solution. 1 - thyrocytes and 2 - colloid of large follicles, 3 - desquamated thyrocytes in the lumen of the follicle, 4 - perifollicular connective tissue. A - Staining with hematoxylin and eosin. Magnification x400. B - Semi-thin slice. Methylene blue color. Magnification x400.

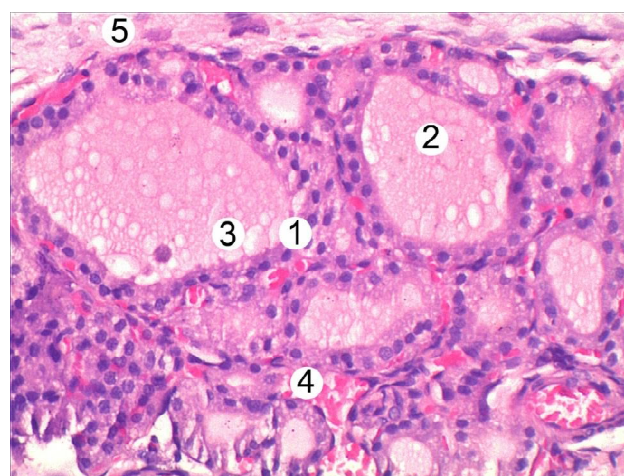
heterochromatin. In some follicles at this time of the experiment were desquamated thyrocytes in the colloid (Fig. 2A, 2B).

Medium and small follicles, which did not predominate numerically, were covered with cubic epithelium with central nuclei and light cytoplasm. The lumen of such follicles was filled with thyroglobulin, which had a dispersed appearance. Resorptive vacuoles were observed in some follicles (Fig. 3).

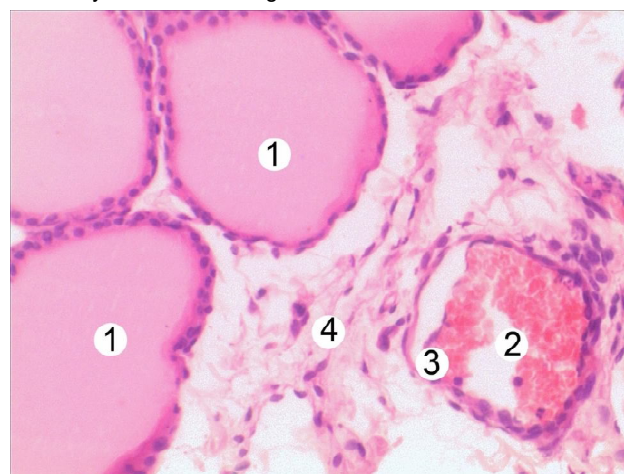
Significant changes in the components of the hemomicrocirculatory tract were found 14 days after skin burns on the background of 0.9 % NaCl solution in the swollen interfollicular connective tissue of the thyroid gland. Numerous erythrocytes were present in the unevenly dilated capillaries, and perivascular edema was present around them. The nuclei of the endothelial cells lining these hemocapillaries are dense, intensely basophilic. Adventitia of most arterioles and venules is infiltrated by leukocyte cells. They were also characterized by plethora and unequal

lumen diameter along the length of the vessel, in addition, there was detachment of the endothelium from the basement membrane (Fig. 4).

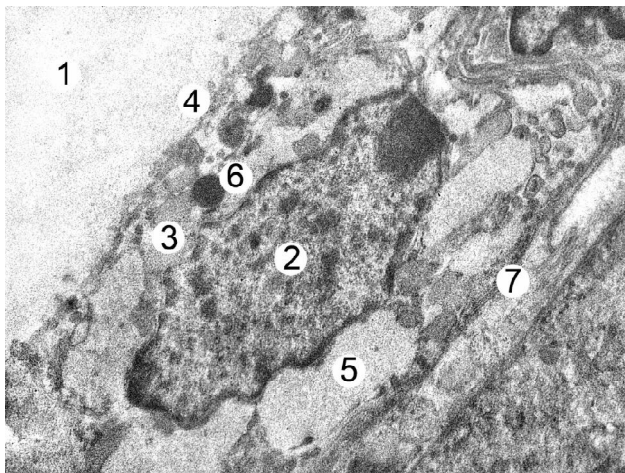
At the ultrastructural level, 14 days after skin burn on the background of 0.9 % NaCl solution, the wall of large follicles was lined with a single layer of squamous epithelium, the boundaries between the cells of which were poorly contoured. The apical surface of thyrocytes of these follicles is smoothed, with several microvilli, which indicated their low functional activity. The basal part of the plasmalemma was adjacent to the unevenly thickened basement membrane. The elongated forms of the nucleus are filled with karyoplasm, in which the accumulations of heterochromatin were placed marginally, and euchromatin occupied a more central position. One, and in some



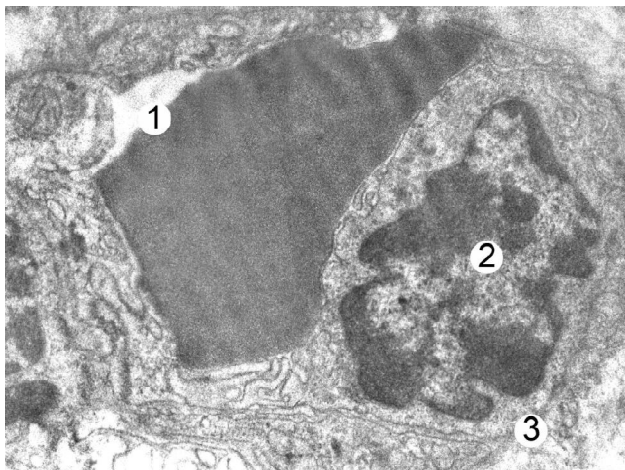
**Fig. 3.** Medium and small follicles of the thyroid gland of the animal 14 days after skin burn on the background of the introduction of 0.9 % NaCl solution. 1 - thyrocytes, 2 - colloid, 3 - resorption vacuoles, 4 - vessels, 5 - connective tissue. Staining with hematoxylin and eosin. Magnification x200.



**Fig. 4.** Histological changes in the thyroid gland of the animal 14 days after skin burn on the background of 0.9 % NaCl solution. 1 - follicles, 2 - venules with 3 - endothelial detachment, 4 - swollen connective tissue. Staining with hematoxylin and eosin. Magnification x400.



**Fig. 5.** Ultrastructure of the wall of the follicle of the thyroid gland of the animal 14 days after skin burn on the background of the introduction of 0.9 % NaCl solution. 1 - lumen of the follicle, 2 - nucleus and 3 - cytoplasm of thyrocyte, 4 - single microvilli on the apical surface of cells, 5 - vacuolated tubules of granular endoplasmic reticulum, 6 - lysosome, 7 - basement membrane. Electronogram. Magnification x13 000.



**Fig. 6.** Submicroscopic organization of the hemocapillary of the thyroid gland of the animal 14 days after skin burn on the background of the introduction of 0.9 % NaCl solution. 1 - capillary lumen with erythrocytes, 2 - endothelial cell nucleus, 3 - capillary basement membrane. Electronogram. Magnification x12 000.

thyrocytes, two nucleoli were visible. Nuclear pores are poorly expressed due to the electron-tight fit of heterochromatin to the karyolemma. The cytoplasm of squamous follicular epitheliocytes is poor in organelles. There was a small number of tubules of the granular endoplasmic reticulum with a small number of ribosomal granules on their membranes. In some thyrocytes, the components of the granular endoplasmic reticulum reached very large sizes, were expanded. The Golgi tanks were also characterized by variability in lumen size. Electron-dense lysosomes, mostly round in shape and of different sizes, were located in groups in the cytoplasm of follicular epitheliocytes. There were few mitochondria. They

have damaged cristae and enlightened matrix, some of them resembled vacuoles due to significant destruction of the inner membrane (Fig. 5).

Significant changes in hemocapillaries at the submicroscopic level were observed 14 days after skin burn on the background of 0.9 % NaCl solution administration. Most of them were characterized by wide lumens, densely filled with shaped elements, mainly erythrocytes. However, there were also significantly narrowed capillaries with a slit lumen. Capillary wall endotheliocytes contained osmophilic nuclei with a small nucleolus and a predominance of heterochromatin in the karyoplasm. Their karyolemma had numerous intussusception. The cytoplasm of endothelial cells was significantly swollen, but with a small number of pinocytic microbubbles, indicating a low level of transendothelial metabolism. Organelles are few, mostly found mitochondria (Fig. 6).

### Discussion

Referring to the data of our previous studies [18], we can trace the morphological changes of thyroid components in 1, 7 and 14 days after thermal burns on the background of the first 7 days of 0.9 % NaCl solution at optical and electron microscopic levels (Table 1).

Therefore, we see that 1 day after thermal trauma of the skin (ie in the stage of burn shock) on the background of the introduction of 0.9 % NaCl solution in the thyroid gland, there are reactive adjuvant-compensatory changes and initial manifestations of destruction. These changes in vascular, stromal and parenchymal components of the body correspond to the state of "stress", which is characterized by intensification of metabolic processes.

7 days after the simulated burn injury on the background of the introduction of 0.9 % NaCl solution in the structural elements of the thyroid gland is already dominated by the phenomena of destruction and alteration, which may be accompanied by clinically significant deterioration of functional activity of the organ.

Increased destructive changes are observed after 14 days of observation, as evidenced primarily by desquamation of thyrocytes, significant reduction and destruction of their organelles, the disappearance of microvilli, as well as edema of the connective tissue of the thyroid gland.

Unfortunately, relatively little attention has been paid to the study of the thyroid response to thermal skin burns, and therefore the body of available scientific data on this issue is limited.

Functional changes in the thyroid gland after severe burns were studied by determining the level of thyroid hormones in the blood, determining the uptake of radioactive iodine by the thyroid gland and describing pathological changes in the gland. However, the results of such studies contain contradictions.

The following are the data and conclusions of studies



**Table 1.** Morphological changes in the components of the thyroid gland at 1, 7 and 14 days after thermal burns on the background of the introduction of 0.9 % NaCl solution at the optical and electron microscopic level.

Indicators	Term of observation		
	1 day	Day 7	Day 14
The size of the follicles	Mostly medium in size.	Different. In the center of the lobe - small (highly prismatic epithelium), on the periphery - large (epithelium flat, with the phenomena of desquamation).	Mostly large, overstretched (epithelium flat, with the phenomena of desquamation).
Thyocytes	Low-prismatic form, resorption vacuoles are present. Mitochondria are swollen, with symptoms of cristae discomplexation. Lysosomes and phagosomes that cleave colloids on the apical surface. Available microvilli.	Cytoplasmic edema, destruction of organelles, mitochondria are few, their cristae are reduced. On the apical surface - a few vesicles and lysosomes. Single microvilli.	The cytoplasm is poor in organelles, few mitochondria with damaged cristae and an enlightened matrix. Available electron-dense lysosomes. The apical surface is smoothed.
Connective tissue	Swelling of loose connective tissue, intercellular edema.	Swelling of loose connective tissue, intercellular edema.	Capsule and trabeculae edema, leukocyte infiltration.
Vessels	Hemocapillaries without signs of excessive blood supply, endothelial cytoplasm without signs of edema.	Blood supply to arteries and veins, endothelial destruction, marginal leukocytes. Blood filling of hemocapillaries, stasis and sludge of erythrocytes, deformation of endothelial cells.	Extended components of the arterial and venous bed, deformation of the vascular lumen. Dilated hemocapillaries with numerous erythrocytes and perivascular edema.

in which pathological changes of the thyroid gland after severe burns were studied using light and electron microscopy, as well as peroxidase histochemistry [2, 3, 4, 13, 16].

At the optical level, the authors observed ubiquitous expansion of follicles at 2, 12, 24 hours and 3 days after burn, with follicular epithelial cells were markedly flattened, cubic or flat. This contradicts our results somewhat, as we observed mostly large follicles covered with squamous epithelium only on the 14th day of observation. In the apical part of follicular cells, the authors noted a meager amount of cytoplasm with a significantly reduced number of PAS-positive granules, colloid droplets were virtually absent. In addition, a large number of blisters and furrows (cracks) appeared in the apical cytoplasm within 12 hours to 3 days after the burn.

In contrast to our data, the authors of previous studies note the gradual restoration of the structure of the thyroid gland in 3 days after the burn. They note that in the apical cytoplasm of follicular cells, a large number of PAS-positive drops of colloid were formed from 10 to 15 days after the burn. The colloid in the lumen of the follicle was depleted, which is a sign of increased hormone secretion.

Also in previous studies it was noted that the cells of the follicular epithelium gradually returned to normal in the period from 3 to 6 days after the burn. Signs of organelle damage were significantly reduced. A characteristic feature of this stage was an increase in the number of lysosomes, multivesicular cells and autophagosomes, the appearance of polyribosomes in the cytoplasm, an increase in the

nucleus of euchromatin, the appearance of a large nucleolus. There were signs of active functioning of follicular epithelial cells in the period from 10 to 15 days after thermal burns. The main morphological manifestations were the formation of numerous pseudopodia and colloid droplets, the appearance of well-developed microvilli, as well as the accumulation of large numbers of lysosomes and mitochondria in the cytoplasm of follicular cells of the apical surface; expansion of ER; the presence of a well-developed Golgi complex; euchromatin and giant nucleolus; increase in the number of fenestrae in the endothelium of the hemocapillary wall.

The results obtained by us also do not confirm the above, because 14 days after the burn we observed the maximum degree of destructive changes in the thyroid gland.

### Conclusions

1. 14 days after thermal skin burn on the background of the first 7 days of 0.9 % NaCl solution in the thyroid gland of experimental animals, destructive changes in vascular walls, especially microcirculatory tract, thinning and destructuring of the follicle wall, with desquamation of epitheliocytes and its predominance lobules of large follicles was found.

2. The detected changes cause a violation of the secretory cycle of thyrocytes, transendothelial metabolism and lead to an imbalance in the production and excretion of thyroid hormones.

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#### МОРФОЛОГІЧНІ ЗМІНИ ЩИТОПОДІБНОЇ ЗАЛОЗИ БІЛИХ ЩУРІВ ЧЕРЕЗ 14 ДІБ ЗА УМОВ ЗМОДЕЛЬОВАНОЇ ЕКСПЕРИМЕНТАЛЬНОЇ ТЕРМІЧНОЇ ТРАВМИ НА ФОНІ ВВЕДЕННЯ 0,9 % РОЗЧИНУ НАСЛ

Тірон О.І.

За даними Всесвітньої організації охорони здоров'я (ВООЗ), у світі щороку реєструють близько 11 мільйонів опікових травм, з яких 180000 випадків є фатальними. Одним із системних наслідків опікових травм є так званий опік-асоційований гіперметаболізм, клінічна картина якого включає імунологічну дисфункцію, втрату мінеральної щільності кісткової тканини, ендокринні порушення, серед яких - дисфункція щитоподібної залози. Мета дослідження - встановити гістологічні та ультраструктурні зміни щитоподібної залози експериментальних тварин через 14 діб після змодельованої термічної травми шкіри на фоні введення впродовж перших 7 діб 0,9 % розчину NaCl. На світлооптичному та ультраструктурному рівнях дослідження через 14 діб після термічного опіку шкіри на фоні введення 0,9 % розчину NaCl у щитоподібній залозі піддослідних тварин встановлено: фолікули - переважно великі, перерозтягнуті (епітелій плаский, з явищами десквамації); цитоплазма тироцитів бідна на органели, частина мітохондрій з пошкодженими кристами та просвітленим матриксом, наявні електронно щільні лізосоми, апікальна поверхня згладжена; спостерігається набряк капсули та трабекул, лейкоцитарна інфільтрація; компоненти артеріального та венозного русла розширені, спостерігається деформація просвіту судин; гемокапіляри розширені з чисельними еритроцитами та периваскулярним набряком. Виявлені зміни спричиняють порушення секреторного циклу тироцитів, трансендотеліального обміну та ведуть до дисбалансу в утворенні та виведенні тиреоїдних гормонів.

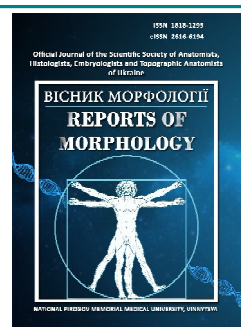
**Ключові слова:** щитоподібна залоза, структурні зміни, опік шкіри, 0,9 % розчин NaCl.



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## Features of skinfold thickness in men with benign nevi

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*Nevi, although benign neoplasms of the skin, but have a certain tendency to malignancy, which is influenced by various external and internal human factors. Predicting the risk of benign nevi against this background is an important topic for experimental research. The aim of the study was to establish the features of the skinfold thickness (SFT) in men of the first adult age with benign nevi. SFT was determined according to the Bunak scheme for men (aged 22-35 years) with melanocyte benign simple nevi (n=34), melanocyte benign dysplastic nevi (n=27), melanocyte benign congenital nevi (n=14) and non-melanocyte benign (n=17). The control group - SFT of 82 practically healthy men of the same age group was selected from the data bank of the Research Center of National Pirogov Memorial Medical University, Vinnytsya. Statistical processing of the results was performed in the license package "Statistica 5.5" using non-parametric evaluation methods. It was found that in practically healthy men higher than in patients - SFT on the anterior and posterior surfaces of the shoulder and thigh (in all groups of patients); SFT on the forearm, at the lower angle of the scapula, chest and shin (only in patients with melanocyte benign dysplastic nevi). Also in healthy men are found lower than in patients - SFT on the side (in all groups of patients); SFT in the abdomen (in patients with melanocyte benign simple and non-melanocyte benign nevi). When comparing SFT between patients with benign nevi, in most cases, lower values of SFT found in patients with melanocyte benign dysplastic nevi. The obtained results indicate the initial manifestations of abdominal (android) type of fat deposition in the body in patients with benign nevi (most pronounced in patients with melanocyte benign simple nevi).*

**Keywords:** benign nevi, skinfold thickness, men.

### Introduction

Nevi are usually benign melanocyte neoplasms that occur either in utero or during life and have different types of localization - both on the skin and on the mucous membranes of the mouth, genitals, etc. [10, 11, 12]. Nevi include common nevi, Spitz's nevus, blue nevus, and cutaneous melanocytosis; they can all be both congenital and acquired. According to the latest classifications, melanocytomas, which have a higher risk of malignancy, ie a transitional state between benign and malignant skin neoplasms, are considered a separate type of nevus [7, 21].

When it comes to malignancy of nevi, the worst result of this process is degeneration into melanoma, the prevalence of which is steadily increasing, as is the severity of the consequences it causes. From 2000 to 2006, the YPLL rate due to melanoma mortality increased by 8.7 %, and the cost of treatment was more than \$ 400,000 [9]. That is why medicine is currently moving towards creating new methods for early diagnosis of skin cancer [20].

The prevalence of nevi is heterogeneous and varies in

different countries and regions [16]. In Grenada (Spain), a survey of children aged 8-10 years revealed that the average number of nevi was 19.38 units (mostly less than 2 mm in diameter) [3]. In Olmsted County (USA) from 2000 to 2005, the overall incidence of nevi was 76.0 per 100,000 person-years [1].

If we consider the internal factors, then for most types of nevi, the characteristic areas of mutations responsible for their occurrence have been identified. Thus, for congenital normal nevi it is a mutation of BRAF V600E, for blue nevus - GNAQ, for acquired Spitz nevus it is HRAS [21].

Of the external factors, most attention is paid to insolation [11, 16, 21]. But the theory of the impact of smoking on increasing the risk of nevi has not found practical confirmation in experimental studies [18].

Spanish scientists conducted a study taking into account the constitutional elements - the phototype of man in order to identify the predisposition to nevi. According to the results of the study, the occurrence of nevi is associated with a low

type of phototype (ie the presence of blonde hair and fair skin) [3]. Thus, it can be assumed that a constitutional approach can be promising for assessing the risk of nevi.

The aim of the study was to establish the features of skinfold thickness in men of the first adult age with benign nevi.

**Materials and methods**

Men aged 22 to 35 years with benign nevi (34 with melanocyte benign simple nevi, 27 with melanocyte benign dysplastic nevi, 14 with melanocyte benign congenital nevi and 17 with non-melanocyte benign nevi), laboratory tests and histopathological examinations were performed on the base of Military Medical Clinical Center of the Central Region and the Department of Dermatology and Venereal Diseases with a course of postgraduate education National Pirogov Memorial Medical University, Vinnytsya.

Committee on Bioethics of National Pirogov Memorial Medical University, Vinnytsya (protocol № 10 From 26.11.2020) found that the studies do not contradict the basic bioethical standards of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant WHO regulations and laws of Ukraine.

The diagnosis of nevi was established according to a two-stage algorithm for the classification of pigmented tumors, which was adopted at the First World Congress of Dermatoscopy (Rome, 2001) [17].

All patients were determined skinfold thickness (SFT) according to the scheme of V.V. Bunak [4].

As a control from the database of the research center of the National Pirogov Memorial Medical University, Vinnytsya were selected SFT indicators of 82 healthy men of the same age group.

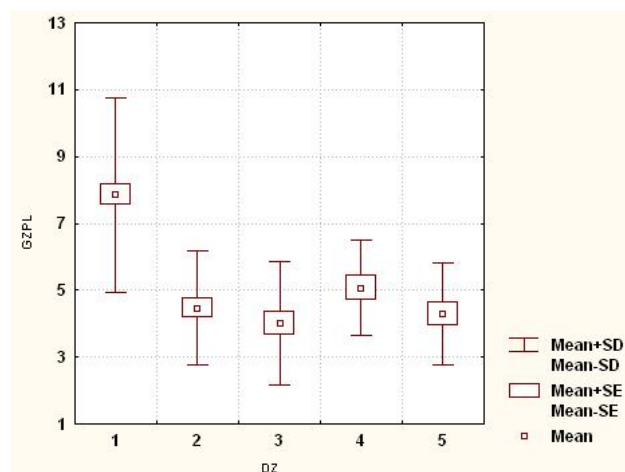
Statistical processing of the results was performed in the license package "Statistica 5.5" using non-parametric evaluation methods. The reliability of the difference between the values between the independent quantitative values was determined using the U-Mann-Whitney test.

**Results**

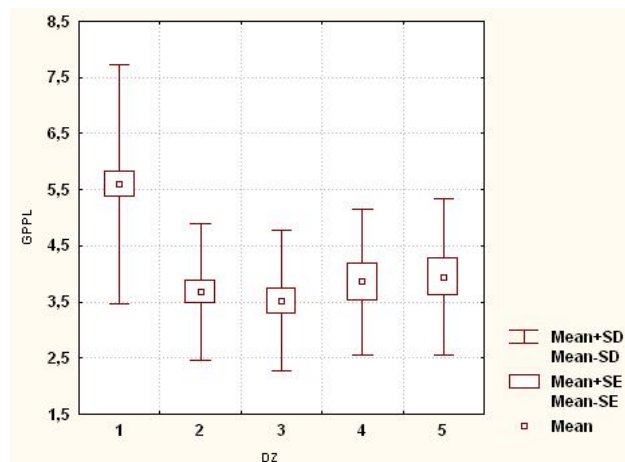
It was found that SFT on the posterior surface of the shoulder in healthy men was significantly ( $p < 0.001$ ) higher than in men with benign nevi; and in men with melanocyte benign congenital nevi - significantly greater ( $p < 0.05$ ) than in patients with melanocyte benign dysplastic nevi (Fig. 1).

SFT on the anterior surface of the shoulder in healthy men is significantly ( $p < 0.01-0.001$ ) higher than in men with benign nevi (Fig. 2).

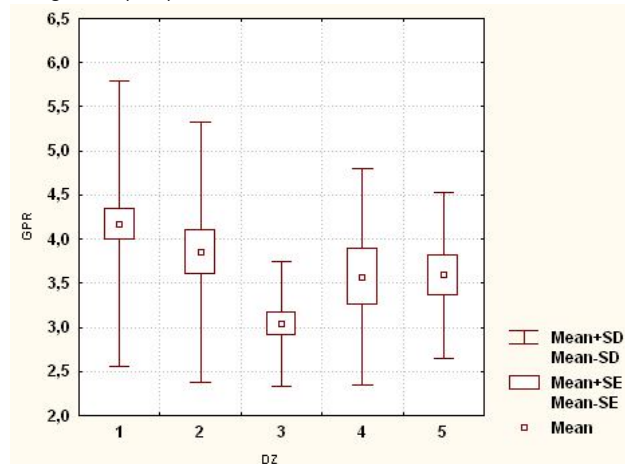
SFT on the forearm in healthy men was significantly ( $p < 0.001$ ) higher than in men with melanocyte benign dysplastic nevi; and in men with melanocyte benign dysplastic nevi - significantly less ( $p < 0.05$ ) than in patients with melanocyte benign simple nevi and tends to lower values ( $p = 0.065$ ) than in patients with non-melanocyte benign nevi (Fig. 3).



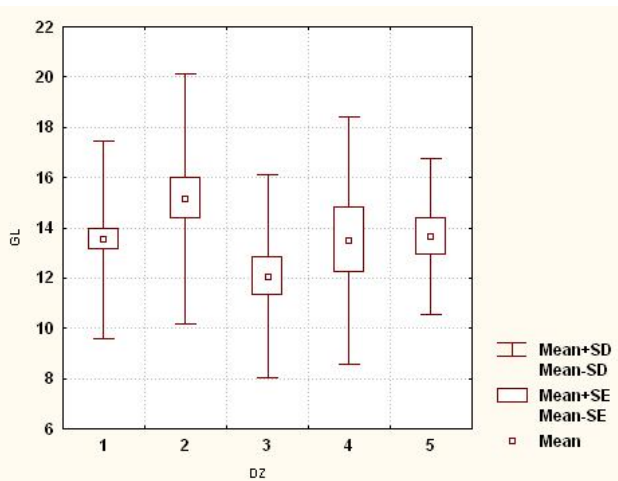
**Fig. 1.** Posterior shoulder SFT (GZPL) in healthy and sick men with benign nevi (mm). In this and the following figures: DZ - the corresponding groups of men; 1 - healthy men; 2 - men with melanocyte benign simple nevi; 3 - men with melanocyte benign dysplastic nevi; 4 - men with melanocyte benign congenital nevi; 5 - men with non-melanocyte benign nevi; Mean - average value; Mean±SE - average value ± mean error; Mean±SD - mean ± standard deviation.



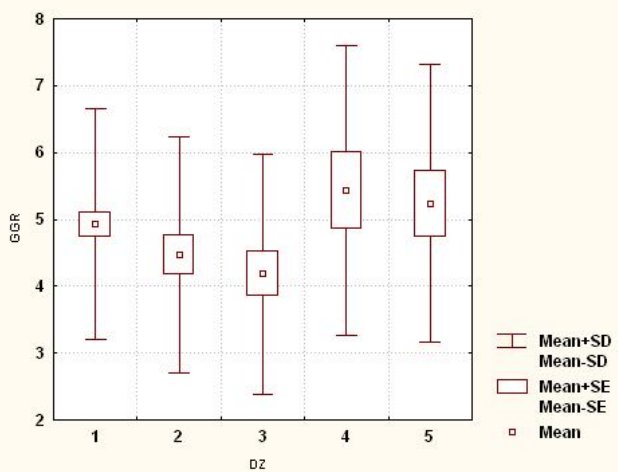
**Fig. 2.** Anterior shoulder SFT (GPPL) in healthy and sick men with benign nevi (mm).



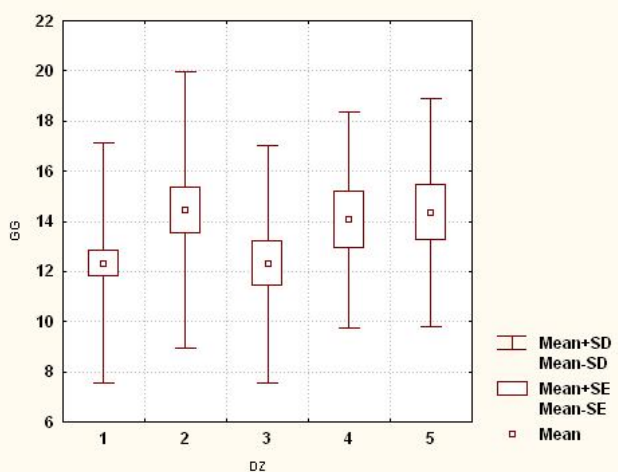
**Fig. 3.** SFT on the forearm (GPR) in healthy and sick men with benign nevi (mm).



**Fig. 4.** SFT under lower angle of the scapula (GL) in healthy and sick men with benign nevi (mm).



**Fig. 5.** SFT on the chest (GGR) in healthy and sick men with benign nevi (mm).



**Fig. 6.** Abdominal SFT (GG) in healthy and sick men with benign nevi (mm).

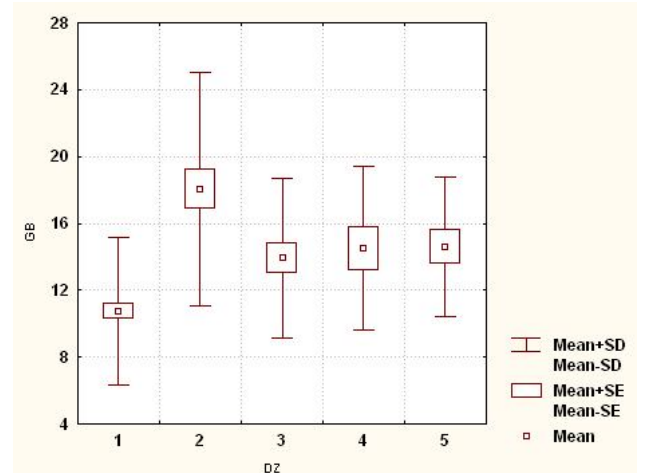
SFT under lower angle of the scapula in healthy men is significantly ( $p < 0.05$ ) higher than in men with melanocyte

benign dysplastic nevi; and in men with melanocyte benign dysplastic nevi - significantly less ( $p < 0.01$ ) than in patients with melanocyte benign simple nevi and has a slight tendency to lower values ( $p = 0.085$ ) than in patients with non-melanocyte benign nevi (Fig. 4).

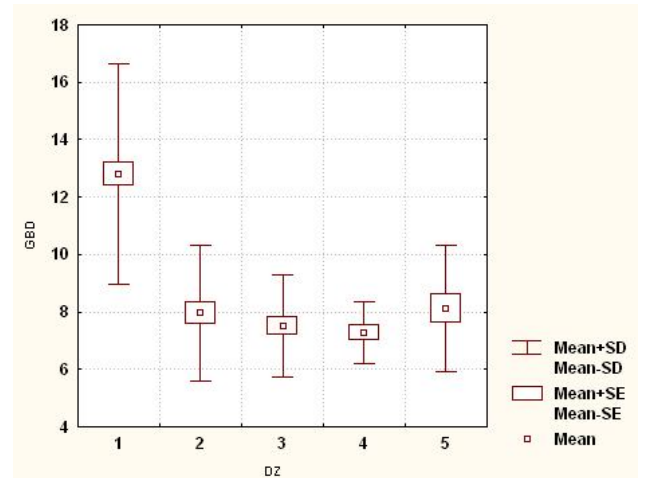
SFT on the breast in healthy men is significantly ( $p < 0.05$ ) higher than in men with melanocyte benign dysplastic nevi; and in men with melanocyte benign dysplastic nevi - tends to lower values ( $p = 0.054$  and  $p = 0.075$ ) than in patients with melanocyte benign congenital and non-melanocyte benign nevi (Fig. 5).

Abdominal SFT in healthy men is significantly ( $p < 0.05$ ) lower or has a slight tendency to lower values ( $p = 0.086$ ) than in patients with melanocyte benign simple and non-melanocyte benign nevi (Fig. 6).

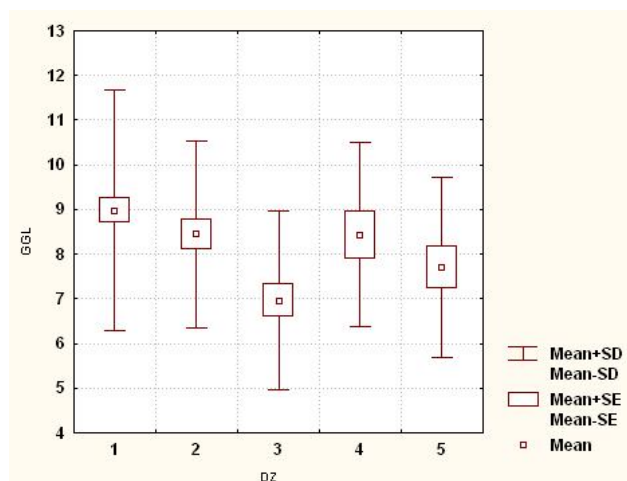
SFT on the side in healthy men is significantly ( $p < 0.01-0.001$ ) lower than in men with benign nevi; and in men with melanocyte benign simple nevi - significantly ( $p < 0.05$ ) greater or tends to higher values ( $p = 0.066$ ) than in patients with melanocyte benign dysplastic and non-melanocyte



**Fig. 7.** SFT on the side (GB) in healthy and sick men with benign nevi (mm).



**Fig. 8.** SFT on the thigh (GBD) in healthy and sick men with benign nevi (mm).



**Fig. 9.** SFT on the shin (GGL) in healthy and sick men with benign nevi (mm).

benign nevi (Fig. 7).

SFT on the thigh in healthy men is significantly ( $p < 0.001$ ) higher than in men with benign nevi; and in men with non-melanocyte benign nevi - tends to higher values ( $p = 0.065$ ) than in patients with melanocyte benign congenital nevi (Fig. 8).

SFT on the shin in healthy men was significantly ( $p < 0.01$ ) higher than in men with melanocyte benign dysplastic nevi; and in men with melanocyte benign dysplastic nevi - significantly ( $p < 0.05$ ) less or tends to lower values ( $p = 0.054$ ) than in patients with melanocyte benign simple and melanocyte benign congenital nevi (Fig. 9).

**Discussion**

In the analysis of SFT between healthy and benign nevi men found (Table 1):

SFT on the anterior and posterior surfaces of the shoulder and thigh in healthy men is significantly higher than in patients with melanocyte benign simple nevi (43.0 %, 34.2 % and 37.7 %, respectively), melanocyte benign dysplastic nevi (respectively). 49.0 %, 37.1 % and 41.3 %), melanocyte benign congenital nevi (respectively 35.4 %, 31.0 % and 43.1 %) and non-melanocyte benign nevi (respectively 45.3 %, 29.5 % and 36.6 %);

SFT on the forearm by 27.2 %, under lower angle of the shoulder blade by 10.8 %, on the chest by 15.0 % and on the shin by 22.5 % in healthy men is significantly higher than in patients with melanocyte benign dysplastic nevi;

SFT on the side in healthy men is significantly lower than in patients with benign nevi (40.4 %, 22.8 %, 25.9 % and 26.3 %, respectively);

Abdominal SFT in healthy men is significantly lower or tends to be lower than in patients with melanocyte benign prostatic (14.6 %) and non-melanocyte benign (14.1 %) nevi.

Given the significantly higher values of SFT on the side and abdomen in patients with benign nevi (most pronounced in patients with melanocyte benign simple

nevi), we observe the initial manifestations of abdominal (android) type of fat deposition in the body.

In the analysis of SFT between men with benign nevi found (see table 1):

significantly lower or lower values in patients with melanocyte benign dysplastic nevi - SFT on the forearm and at the lower angle of the scapula than in patients with melanocyte benign prostatic nevi (14.0 % and 20.5 %, respectively) and non-melanocyte benign nevi (respectively by 15.4 % and 11.6 %); SFT on the shin than in patients with melanocyte benign prostatic (17.5 %) and congenital (17.4 %) nevi; SFT on the breast than in patients with melanocyte benign congenital (22.9 %) and non-melanocyte benign (20.1 %) nevi; SFT on the side than in patients with melanocyte benign simple nevi (by 22.7 %); SFT on the posterior surface of the shoulder than in patients with melanocyte benign congenital nevi (21.1 %);

the tendency to higher values in patients with melanocyte benign simple nevi SFT on the side by 19.1 % than in patients with non-melanocyte benign nevi;

the tendency to higher values in patients with non-melanocyte benign nevi SFT on the thigh by 10.2 % than in patients with melanocyte benign congenital nevi.

The multifactorial nature of human skin cancer is a long-established scientific fact [15, 19], but anthropometric studies on the study of melanocyte skin tumors still remain few.

A review of 44 literature sources in the PubMed database revealed an association between indicators such as freckle density, eye color, hair color, family history, skin type, number of atypical and common nevi, and risk of melanoma [2].

The data of K.J. Buster and co-authors [5] suggest that the elderly, blacks, with low levels of education have a lower

**Table 1.** Differences in SFT between healthy and benign nevi patients, as well as between sick men.

Indicators	Healthy	Sick			
		MBN	MBDN	MBCN	NMBN
SFT on the back of the shoulder	▲	▼	▼▼	▼▲	▼
SFT on the front surface of the shoulder	▲	▼	▼	▼	▼
SFT on the forearm	▲	▲	▼▼		▲
SFT at the lower angle of the scapula	▲	▲	▼▼		▲
SFT on the chest	▲		▼	▲	▲
SFT on the abdomen	▼▼	▲			▲
SFT on the side	▼	▲▲▲	▲▼	▲	▲▼
SFT on the thigh	▲	▼	▼	▼	▲▼
SFT on the shin	▲	▲	▼▼	▲	

**Notes:** SFT - skinfold thickness; MBN - melanocyte benign common nevi; MBDN - melanocyte benign dysplastic nevi; MBCN - melanocyte benign congenital nevi; NMBN - non-melanocyte benign nevi; ▲ or ▼ - significant differences between healthy and sick men; ▲ or ▼ - trends in differences between healthy and sick men; ▲ or ▼ - significant differences in indicators between sick men; ▲ or ▼ - tendencies of differences of indicators between sick men.

risk of skin cancer. In general, in all groups of individuals studied, the criterion of low quality of education acted as a criterion for reducing the risk of skin cancer.

The purpose of the analysis of scientific research in the period from 1985 to 2011 revealed that obesity is a factor in the increased risk of many cancers of the human body, in particular, melanoma (RR=1.26) [6].

J.C. Dusingize, and co-authors [8] conducted an interesting study to find a relationship between genetically predicted constitutional characteristics of the human body and the risk of melanoma. No relationship was found with BMI, but with human growth such a relationship was found [OR 1.08, 95 % CI: 1.02-1.13, 1 SD (9.27 cm) increase in height].

Data on the association between the risk of melanoma and human growth are confirmed in another study, as well as the usefulness of using the number of nevi. In addition, it is indicated that the prevalence of melanoma is almost the same among men and women [13].

Waist circumference can be used as a marker of melanoma of the skin - as evidenced by the purpose of the analysis conducted by Korean scientists [14].

Analysis of the results of 9 publications (total number of study participants 971,795 healthy individuals and 50,561 patients with non-melanocyte skin cancer) allowed to

establish nonlinear feedback between body mass index and the risk of non-melanocyte skin cancer (RR=0.88, 95 % CI: 0.85-0.91, I<sup>2</sup>=71.2 %, p<0.001). The strongest association was observed between body mass index and squamous cell carcinoma and basal cell carcinoma of the skin. Manifestations of sexual dimorphism were practically not detected, except for the reverse weak association in men [22].

A preliminary review of the literature did not reveal any publications in the available scientometric databases in the last 10 years regarding the use of anthropometric indicators to predict the occurrence of benign nevi. Thus, the results of this study are unique not only for the domestic but also for the international scientific community.

## Conclusion

1. Numerous differences in SFT (higher values in healthy men, except for folds on the side and abdomen) have been found between healthy and men with benign nevi, which reflect the initial manifestations of abdominal (android) type of fat deposition in the body.

2. Differences between men with different forms of benign nevi mainly concern lower values of the majority of SFT in patients with melanocyte benign dysplastic nevi.

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### ОСОБЛИВОСТІ ТОВЩИНИ ШКІРНО-ЖИРОВИХ СКЛАДОК У ЧОЛОВІКІВ З ДОБРОЯКІСНИМИ НЕВУСАМИ

#### *Набіль Басім Юсіф Хаддад*

*Невуси, хоч і є доброякісними новоутвореннями шкіри, проте мають певну схильність до малигізації, на що впливають різні як зовнішні, так і внутрішні фактори людини. Передбачення ризику виникнення доброякісних невусів на даному фоні є актуальною темою для проведення експериментальних досліджень. Мета дослідження - встановити особливості товщини шкірно-жирових складок (ТШЖС) у чоловіків першого зрілого віку, хворих на доброякісні невуси. Проведено визначення ТШЖС за схемою Бунака чоловікам (віком 22-35 років), хворим на меланоцитарні доброякісні прості невуси (n=34), меланоцитарні доброякісні диспластичні невуси (n=27), меланоцитарні доброякісні вроджені невуси (n=14) та немеланоцитарні доброякісні невуси (n=17). Контрольна група - ТШЖС 82 практично здорових чоловіків аналогічної вікової групи відібрана з банку даних науково-дослідного центру Вінницького національного медичного університету імені М.І. Пирогова. Статистичну обробку результатів проведено в ліцензійному пакеті "Statistica 5.5" з використанням непараметричних методів оцінки. Встановлено, що у практично здорових чоловіків більші, ніж у хворих - ТШЖС на передній та задній поверхнях плеча і на стегні (в усіх групах хворих); ТШЖС на передпліччі, під нижнім кутом лопатки, на грудях і на гоміліці (лише у хворих на меланоцитарні доброякісні диспластичні невуси). Також у здорових чоловіків встановлені менші, ніж у хворих - ТШЖС на боці (в усіх групах хворих); ТШЖС на животі (у хворих на меланоцитарні доброякісні прості та немеланоцитарні доброякісні невуси). При порівнянні ТШЖС між хворими на доброякісні невуси чоловіками, в більшості випадків, встановлені менші значення ТШЖС у хворих на меланоцитарні доброякісні диспластичні невуси. Отримані результати вказують на початкові прояви абдомінального (андроїдного) типу відкладення жиру в організмі у хворих на доброякісні невуси (найбільш виражені у хворих на меланоцитарні доброякісні прості невуси).*

**Ключові слова:** доброякісні невуси, товщина шкірно-жирових складок, чоловіки.

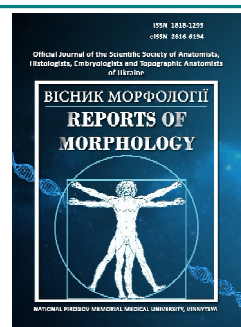




## REPORTS OF MORPHOLOGY

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# Influence of quercetin on morphological changes in rats testes after 180 days during central deprivation of luteinizing hormone

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### CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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A relevant and popular area of research is the protective effect of the bioflavonoid quercetin, which makes it possible to use it to correct testicular dysfunction of various origins. The aim of the study was to determine the effect of quercetin on the microscopic organization of rat testicles, nitric oxide production and the intensity of oxidative stress in rat testicles on the 180th day of the experiment, during experimental central deprivation of luteinizing hormone synthesis caused by triptorelin solution. The experiment was performed on 20 adult male white rats. Rats were divided into 2 groups of 10 animals in each group: control group (I), group with central deprivation of LH synthesis + quercetin (II). Animals from the group with central deprivation of LH synthesis were injected subcutaneously with triptorelin acetate at a dose of 0.3 mg of active substance per kg and quercetin 100 mg per kg of body weight 3 times a week, while the control group was injected with saline. Ultrathin sections made by ultramicrotome were contrasted with 1 % aqueous uranyl acetate and lead citrate according to the Reynolds method and examined by electron microscopy. According to standard methods, the material was poured into paraffin blocks, from which sections with a thickness of 4 μm were made and stained with hematoxylin and eosin. Histological specimens were examined using a Biorex 3 light microscope with a digital microfilter with software adapted for these studies. All biochemical studies were performed in 10 % of testicular tissue homogenate using a Ulab 101 spectrophotometer. Statistical processing of the study results was performed using Microsoft Office Excel software and Real Statistics 2019 extension. The nonparametric Mann-Whitney test was used to determine the statistical significance of differences between groups. Our study of the interstitial space in the testes of white rats showed the heterogeneity of populations of endocrinocytes and macrophages and the variability of structural and functional parameters. In the tissues of the testes in conditions of prolonged central deprivation of testosterone synthesis develops oxidative stress, which on the 180th day of the experiment leads to the development of edema of the interstitial space, followed by tissue fibrosis. Changes in the polarization of macrophages in our opinion may cause oxidative stress in the testes, as evidenced by increased iNOS activity and decreased arginase activity, but use of quercetin protects rat testicular tissue from oxidative damage caused by triptorelin by increasing direct antioxidant system and effects on the lipoxigenase pathway of arachidonic acid metabolism.

**Keywords:** testis, interstitial endocrinocytes, macrophages, quercetin, NO synthase, rats.

### Introduction

The reproductive health of the population is an integral part of the demographic processes taking place in society, therefore, the problems associated with its violation today go beyond the medical, and acquire a social character [1]. In recent decades, men all over the world have seen a sharp deterioration in spermogram indicators, according to reproductive centers, the percentage of fertilization is

decreasing, and cases of embryonic mortality are increasing. Over the past decades, a clear tendency towards a decrease in the activity of spermatogenesis in men has been observed throughout the world [13]. For the period from 2015 to 2020 the increase in the absolute number of patients with prostate diseases in our country alone was 36.2 % [14]. There is an increase in infertile

marriages, in which, according to statistics, the proportion of the male factor is increasing. If several decades ago the share of male infertility, as the cause of infertile marriage, was, according to various sources, from 15 to 25 %, today it is, according to various estimates, from 30 to 60 % [1].

As you know, testosterone (via luteinizing hormone) and follicle-stimulating hormone are two main and independent regulators of spermatogenesis, since the effects of each of them are realized at certain stages of the spermatogenic cycle [21]. Under stress of various etiologies in rats, disturbances in the hypothalamic-pituitary system are observed, which leads to a violation of the production of releasing factors by neurosecretory cells of the hypothalamus, as a result, the production of gonadotropic hormones by the anterior pituitary gland is inhibited [2, 15]. A decrease in the level of follicle-stimulating hormone in the blood serum of male rats was found under emotional pain stress [4], under hypokinetic stress [6]. Similar results were obtained when studying the influence of emotional stress and systematic physical activity on human sexual function [22]. Under emotional stress in men, the authors found a decrease in the concentration of gonadotropic hormones and a decrease in the concentration of testosterone, which was accompanied by changes in the main parameters of the spermogram [18]. Modern research has proven the participation of the immune system in the development of spermatogenesis pathology [12].

The protective effect of the bioflavonoid quercetin revealed on the experimental model makes it possible to use it for the correction of testicular dysfunction of various origins [10, 19]. These facts indicate the need to take measures to clarify the causes of reproductive deviations, study the mechanisms and search for prophylactic means of correction.

*The aim of the study* was to determine the effect of quercetin on the microscopic organization of rat testicles, nitric oxide production and the intensity of oxidative stress in rat testicles on the 180th day of the experiment, during experimental central deprivation of luteinizing hormone synthesis caused by triptorelin solution.

### Materials and methods

The experiments were carried out on 20 sexually mature male white rats. Rats were divided into 2 groups with 10 animals in each group: the control group (I), the group with central deprivation of LH synthesis + quercetin (II). Animals from the group with central deprivation of testosterone synthesis were injected subcutaneously with triptorelin acetate at a dose of 0.3 mg of the active substance per kg [9, 16] and quercetin 100 mg per kg body weight 3 times a week [7], while the control group was administered saline. Experiment conducted for 180 days. Animals were kept in standard vivarium conditions of the Poltava State Medical University. **Committee on Bioethics** of Poltava State Medical University (protocol № 195 From 24.06.2021) found that the studies do not contradict the basic bioethical standards

of the "European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes"; (Strasbourg, 1986), as well as with the "General Ethical Principles of Animal Experiments" adopted by the First National Congress on Bioethics (Kyiv, 2001).

After an overdose of ketamine, the animals were decapitated, the prepared small pieces of the testes were fixed in a 2.5 % glutaraldehyde solution (pH=7.2-7.4). Postfixation of the material was carried out with 1 % solution of osmium (IV) oxide, followed by dehydration in propylene oxide and a sample was embedded into the epoxy resins mixture. Ultrathin sections made with an ultramicrotome were contrasted with a 1 % aqueous solution of uranyl acetate and lead citrate according to the Reynolds' method and studied with an electron microscope [3].

Using standard methods, the material was imbedded in paraffin blocks, of which sections 4  $\mu$ m thick were made and stained with hematoxylin and eosin. Histological preparations were examined using Biorex 3 light microscope with digital microfilter with software adapted for these studies (Serial No. 5604).

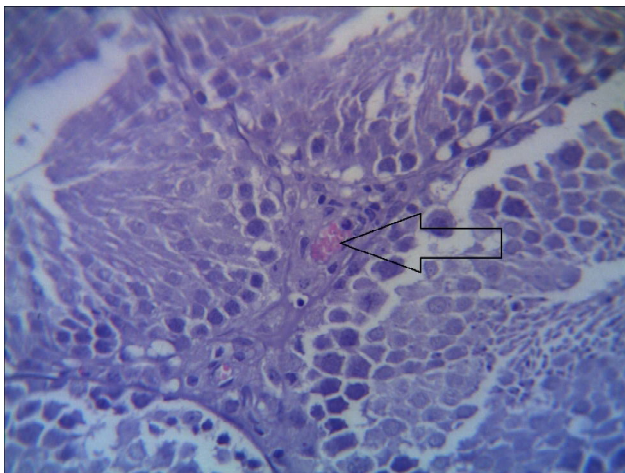
We carried out all biochemical studies in 10 % homogenate of testis tissue using Ulab 101 spectrophotometer. General activity of NO-synthase (gNOS), activity of constitutive isoforms (cNOS), activity of inducible isoform (iNOS) was determined by increase of nitrite concentration after incubation in buffer solution (pH=7.4) containing 0.3 ml of 320 mM L-arginine solution and 0.1 ml of 1 mM NADPH+H solution [5]. Nitrite concentration was measured with help of Griess reagent [5]. Arginase activity was evaluated by increase of L-ornithine content after incubation in buffer solution (pH=7.0) containing 0.2 ml of 24 mM L-arginine solution [5].

Basic production of superoxide anion radical (SAR), its production by the mitochondrial electron transport chain (ETC) and microsomal ETC was determined by the growth of diformazan concentration, formed in the reaction of SAR with nitro blue tetrazolium [8]. Superoxide dismutase (SOD) activity was determined by inhibition of adrenaline autooxidation, while catalase activity was determined by the amount of hydrogen peroxide, remained after its catalase-dependent reduction [8]. The concentration of free malondialdehyde (MDA) was determined by reaction with 1-methyl-2-phenylindole resulting in formation of specific colored substance [8].

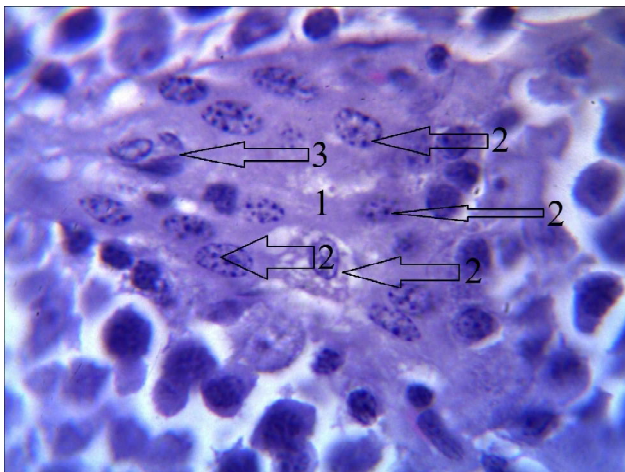
Statistical processing of the study results was carried out using the Microsoft Office Excel software and the Real Statistics 2019 extension to it. The nonparametric Mann-Whitney test was used to determine the statistical significance of differences between the groups. The difference was considered statistically significant at  $p < 0.05$ .

### Results

The 180th day of the experiment was characterized by structural changes in both the parenchymal and stromal components of the testes. So in most of the convoluted



**Fig. 1.** Seminiferous tubules of experimental rat on the 180th day. Microimage. Stain: hematoxiline and eosine. Lens: 10; Ocular lens: 10. Interstitial space with stasis.



**Fig. 2.** Interstitial space of experimental rat on the 180th day. Microimage. Stain: hematoxiline and eosine. Lens: 40; Ocular lens: 15. 1 - Interstitial space. 2 - Interstitial endocrinocytes - large. 3 - Interstitial endocrinocytes - small.

seminiferous tubules, the basement membrane is convoluted, in the rows of the spermatogenic epithelium, an increase in the height of the spermatogenic epithelium was determined due to the disorientation of the cells. The edematous cells are detached from each other. In some convoluted seminiferous tubules, partial desquamation of spermatids was determined, with the appearance of spermatogenic balls. In the nuclei of spermatocytes and spermatids there is a thickening and a decrease in volume in comparison with the control group. Hypochromia of nuclei, with edematous cytoplasm increased in volume. Some convoluted seminiferous tubules were in the stage of complete desquamation, but their number was minimal, and amounted to 2-3% of the total, due to which the height of the spermatogenic epithelium progressively decreased in them and was inferior to the data of the control group. The supporting epithelial cells are edematous, the nuclei are enlarged and lightened. Spermatogonia are

edematous in Figure 1.

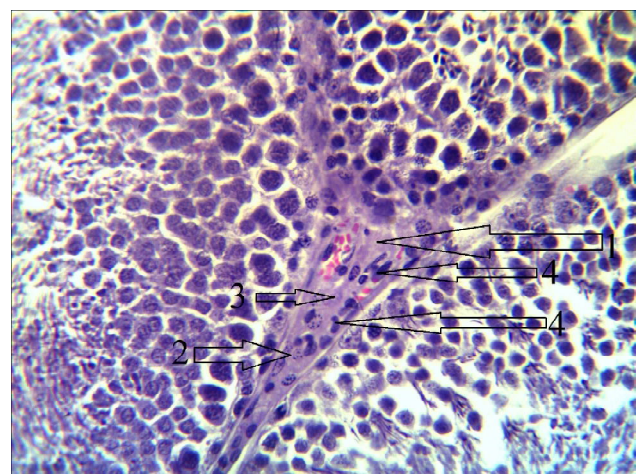
Studying the interstitial space of the testes of the experimental group, we found that the interstitial tissue is enlarged, edematous due to the microcirculatory and connective tissue components. A significant increase in the number of arterioles and venules was observed in the interstitium, and numerous arterio-arterial anastomoses were identified. The walls of the vessels are edematous, the diameter is increased, the sludge of blood cells inside the vessels was determined (see Fig. 1).

Studying the structure of interstitial endocrinocytes, which were clearly defined against the background of connective tissue by oxyphilic color of the cytoplasm and light-basophilic nuclei of a round or oval shape. Cells are irregular, polygonal, round or oval nuclei. We divided the entire population of endocrinocytes, depending on the density of the nucleus, into light and dark cells, and according to the size of nuclei and the volume of cytoplasm, large and small (Fig. 2).

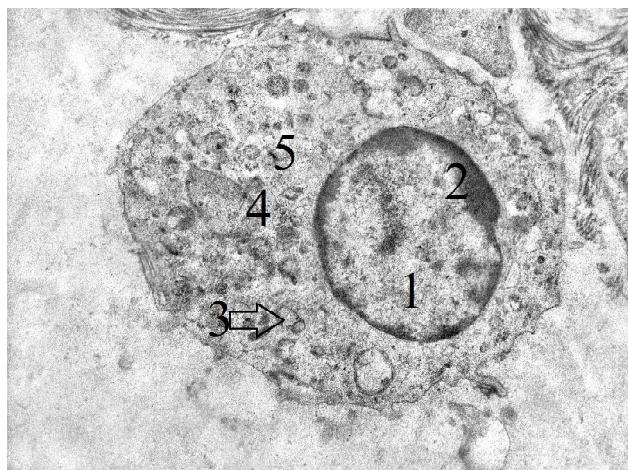
The total number of interstitial endocrinocytes was significantly reduced in comparison with the control group. The number of active cells is reduced and amounted to 12 % of the total number of cells.

When we studied the macrophage system of the interstitium of the testes of the experimental group, as in our previous studies, we clearly traced two populations of cells by the type of localization in the connective tissue [17]. Parietal macrophages were detected near the basement membrane of the convoluted tubule, their number increased in comparison with both the control group and the previous study periods. Interstitial macrophages are single, inactive (Fig. 3).

Interstitial macrophages were large, nuclei oval or round, electron dense with a predominance of heterochromatin. Karyolemma is dense, two-layer, one nucleus. The cell cytoplasm is small in size with all



**Fig. 3.** Interstitial space of experimental rat on the 180th day. Microimage. Stain: hematoxiline and eosine. Lens: 40; Ocular lens: 15. 1 - Interstitial space. 2 - Interstitial endocrinocytes. 3 - Interstitial macrophages. 4 - Parietal macrophages.



**Fig. 4.** Interstitial macrophage (IM) of rats of the control group of animals. Magnification x12 000. 1 - nucleus, 2 - chromatin, 3 - mitochondria, 4 - endoplasmic reticulum, 5 - cytoplasm.

subcellular elements (Fig. 4). The parietal ones had an elongated flattened oval nucleus, which had several nucleoli. The karyolemma is distinct, the karyoplasm is electron-dense, and the chromatin is heterogeneous. The cytoplasm is light, with a small number of lysosomes; mitochondria are small and round. All of the above indicates that the ultrastructural organization of macrophages did not differ from the cells of the control group.

When substantiating the biochemical parameters of testis tissues, we obtained such results as the total NOS activity on the 180th day of central deprivation of luteinizing hormone synthesis was  $0.463 \pm 0.044$  mmol/min, which did not differ much in comparison with the parameters of the control group of animals (Table 1), however, the activity of cNOS decreased by 7.23 times, while the activity of iNOS increased by 3.15 times. The concentration of nitrite in the testes of rats increases 2.45 times. The arginase activity is

decreased 4.13 times.

Thus, the increased production of nitric oxide under conditions of central disturbance in the synthesis of luteinizing hormone, with a direct effect on the endocrinocytes of the interstitial space of the testes to testosterone production, is provided by the activity of the inducible isoform of NOS. At the same time, an increase in iNOS activity with a decrease in the activity of the arginase pathway of L-arginine cleavage may indicate a change in the polarization of testes macrophages with a predominance of the pro-inflammatory phenotype (M1), which we have in an increase in active parietal forms.

Basic production of  $O_2^-$  - on the 180th day of the experiment increased 52.96 times compared with the control group (Table 2).  $O_2^-$  production of mitochondrial ETC decreased 6.37 times, and microsomal ETC - 35.23 times. The SOD activity decreased 1.37 times, while the catalase activity did not change statistically significantly. The concentration of MDA in the testes of rats was reduced by 2.36 times.

### Discussion

Thus, our study of interstitial endocrinocytes and macrophages in the testes of rats showed the heterogeneity of the populations of these cells, the variability of the structural and functional parameters of endocrinocytes and macrophages. The results obtained agree with the literature data, which set out the basic principles and regularities of the organization of the cell population of the interstitial space of the testis [20].

Also, in the tissues of the testicles under conditions of prolonged central deprivation of testosterone synthesis, oxidative stress develops, which on the 180th day of the experiment leads to the development of edema of the interstitial space with subsequent tissue fibrosis. A change in the polarization of macrophages can be the cause of the

**Table 1.** Nitric oxide cycle function during 180-day central deprivation LH synthesis + quercetin ( $M \pm m$ ).

Groups	Parameters				
	gNOS activity, $\mu\text{mol/min per g of protein}$	iNOS activity, $\mu\text{mol/min per g of protein}$	cNOS activity, $\mu\text{mol/min per g of protein}$	Arginase activity, $\mu\text{mol/min per g of protein}$	NO <sub>2</sub> -concentration, nmol/L
Control	$0.542 \pm 0.041$	$0.130 \pm 0.022$	$0.411 \pm 0.032$	$2.480 \pm 0.052$	$3.834 \pm 0.252$
Experimental	$0.463 \pm 0.044^*$	$0.414 \pm 0.040^*$	$0.057 \pm 0.002^*$	$1.013 \pm 0.051^*$	$11.55 \pm 0.21^*$

**Note:** \* - indicates that the difference is statistically significant when compared with control group ( $p < 0.05$ ).

**Table 2.** Oxidative stress markers during 180-day central deprivation LH + quercetin synthesis ( $M \pm m$ ).

Groups	Parameters					
	SOD activity, c.u.	Catalase activity, nkat/g of tissue	Basic $O_2^-$ - production, nmol/s per g of tissue	Production of $O_2^-$ - from mitochondrial ETC, nmol/s per g of tissue	Production of $O_2^-$ - from microsomal ETC, nmol/s per g of tissue	Free MDA, $\mu\text{mol/g of tissue}$
Control	$1.872 \pm 0.110$	$182.0 \pm 17.0$	$0.264 \pm 0.012$	$7.840 \pm 0.131$	$9.553 \pm 0.192$	$6.640 \pm 1.442$
Experimental	$1.363 \pm 0.011^*$	$12.72 \pm 0.11^*$	$13.77 \pm 0.11^*$	$1.234 \pm 0.035^*$	$0.271 \pm 0.004^*$	$15.70 \pm 0.18^*$

**Note:** \* - indicates that the difference is statistically significant when compared with control group ( $p < 0.05$ ).

development of oxidative stress in the testes, as evidenced by an increase in iNOS activity and a decrease in arginase activity, but our use of quercetin protects rat testicular tissue from oxidative damage caused by the administration of triptorelin by increasing direct antioxidant protection and affecting the lipoxygenase pathway of metabolism arachidonic acid [11].

The results obtained are a theoretical basis for the development of methods for correcting violations of the generative and endocrine function of the testes under extreme influences on the body, with damage to endo- and paracrine regulation. Data on the functional morphology of the testes at the stages of adaptation to changes in the endocrine and immune function of the testes expand the existing understanding of the causes of disturbances in spermatogenesis and its regulation. The data can be used in research and teaching at the departments of medical universities and biological faculties of universities.

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#### **ВПЛИВ КВЕРЦЕТИНУ НА МОРФОЛОГІЧНІ ЗМІНИ СІМ'ЯНИКІВ ЩУРІВ НА 180 ДЕНЬ ПІД ЧАС ЦЕНТРАЛЬНОЇ ДЕПРИВАЦІЇ ЛЮТЕЇНІЗУЮЧОГО ГОРМОНУ**

**Стецюк Є. В., Шелітько В. І.**

Актуальним і затребуваним напрямком досліджень є протективна дія біофлавоноїду кверцетину, яка дає можливість використовувати його для корекції тестикулярної дисфункції різного генезу. Метою дослідження було встановити вплив кверцетину на мікроскопічну організацію яєчок щурів, продукцію оксиду азоту та інтенсивність окисного стресу в яєчках щурів на 180-ту добу експерименту, під час експериментальної центральної депривації синтезу лютеїнізуючого гормону, викликаній введенням розчину триптореліну ацетату. Експеримент проводили на 20 статевозрілих самцях білих щурів. Щури були розділені на 2 групи по 10 тварин у кожній групі: контрольна група (I), група з центральною депривацією синтезу ЛГ + кверцетин (II). Тваринам із групи з центральною депривацією синтезу ЛГ підшкірно вводили триптореліну ацетат у дозі 0,3 мг діючої речовини на кг та кверцетин 100 мг на кг маси тіла 3 рази на тиждень, при цьому контрольній групі вводили фізіологічний розчин. Ультратонкі зрізи, виготовлені ультрамікротомом, контрастували з 1 % водним розчином ураніацетату та цитрату свинцю за методом Рейнольдса та досліджували за допомогою електронного мікроскопа. За стандартними методами матеріал заливали в парафінові блоки, з яких виготовляли зрізи товщиною 4 мкм і забарлювали гематоксиліном та еозином. Гістологічні препарати досліджували за допомогою світлового мікроскопа Biogex 3 з цифровим мікрофільтром з програмним забезпеченням, адаптованим для цих досліджень. Усі біохімічні дослідження проводили в 10 % гомогенаті тканини яєчка за допомогою спектрофотометра Ulab 101. Статистичну обробку результатів дослідження проводили за допомогою програмного забезпечення Microsoft Office Excel та розширення Real Statistics 2019 до нього. Для визначення статистичної значущості відмінностей між групами використовували непараметричний критерій Манна-Уїтні. Проведене нами дослідження інтерстиційного простору в сім'яниках білих щурів показало неоднорідність популяцій ендокриноцитів та макрофагів та мінливість структурно-функціональних параметрів. У тканинах яєчок в умовах тривалої центральної депривації синтезу тестостерону розвивається окисний стрес, який на 180-й день експерименту призводить до розвитку набряку інтерстиціального простору з наступним фіброзом тканини. Зміна поляризації макрофагів, на наш погляд, може бути причиною розвитку окисного стресу в сім'яниках, про що свідчить підвищення активності iNOS та зниження активності аргінази, але використання кверцетину захищає тканину яєчок щурів від окисного пошкодження, викликаного введенням триптореліну за рахунок підвищення прямої антиоксидантної системи та вплив на ліпоксигеназний шлях метаболізму арахідонової кислоти.

**Ключові слова:** сім'яник, інтерстиційні ендокриноцити, макрофаги, кверцетин, NO-синтаза, щури.

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The introduction reflects the state of research and the relevance of the problem according to the world scientific literature (at least 15 references to English articles in international journals over the past 5 years). At the end of the entry, the purpose of the article is formulated (contains no more than 2-3 sentences, in which the problem or hypothesis is addressed, which is solved by the author).

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