PREDICTING THE EFFECTIVENESS OF MYOPIA CONTROL WHEN USING ORTHOKERATOLOGICAL LENSES BASED ON INDIVIDUAL EYE PARAMETERS

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ABSTRACT

Introduction. The prevalence and progressive course of myopia is one of the most important medical and social problems worldwide. In recent years, in our country and abroad a tendency to increase the incidence of myopia, becoming in some countries an epidemic, is observed. In recent years, the most common method of effective control of myopia is the method of refractive therapy with orthokeratological lenses. **Aim:** to develop criteria for predicting the effectiveness of myopia control using orthokeratological lenses based on individual eye parameters. **Object and methods.** A total of 60 children (117 eyes), who were selected by OKL of combined design, SkyOptix, licensed by KATT Design Group (Canada), were included in the clinical study. The average age was 11, from 7 to 14 years, of which 37 were females (61.7%), 23 males (38.3%). Ophthalmological examination consisted of visometry without correction and with optical correction, autorefractometry on the narrow pupil and in the state of drug cycloplegia, biomicroscopy, biometry, ophthalmoscopy of the central and peripheral fundus, keratotopography of the horns, pupilometry. **Results.** Among the studied people, the average refractive index at the beginning of the study was –2.25 [–3; –1.5] diopters. The initial diameter of the pupils was determined from 2.78 to 6.30 mm according to the pupilometry performed on the topograph. The average values of eccentricity (Ex) studied in the flat meridian averaged 0.51 [0.47; 0.58], in the steep – 0.53 [0.43; 0.59] at the beginning of the study. In our study, the keratometry of the cornea averaged 43.5 at the beginning of the study [42.7; 44.4]. **Conclusions.** Our findings show that when examining a child with progressive myopia, it is important to pay attention to the diameter of the pupil in photographic conditions, because it can be a predictor of progression and influence the choice of correction individually. The smaller the value of keratometry before the appointment of refractive therapy, the greater the value of the size of the APS, so this factor can be indicated as prognostic. The differential topographic force of the cornea along the peripheral ring corresponding to the reverse zone of the lens is a prognostic practical factor. Taking into account the primary parameters of the eye allow to customize the approach to each child with myopia, improving the individual design of orthokeratological lenses.

Keywords: *myopia, axial size of the eye, orthokeratology lenses, pupil size.*

INTRODUCTION

The prevalence and progressive course of myopia is one of the most important medical and social problems worldwide. In recent years, in our country and abroad, a tendency to increase the incidence of myopia, becoming in some countries an epidemic, is observed. [1, 2]. According to statistical forecasts, the number of nearsighted people is expected to reach 5 billion by 2050, which will be almost 50% of the world's population (up to 50.4% in Eastern Europe). Moreover, the number of patients with a high degree of myopia will increase from 2.7% to 9.8% [2]. In the structure of ophthalmic pathology of Ukraine among the 18-year-old population and older myopia is 12.38%, ranking second among diseases of the visual organ [3]. Statistics for 2014–2017 show that among children 0-6 years the frequency of registration of myopia is 3.68 per 1000 children of the correspond-

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ding age, in 7–14 year-olds 10 times higher (35.57 per 1000 children of the corresponding age), in adolescents aged 15–17 years – 23 times higher (84.86 per 1000 adolescents of the appropriate age) [4]. In addition, progressive myopia is one of the most common diseases in the structure of childhood disability, accounting for 80% of all detected eye pathology and 32.7% in the structure of childhood blindness in Ukraine [4–8]. Therefore, myopia is not only a medical and social but also an economic problem: in developed countries, significant financial resources are spent on measures to prevent and treat this disease.

For today, in the arsenal of practical work of an ophthalmologist there are a huge number of methods of hardware, conservative and surgical treatment. It was previously thought that incomplete correction may slow the progression of myopia, but randomized trials have shown that the anteroposterior size of the eyeball increases more. Various designs of optical correction with bifocal, progressive glasses, multifocal contact lenses are offered, numerous results are obtained, which testify both to and against the mechanism of myopia stabilization. [9–19].

In recent years, the most common method of effective control of myopia is the method of refractive therapy with orthokeratological lenses (OKL) [9, 10, 20–26]. It has been proved that the change in the curvature of the outer surface of the cornea and, as a consequence, the change in the refraction of the eye under the influence of OKL is due to changes in the architecture of the corneal epithelium. The hydrodynamic forces arising in the lacrimal layer under the OKL affect the epithelium. Because of the action of OKL, myopic design there is a flattening of the epithelium in the central zone and its thickening (zone of increased curvature) on the middle periphery of the cornea. As a result, the optical zone of the cornea is formed, which provides high visual acuity during the day. Experimental evidence has been obtained that effective inhibition of myopia progression by OKL is based on a change in the nature of peripheral refraction. A number of authors describe the development of peripheral myopic defocus, which slows the growth of the anteroposterior size of the eyeball [15, 24, 27–31]. Other researchers believe that the use of OKL changes corneal aberrations and increases accommodation reserves, and because of these changes, the progression of myopia stabilizes. [32–36].

In addition, the effectiveness of the method varies from patient to patient; the question arises as to why, and on what factors it depends. The study of these indicators may shed light on the mechanisms of slowing the progression of myopia in children and adolescents using refractive therapy OKL. The above information is due to the need to develop criteria for predicting the course of myopia when using OKL, taking into account the individual parameters of the patient's eye.

Purpose, subjects and methods:

1. The purpose of the study was to develop the criteria for predicting the effectiveness of myopia control using orthokeratological lenses based on individual eye parameters.

2. Subjects & methods

Research design. The study was performed at the Department of Ophthalmology of Kharkiv National Medical University, on the basis of the Pediatric Ophthalmology Center "Raduzhka", Kramatorsk, with which a contract was concluded. All studies were conducted in compliance with basic bioethical norms and requirements of the Declaration of Helsinki adopted by the General Assembly of the World Medical Association, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant WHO regulations, the International Council of Medical Societies, the International Code of Medical Ethics) and the Order of the Ministry of Health of Ukraine No.690 on September 23, 2009. The study was initiated after obtaining the patient's consent and informed consent of one of his parents to participate in a clinical examination in accordance with the UN Convention on the Rights of the Child.

A simple cohort case study was initiated after the patient's consent and the informed consent of one of the parents to participate in a clinical trial in accordance with the provisions of the UN Convention on the Rights of the Child.

Obtaining formal consent to participate in the study.

a. The research doctor received the document of consent from the participants of this study.

b. Consent to participate in the study was given by the parents of the sick child in writing at the medical center after diagnosis.

Sixty children (117 eyes), who were selected by OKL of combined design, SkyOptix, licensed by KATT Design Group (Canada), were included in the clinical study. The average age was 11 [10; 13], from 7 to 14 years, of which 37 were females (61.7%), 23 males (38.3%). According to the degree of myopia, the patients of the main group were distributed as follows:

• patients with mild myopia – 15 patients (27 eyes – 23.1%);

• patients with moderate myopia – 45 patients (90 eyes – 76.9%).

Criteria for inclusion in the study:

• children aged 7 to 14;

• diagnosis of uncomplicated mild to moderate myopia;

• informed consent of the patient and his/her parents.

Verification of the diagnosis of refractive error (myopia), its type and degree were performed based on the history data, the results of general and instrumental ophthalmological examination according to the order of the Ministry of Health of Ukraine No.827 on December 08, 2015. Therefore, the patients underwent a standard examination of a child with myopia, which included determining complaints, detailed history (duration of the causative disease, treatment methods used), heredity, growth rate of the child, comorbidities.

The general ophthalmological examination consisted of visometry without correction and with optical correction, autorefractometry on the narrow pupil and in the state of drug cycloplegia, biomicroscopy, and biometry, ophthalmoscopy of the central and peripheral fundus.

The standard ophthalmological examination did not involve a detailed study of corneal asphericity, thus we additionally performed corneal corneotopography (Keratotopograph, Easygraph, Germany), pupilometry, determination of peripheral refraction of the eye with calculation of algebraic refractive index (Optorefractometer).

Biometric investigations were performed using an ultrasound scanner (A-scan, PIROP, Poland). Before starting the work, the device was calibrated according to the instructions for use. The data of 10-fold automatic registration was displayed on the screen with the final average value, which was taken into account as a result. Indications were recorded in mm with an accuracy of 0.01 mm. Biometrics were performed before the start of refractive therapy or the appointment of glasses and every 6 months of follow-up.

Determination of the anterior surface of the cornea, namely the eccentricity of the flat and steep meridians, keratometry, corneal astigmatism was performed using corneal corneotopography (Keratotopograph, Oculus Easygraph, Germany).

Pupilometry was performed using the keratotopograph mentioned above. The lighting conditions were the same; the red light corresponded to the photographic conditions of the survey. This corneotopograph has a large bell, so in close contact with the patient's face, the effect of ambient lighting is negligible. For the reliability of the obtained data, pupilometry was performed each time during a scheduled visit of patients. Namely, pupil diameter was measured at 1, 7, 14 days, 1 month and every three months to obtain a mean numerical value for each patient. In our study, we studied exactly those parameters of the anterior segment of the eye, which we believe may affect the results of effective use of OKL. The method of constructing logistic regression models was used to analyze the probability (increase in APS for two years).

OKL were selected according to the selection protocol with mandatory lens centering. Patients used lenses every day during night sleep. The duration of sleep was agreed by the parents and should have been lasted at least 8 hours.

Statistical data processing was performed using Statistica 10.0 software. The conformity of the analyzed parameters of the law of normal distribution was evaluated by the values of Kolmogorov-Smirnov, Lilliefors and W-criteria Shapiro-Wilk tests. Since in most cases the distribution did not comply with the law of normal distribution, the data are presented in the form of the number of observations in the group, the median and the interquartile range. Assessment of the statistical significance of differences in indicators in the compared groups was performed using a non-parametric criterion for independent groups - Mann-Whitney rank test. The significance level p was assumed to be 0.05, which meets the criteria adopted in biomedical studies. If the value of p was less than 0.001, then p was indicated in the format $p<0.001$.

Results & Discussion

The average refractive indices at the beginning of the study were –2.25 [–3; –1.5] diopters; after a year of observation, this figure did not change significantly. At the beginning of the study, the eye length of the APS was 24.33 [23.72; 24.65] mm, after 2 years of observation 24.37 [23.79; 24.82] mm.

The initial diameter of the pupils was determined from 2.78 to 6.30 mm according to the pupilometry performed on the topograph. The average pupil diameter was 4.52 [4.07; 5.02] mm. To assess the influence of the patient's pupil diameter on the rate of myopia progression, a correlation analysis was performed, which showed that with a weak degree of myopia, the base pupil diameter had an inverse correlation (–0.53, $p=0.001$) with the annual progression gradient (AGP). That is, the larger the pupil, the less progress of myopia, because the growth of APS is slower.

The average values of eccentricity (Ex) studied in the flat meridian averaged 0.51 [0.47; 0.58], in the steep – 0.53 [0.43; 0.59] at the beginning of the study. The following results were obtained when evaluating the correlation between baseline Ex and the size of the APS before refractive therapy. With a weak degree of myopia, there is a direct strong correlation between the value of Ex, both in the flat and steep meridians, and the size of the APS at the beginning of therapy, which is equal to 0.28 at a significance level of p=0.011. In our study, the keratometry of the cornea averaged 43.5 at the beginning of the study [42.7; 44.4].

Evaluating the correlation between the initial value of keratometry and the size of APS, a negative correlation was found –0.69 in the group with mild myopia (p<0.001) and –0.67 – among children with moderate myopia (p <0.001).

Statistical processing showed a negative correlation of –0.2 (p=0.03) and –0.22 (p=0.019) between the differential strength of the cornea in the reverse 6 mm zone and the peripheral refraction in the corresponding peripheral refraction of 20–25°C temporal and nasal sides, respectively.

A positive correlation with a correlation coefficient of 0.21 (p=0.026) was received between the defocus in the temporal part and the gradient of myopia progression for the year. While in the nasal part the same result was obtained with a correlation coefficient of 0.2 (p=0.036), that is, the more positive the defocus (namely, the smaller the myopic defocus) is the greater the gradient of progression or increase in APS during the study period.

Considering that a certain number of studies by different authors revealed a correlational dependence between the baseline state of corneal Ex and the annual gradient of myopia progression, we assumed that we would get the same results. Thus, when determining the correlation between the average Ex and the initial refraction of patients, the obtained correlations were 0.08 and 0.04 (p=0.444, p=0.861) for mild and moderate degrees, respectively, but the level of significance was unreliable. Bingjie Wang reported that corneal eccentricity had a statistically significant relationship with axial length change in univariate but not multivariate analysis. The authors found that a greater value of corneal eccentricity is associated with a greater change in axial length. A more elongated corneal periphery results in greater peripheral hyperopic defocusing of the retina, which is thought to stimulate increased axial length [37]. In our study, we obtained a strong direct relationship between the initial Ex value and the difference in refraction (Δ R) after 24 months of follow-up, which was 0.32 (p=0.001) with a weak degree of myopia. Consequently, we can assume that the greater the value of Ex of the cornea, the greater the change in refraction we can expect, however given the above-mentioned lack of connection with changes in APS, it is necessary to differentiate refractive myopia from axial myopia.

As a result of probability analysis (increase in APS for two years), the method of construction of logistic regression models was used and we selected five factor features (X):

1. *Initial refraction* (X1) of the patient before the appointment of orthokeratological lenses.
2. *Pupil diameter* (X2).

As follows, the size of the pupil determines how much light actually enters the eye, but it mostly blocks peripheral light rays when narrowed. Past studies have shown that OKLs cause a shift of the peripheral defocus to the myopic side in the more remote periphery. From this point of view, the size of the pupil may affect the relative contribution of peripheral myopic defocus to the effectiveness of refractive therapy OKL.

Given that in our previous studies the base pupil diameter was inversely correlated with the annual progression gradient, that is, the smaller the pupil diameter is, the greater is the value in the difference in APS for the observation period we received. And vice versa, the more pupil size, the less progression of myopia, so this factor should be used as a prognostic factor.

Thus, Zhi Chen and co-authors also evaluated the influence of pupil size, but in scotopic conditions, because according to the authors, the size was more stable. In other cases, the photopic state imitates the conditions of everyday life, so scientists conducted research under such conditions. According to the researchers, a larger pupil diameter increases the effectiveness of OKL and slows down the axial growth of the eye length in myopia. The authors also believe that this occurs due to changes in peripheral defocus in the myopic direction [38]. In the comparison group of the study, patients used regular daily lenses as a correction, but no correlation was found between the base pupil area and the increase in axial size, as in our study in the comparison group, where glasses were used, such a relationship was not noted.

3. *Keratometry* (X3)

According to the literature, in some cases of progression of myopia due to the fact that a flatter cornea causes more hyperopic defocus on the border of the small pupil, and with flattening of the cornea OKL practitioner may start a vicious circle of greater progression of myopia. During ortho-k treatment, the degree of myopia is reduced by flattening the central cornea. This central flattened zone is referred to as the treatment zone. It has been hypothesised that a reduced treatment zone following ortho-k creates increased peripheral refractive power and higher spherical aberration, which may further retard myopia progression. [39–41]. Therefore, the question of the effectiveness of OKL in all patients with myopia is ambiguous. The author also suggests that patients who have a greater change in the strength of the cornea on the periphery, progress less. Therefore, if the eccentricity of the cornea is too low, the potential correction of myopia will be limited due to insufficient peripheral defocus.

According to our study, the lower the value of keratometry before refractive therapy, the greater the value of the size of the APS, so this factor was also included as a prognostic.

4. *Peripheral force of the cornea in the ring of the reverse zone* (X4 and X5)

Taking in account the differential strength of the cornea on the periphery, we can predict the results of peripheral refraction in OKL users, assuming that the greater the strength of the cornea in the reverse 6 mm zone, the more pronounced myopic refraction in the retinal projection zone on the periphery. It is very important for orthokeratologists to have an idea of the peripheral refraction of a patient with progressive myopia with the use of OKL to control myopia, but it should be noted that not everyone in practice has the ability to make such calculations. Therefore, knowing the differential topographic strength of the cornea in the peripheral ring corresponding to the reverse zone of the lens, according to our study, we can say that this is a prognostic practical factor.

Similarly, it is determined in the literature that the greater the degree of myopia, the more pronounces the curvature of the middle periphery of the cornea changes (increases), inducing at the same time more significant peripheral myopic defocus and positive spherical aberrations. A relationship between the changes in periphery refraction on the keratotopogram after OKL and the rate of growth of APS was found [42]. Recently, a new method of analyzing the relative refraction of the cornea based on the keratotopogram in children using OKL was developed, and its relationshipwith the control of myopia was shown. The value of the maximum relative refraction of the cornea greater than 4.5 dptre demonstrated a high probability of the effect of slowing the progression of myopia [43].

5. *The diameter of the cornea*

Axial length of the eye (APS) at the time of treatment (initial) allows determining the type of myopia axial or refractive, and is one of the main prognostic factors in the progression of myopia. This correspondence is noted by V.I. Pospelov, in whose work the axial size of the eyeball from 24 to 26 mm, is called axial uncomplicated, which also characterizes the patients included in the group of our study [44].

The regression coefficients of the factor features are given in *Table 1*.

Table 1. Signs included in the model for predicting the likelihood of progression of myopia when using OKL

The name of the sign	The level of the sign	Regression coefficient	Standard error
Initial refraction	X1	–0.33	0.24
Pupil diameter	X2	–1.702	0.463
Keratometry	X3	–0.119	0.294
Peripheral force of the cornea on the ring of the rotary zone *temporally*	X4	0.137	0.347
Peripheral force of the cornea on the ring of the rotary zone *nasally*	X5	–0.403	0.358
Corneal diameter	X6	–0.498	1.001
APS initial	X7	0.059	0.495
	Const	15.239	24.98

The logistic regression equation of the model for predicting the probability of progression of myopia on the background of the use of OKL had the form:

$$p = \frac{1}{1+e^{-(15.239-0.33*X1-1.702*X2-0.119*X3+0.137*X4-0.403*X5-0.498*X_6+0.059*X_7)}} \quad (1)$$

The classification ability of the model was determined according to the training sample and amounted to 79.5%. The probability of a true positive result (increase in APS less than 0.3) when using this model was 91.9%, and the probability of a true negative result – 38.5%. (*Table 2*).

Evaluation of the quality of the model using ROC-analysis (*Fig. 1*) showed the following: the area under the ROC-curve (AUC) was equal to 0.86 ($p<0.001$), which characterizes the good quality of the classification of traits. The sensitivity of the model was 82.6%, specificity – 73.1%.

Table 2. Classification table of the calculated probability of myopia progression when using OKL

Observation groups	Predicted cases		Percentage of correct indicators
	APS<0.3	APS>0.3	
	n=95	n=17	
APS<0.3	79	7	91.9%
APS>0.3	16	10	38.5%
total percentage	–	–	79.5%

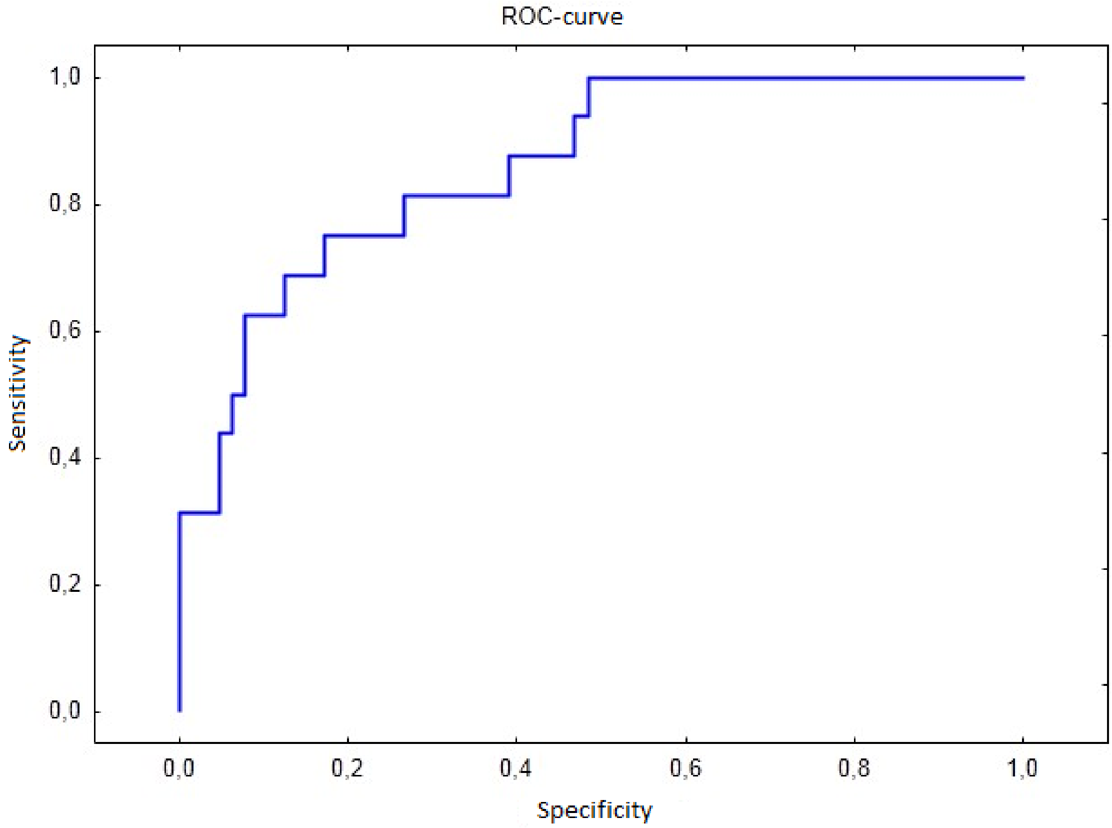

Fig. 1. The ROC-analysis data.

Clinical case 1

Patient A., aged 12, was brought with complaints of decreased vision. Hereditary history was unremarkable. The data of the primary ophthalmological examination were as follows.

Visual acuity OD=0.15, OS=0.15 Refraction OD= =–2.25 diopters, OS=–2.5 diopters (X1), pupil diameter (X2) – OD=6.09 mm, OS=5.25 mm, refractive power of the cornea (keratometry – X3) OD=46 diopters, OS=46.12 diopters; axial eye length OD=23.62 mm, OS=23.46 mm (sign X7); diameter of the cornea OD=11.5 mm, OS=11.51 mm (sign X6); orthokeratological lenses were selected for the child. When performing a corneotopography in the process of use, the difference (change between the initial cornea and under the influence of OKL) was determined on the refractive map. Refraction in the middle periphery of the cornea, corresponding to the rotational zone of the OKL on the temporal and nasal sides, was assessed. Thus, on the temporal side (X4) – OD=0.16, OS=0.19, on the nasal side (X5) this figure was – OD=0.8, OS=0.7.

Using the equation of binary logistic regression, calculate the sum of the values:

$$p(OD)=1/(1+\exp(-(15.239-0.33*(-2.25)-1.702*6.09-0.119*46+0.137*0.16-0.403*0.8-0.498*11.5+0.059*23.62)))=0.01$$

$$p(OS)=1/(1+\exp(-(15.239-0.33*(-2.5)-1.702*5.25-0.119*46.12+0.137*0.19-0.403*0.7-0.498*11.51+0.059*23.46)))=0.05$$

Conclusion. The patient is not at risk of myopia progression (estimated value of "p" less than 0.5). Re-examination of the child 12 months after the end of the term using lenses showed no progression of myopia and an increase in axial length within normal limits.

Clinical case 2

Patient L., aged 11, presented with complaints of decreased vision. Hereditary history was unremarkable. The data of the primary ophthalmological examination were as follows.

Visual acuity OD=0.1, OS=0.1. Refraction OD==–1.75 diopters, OS=–2.5 diopters (X1), pupil diameter (X2) – OD=3.58 mm, OS=3.27 mm, refractive power of the cornea (keratometry – X3) OD=42.1 diopter, OS=41.9 diopter; axial eye length OD=24.96 mm, OS=25.17 mm (sign X7); diameter of the cornea OD==12.16 mm, OS=12.23 mm (sign X6); orthokeratological lenses were selected for the child. When performing a corneotopogram in the process of use, the difference (change between the initial cornea and under the influence of OKL) was determined on the refractive map. Refraction in the middle periphery of the cornea, corresponding to the rotational zone of the OKL on the temporal and nasal sides, was assessed. Thus, on the temporal side (X4) – OD=–0.52, OS=–1.06, on the nasal side (X5) this figure was – OD=–0.57, OS=1.69.

Using the equation of binary logistic regression, calculate the sum of the values:

$$p(OD)=1/(1+\exp(-(15.239-0.33*(-1.75)-1.702*3.58-0.119*42.1+0.137*(-0.52)-0.403*(-0.57)-0.498*12.16+0.059*24.96)))=0.57$$

$$p(OS)=1/(1+\exp(-(15.239-0.33*(-2.5)-1.702*3.26-0.119*41.9+0.137*(-1.06)-0.403*1.69-0.498*12.23+0.059*25.17)))=0.52$$

Conclusion. The patient is at risk of myopia progression (estimated value of "p" greater than 0.5), so he changed the design of OKL with a smaller optical zone for more effective control of myopia.

As a part of the research and mathematical calculations, an interactive WEB application was also developed, which can be accessed from various types of devices connected to the World Wide Web. Modern solutions and approaches used in IT (Information Technology) were used for development.

The following technologies were used as tools for development:

- HTML 5 (HyperText Markup Language, version 5), CSS 3 (Cascading Style Sheets) and JavaScript to create a frontend part;
- PHP programming language version 7.4 for developing backend parts.

The developed WEB-application was hosted using the Salesforce [https://developer.salesforce.com/]. This service allows hosting the applications on the Internet for free and provides developers with all the necessary tools. The program code of the application is located in the Github [https://github. com/] repository, which is intended for storing various versions of the application, which are created during its development. Link to the application: [https://ophtalmologyequation.herokuapp.com].

Creating a page layout to place all the necessary fields and their captions with units of measurement was done using the modern Bootstrap framework

[https://www.amazon.com/Full-Stack-Web-Development-Beginners/dp/B092P76L9Y], which allows making a stylized and adaptive layout for WEB-applications. The structure of the WEB application page has a standard look with the rules of their creation: <head>, <footer> and <body> tags in between. Between the <head> </head> tags is the necessary information about the page and the CDN link to the Bootstrap framework. Between the <footer> </footer> tags, information was placed about the affiliation of the developed application. The main content together with the formula is located between the <body> </body> tags. The form for calculating the Logistic Regression Equation is a set of fields with captions and default field values (*Fig. 2*) and shows a fragment of the form with the title, instructions and fields for data entry.

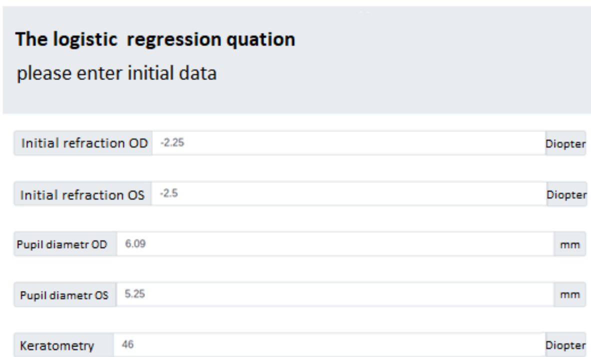

Fig. 2. Fragment of the form for calculating the values of the logistic regression equation.

$$(p\frac{1}{1+e^{-(15.239-0.33*X1-1.702*X2-0.119*X3+0.137*X4-0.403*X5-0.498*X_6+0.059*X_7)}})$$

All parameters used in the form are taken from our previous research results. After entering all the necessary parameters and checking them, click on the "Calculate" button. The result of the calculation is displayed below (*Fig. 3*). As follows from Fig. 3, the obtained pointers have different colors depending on the values.

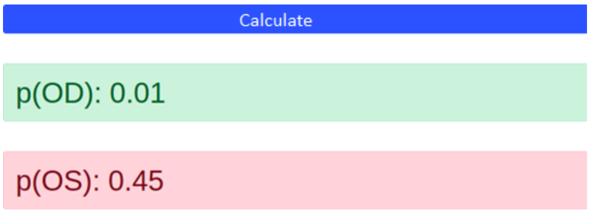

Fig. 3. Results of the calculation of the logistic regression equation.

If the value is in the range 0 ... 0.5, the field with the answer is highlighted in green. However, if the value obtained is not within these limits, it is highlighted in red to attract attention. In the example shown in Fig. 3, the values for the eye OD fall in the range of 0.5, so this value is good, but the value for the eye OS should be noted. Thus, changing the values of the parameters can determine the rate of progression of myopia on the background of the use of OKL, taking into account the individual parameters of the anterior segment of the eye of each patient.

Conclusions

1. It is determined that when examining a child with progressive myopia, it is important to pay attention to the diameter of the pupil in photographic conditions, because it can be a predictor of progression and influence the choice of correction individually. The children with a pupil diameter smaller than the average have a greater tendency to increase APS and, accordingly, to the progression of myopia. With the progressive form of myopia and the basic pupil size less than 4.52 mm, the most effective method of control is the appointment of refractive therapy with orthokeratological lenses.
2. It is established that the basic value of the corneal Ex has a direct correlation between the axial size of the eye before the appointment of OKL in mild myopia. However, there is no correlation between the baseline Ex and the annual gradient of myopia progression with the use of OKL because the profile of the cornea changes and there are other factors influencing the dynamics of changes in APS.
3. It is determined that the smaller the value of keratometry before the appointment of refractive therapy, the greater the value of the size of the APS, so this factor can be indicated as prognostic.
4. It is found that the differential topographic strength of the cornea along the peripheral ring corresponding to the reverse zone of the lens is a prognostic practical factor.
5. Criteria for predicting the progression of myopia have been developed in patients using OKL based on a mathematical prognostic model, taking into account the primary parameters of the eye, which allows customizing the approach to each child with myopia, improving individual design of orthokeratological lenses.

DECLARATIONS:

Statement of Ethics

The authors have no ethical conflicts to disclosure.

Consent for publication

All authors give their consent to publication.

Disclosure Statement

The authors have no potential conflicts of interest to disclosure. The authors declare that the review was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Data Transparency

The data can be requested from the authors.

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