

About scientific results of the 3rd Global Pediatric Ophthalmology Congress (London 2018).

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Abstract

Describes the main results and the final resolution 3rd Global Congress of Pediatric Ophthalmology, London, March 22-23, 2018. The analysis of the most important reports and the final resolution of the Congress are given. Presentations of important reports are given.

Keywords: *Physiology and biomechanics of the eye; The physiology of vision; Video security*

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Modern ophthalmology is largely a branch of applied physics and chemistry. The main scientific achievements in ophthalmology have been recently reached at the interdisciplinary level, which allowed creating the latest means of diagnosis and treatment of a number of eye diseases. However, this approach requires knowledge of ophthalmology in adjacent scientific fields. This is a requirement of the time. Therefore, the results of fundamental research in ophthalmology are so important for clinical practice, which allows not only to see the essence of the problem, but also to use a systematic approach to solve it.

As practice shows, such systematic approach can significantly increase the effectiveness of the development of innovative diagnostic and treatment tools. But for the full implementation of these innovations, it is necessary to have a clear understanding of how the optical, accommodative and drainage systems of the eye are interconnected and how they work together in normal and pathological conditions. Therefore, the knowledge in the field of physiology and biomechanics of the eye is rather important.

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Perhaps for the first time in the history of ophthalmology, the organizing Committee of the 3rd Global Pediatric Ophthalmology Congress (March 22-23, London) proposed a separate interdisciplinary session “Physiology and biomechanics of the eye”, and this is a historic step. The program of the Congress is presented on the website, where all the reports of this interdisciplinary session are fully presented [1]. Chairing the session along with the other moderators prof. Olga Svetlova from Russia.

The Congress was attended by representatives from North and South America, Europe, Asia and Africa, a total of about 100 experts from different fields of science.

The following scientific sessions were presented at the Congress:

1. The retina and its diseases. Corneal diseases (6 reports).
2. Interdisciplinary Symposium “ Physiology and biomechanics of the eye “(13):
 - a. Physiology of the human eye and the modern theory of adaptive myopia (5).
 - b. Physiology of vision and safety of modern light environment (2).
 - c. Physiology of vision and binocular executive mechanisms (3).
 - d. Physiology of vision and executive mechanisms of accommodation (3).
3. Pediatric cataract and glaucoma. Surgery (7).
4. Refractive disorders. Pediatric neuroophthalmology (5).
5. Video presentations (2).
6. Poster session (4).

In our opinion, the following reports were particularly interesting at the Congress.

1. Yizhi Liu., Zhongshan Ophthalmic Center, China- Lens regeneration using endogenous stem cells for treatment of congenital cataract [2].

He developed a special surgical method of cataract removal by phacoemulsification with postoperative “growing” of the lens with the help of preserved endogenous epithelial stem cells of the lens. This ensures the regeneration of the lens in rabbits and macaques, as well as in infants with cataracts at 6-8 months. Compared to the traditional procedure, they move the anterior capsulorexis from the center to the periphery, reducing the diameter to 1-1.5 mm, keeping the capsule, sub capsular cells and the physiological barrier between the anterior and posterior segments. For infants and young children, this procedure reduces postoperative inflammation and the incidence of postoperative complications such as iris adhesion and secondary ocular hypertension, protecting the local structures necessary for lens regeneration.

In our opinion, this is a truly innovative and very promising development.

2. Teuta Haveri, Mimoza Meco and Camelia Kojqiqi, American Hospital No.1 Tirana, Albania: - Statistical study on cornea profil and parameters between generations in Albania; is there a prediction for future keratoconus? [3].

The corneal profiles and intergenerational correlation in Albania were studied to predict the progression of acquired or hereditary keratoconus in patients aged 14 to 40 years. Three-dimensional topography of the cornea in 701 patients was investigated on the Oculus Pentacam HR device. Early signs of keratoconus were flat and thin cornea with asymmetric astigmatism from 2 to 6 D however, astigmatism of the cornea does not allow predicting the possibility of keratoconus development.

In our opinion, major role in the rather frequent development of keratoconus in adolescence today plays the toxicity of the environment: smoke from fires with plastic bottles, plastic chips, car exhausts, etc., as well as contact optical correction and dry eye syndrome in a display civilization, reducing the regeneration of the cornea.

3. Serdiuchenko Vira and Viazovsky Igor, The Filatov Institute of Eye Diseases and Tissue Therapy, Odesa, Ukraine- Modified device for investigation of accommodation; irregular accommodation [4].

This outstanding fundamental work has a world priority [5] and was first published in detail in the Russian Federation in the proceedings of the interdisciplinary conference "Biomechanics of the eye 2004" [6]. For the first time in a 150 years, Vera Serdyuchenko and Igor Viazovsky, managed to prove experimentally the presence of uneven accommodation in different meridians in the human eye. And we are very happy for the authors whose work was noted in the final resolution of the Congress.

4. Valery Kaptsov and Vitaly Deynego, All-Russian Scientific & Research Institute of Railway Hygiene; ELTAN Cl. Corp. Soc., Moscow, Russia. - Analytical review: Light-biological safety and risks of eye diseases among school child in classrooms with led light sources. [8].

This report showed how dangerous to the health of the human body and its eyes, in particular, modern led light sources have high blue light spectrum intensity, which is 3-4 times higher than the safe level of blue in the solar spectrum. This leads to increased rates and earlier development of vascular macular degeneration and other eye diseases. Ophthalmologists should be well aware of how dangerous artificial led lights and displays of gadgets are today. This has already led to the avalanche-like development of some eye pathologies in a number of developed countries.

5. Ivan Koshits, Olga Svetlova and Maksat Egemberdiev; Petercom-Network Management System/Consulting Grope Corporation, Saint-Petersburg, Russia; Department Ophthalmology of North-Western State Medical University named after I.I. Mechnikov, Saint-Petersburg, Russia; Chuy Region United Hospital, Bishkek, Kyrgyzstan.- Theory. Physiological and biomechanical features of the interconnected functioning of the systems of accommodation, and aqueous production and outflow. Hypotheses and actuating mechanisms of growth of the eye's optical axis in the metabolic theory of adaptive myopia and in the theory of retinal defocus [10].

The executive mechanisms of the Koshits – Svetlova Metabolic theory of adaptive myopia (MTAM) and the theory of change of retinal defocus (TCRD) were discussed in details. The acquired myopia of the low and moderate degree without complications is presented in the metabolic theory not as a disease, but as a normal natural adaptation process, which allows to reduce the energy consumption of the eye with long-term intensive work at near distance. Adaptive extension of the optical axis of the eye is a manifestation of the general law of anatomical development of the biological systems: minimizing energy consumption for more efficient survival.

The physiological mechanisms of emergence and development of the Adaptive myopia (AM) in animals and humans at working age are common and are implemented through the regulatory mechanism of creating a temporary functional insufficiency of the uveoscleral outflow pathway. AM develops as a loaded type (ciliary muscle tone close to the maximum when looking from a distance), and the unloaded type (the tone of the CM is minimal when looking from a distance).

The most commonly used in the world Incremental retinal defocus theory has certain drawbacks and is based on a number of hypotheses that are not fully confirmed by scientific research. According to IRDT, peripheral Central defocus of hyperopic type (over-correction) accelerates the development of myopia, and peripheral myopic defocus (under-correction), on the contrary, inhibits its development.

According to the IRDT hypotheses, the management of eye length adjustment to the visual environment does not belong to the brain, but to its independent "periphery" - the retina. The result depends on the size, "blurring" and contrast of some imaginary "spot of illumination" on the retina: the parameters of the spot allegedly regulate the level of neurotransmitter production by amacrine retinal cells, which are hypothetically capable of "seeping" through the pigment epithelium, Bruch's membrane, choroid to the sclera.

The main role in the regulation of the growth of the optical axis of the eye according to the supporters of the IRDT belongs to "the mismatch of the visual focus with the plane of the retina", considering that "image of defocus directly regulates the growth of the eye,"

and the accommodation stress is not the determining link in the refracto-genesis of myopia, and therefore accommodation is not taken into account. In fact, the authors of the IRDT suggest to consider that even with the optic nerve cut, the external optical surrounding is able to regulate (accelerate at times!) genetic program of eye axis growth up to presbyopic period.

However, the IRDT authors assumption that the participation of the brain in the process of refracto-genesis contrary to the vast number of clinical facts, furthermore the hypothesis of the existence in the retina a separate from the brain centre, eye growth “regulator” is mostly incorrect. To confirm the main hypotheses of IRDT, it is necessary to find in the retina sufficiently powerful “mechanisms for the production” of specific inhibitors and scleral growth catalysts, but most importantly - to locate the ways of their delivery to the sclera through the retinal pigment epithelium.

Conclusion

The development of adaptive myopia, apparently, is associated with the manifestation of the usual physiological mechanism, which is the same for humans and animals. The formation of an eye length adequate to the visual load occurs in such way to ensure the lowest possible level of energy consumption with intense and prolonged visual work. The main task of prevention or inhibition of AM is to turn off the natural physiological mechanism of adaptive growth of the optical axis of the eye with the help of early rational optical correction. This key point of the metabolic theory of myopia is reflected in the attached final resolution of the 3rd Global Pediatric Congress [11], and also on the slides of the presentation below.

6. Marina Guseva, Oksana Makarovskaia and Janek Masian; City diagnostic medical center “Vodokanal of St. Petersburg”, Russia; «Ophthalmology Laser Clinic» Cl. Corporation, Archangelsk, Russia; Department Ophthalmology of North-Western State Medical University named after I.I. Mechnikov. – The art of choosing rational optical correction using the eyeglasses and contact lenses of modern design in the light of the metabolic theory of adaptive myopia [9].

Clinical studies were conducted in 3546 patients aged 14 to 37 years with myopia of all degrees. The duration of observations was 3, 5 and 7 years. The expediency and efficiency of the application of early rational optical correction (ERO) of adaptive myopia (AM) ($p < 0.01$) was confirmed. The higher the individual visual acuity (IVA), the greater the stopping effect ($p < 0.01$), which allows to assign a more comfortable and bearable ERO. It was proven that the method of minimal optical under-correction for near distance (plus 0.5-0.75 D) and minimal over-correction for far distance (minus 0.12-0.25 D) was more efficient compared with the common way of significant under-correction (plus 0.5 and 0.75 D) for near and far vision ($p < 0.001$). The obtained clinical results confirm the efficiency of the Koshits-Svetlova Metabolic theory of adaptive myopia.

This key point of this report is reflected in the attached final resolution of the 3rd Global Pediatric Congress [11], and also on the slides of the presentation below.

7. Olga Svetlova, Ivan Koshits. Theory. Actuating mechanisms of accommodation and development of the theory of accommodation by Helmholtz [7].

For the first time on the international level, the first most complete classification of accommodative mechanisms was presented, which included the Helmholtz mechanism of lens accommodation and many other additional mechanisms of accommodation. Clearly showed the incorrectness of widely spread in developed countries accommodation theories, which contradicted the laws of mechanics, is. This report aroused great interest of participants, especially from the USA. This key point of this report is reflected in the attached final resolution of the 3rd Global Pediatric Congress [11], and also on the slides of the presentation below.

8. Ivan Koshits, Olga Svetlova. Theory. Morpho-physiological characteristics of macula in forming shaped binocular vision.

The authors explained the physiological incorrectness of the centuries-old concept of “eye focus” and the modern concept of “eye defocus”. In addition, on the basis of morpho-physiological analysis, the authors have introduced important for binocular vision, the

concept of “Optical sight” of the eye, comprising a ring of blue cones of the macula and created the theory of installation of the eyes to the sharpness, when the brain analyzes the mutual arrangement of the dispersion bands of blue, green and red light on the surface of the macula and fovea. This key point of this report is reflected in the attached final resolution of the 3rd Global Pediatric Congress [11], and also on the slides of the presentation below.

The final resolution of the 3rd Global Pediatric Ophthalmology Congress, London 2018.

3rd Global Pediatric Ophthalmology Congress notes the significant achievements of recent years in pediatric ophthalmology and considers it necessary to note the following.

1. Undoubtedly, one of the main urgent tasks in pediatric ophthalmology is the fight against the pandemic of adaptive myopia. By the year of 2050, up to 5 billion people will be affected by myopia, that's half of the world's population. This means that we do not yet have truly working and practically applicable theory of myopia. The most widespread theory of peripheral defocus is known for its shortcomings and is based on a number of hypotheses that are not fully supported by scientific research. In order to rely on the hypotheses proposed in this theory, it is necessary to carry out a number of fundamental physiological studies for their reliable confirmation. And we draw the attention of governments and private investors from all the countries to the necessity of funding such researches and trials.

2. Possibly, for the first time the metabolic theory of adaptive myopia, proposed by researchers from Russia, was announced in this congress. This metabolic theory is based on interrelated physiological hypotheses, which are well justified. In this theory, it has been shown that the physiological mechanisms of the emergence and development of adaptive myopia in animals and in human at a working age are common. The acquired myopia is represented in this theory not as a disease, but as a normal natural adaptation process, which makes it possible to reduce the energy consumption of the eye during prolonged intensive work at near sight. These are manifestations of the general law of the anatomical development of biological systems - minimizing energy consumption for effective vital activity. It is especially important to note that the metabolic theory of adaptive myopia has been reliably confirmed in clinical studies with observation periods of 3, 5 and 7 years.

These studies are important for the theory and practice of optometry since the notion of “rational correction” is introduced. Rational correction allows to practically perform physiologically adequate optical correction, which not only effectively prevents the development of adaptive myopia, but also inhibits the development of other eye diseases. Owing to the fact that, these diseases are directly related to the deterioration of metabolic processes and/or accelerated by the aging of intraocular structures: first of all glaucoma, retinal and optic nerve degeneration, dry eye syndrome and others. Practical recommendations on optical correction developed by Russian researchers, based on an understanding of the executive mechanisms of the metabolic theory of adaptive myopia, suggest the use of rational correction at the earliest stages of development of acquired myopia (if possible, it is necessary to inhibit the natural adaptation process at an early stage).

In addition, rational correction should prevent the interrelated work of intraocular systems under the conditions of extreme phases of accommodation: the object is at the farthest distance and completely close. Such optical correction allows to exclude the work of the ciliary muscle in the maximal and minimal tone, ensuring an effective outflow of aqueous humor through the uveoscleral path, normalize the natural metabolic processes in the eye and ensure normal regeneration of the collagen in the sclera, including its posterior pole. In practice, this means physiological application of weak overcorrection when looking at a distant objects (by 0.12-0.25 D) and a slight under correction when looking at objects located at near distance (0.25-0.5 D) with the correction for ortho- and exosphere.

3. An important achievement of the congress was a clear understanding of the need to develop and implement an effective control of video security in the visual environment in order to prevent not only the massive development of eye diseases, but also to exclude the negative influence of the modern visual environment on the functioning of many human life systems. Foremost, it is necessary to plan and accelerate interdisciplinary research to develop criteria for a comfortable visual environment when using artificial light sources,

screens of modern TVs, displays and gadgets. It is necessary to pay attention to the increased emittance of blue light waves and the often insufficient component of red light. The general trend of safe illumination with semiconductor light sources and video-safe radiation from displays is the following: it is necessary to have a biologically adequate spectrum that will ensure balanced operation of the visual analyzer and the endocrine system. The Congress draws the attention of the heads of state and government to the need to fund government programs to develop national regulations on visual work, involving ophthalmologists and representatives of other scientific disciplines, specialists in the field of occupational health and safety.

4. The Congress notes the unquestionable importance and special prospects of scientific research in the field of "Physiology and Biomechanics of the Eye". These studies have already led to the adequate development of Helmholtz's lens accommodation theory, and also revealed many new additional accommodation mechanisms, gave them a detailed classification and described the executive mechanisms. Also, these studies have allowed getting deeper understanding about the possible physiological mechanisms of the interconnected functioning of the retina and cerebral neuronal fields for the implementation of the binocular vision, as well as the accommodation control system. Today, Russia is the leader in these interdisciplinary studies.

5. The Organizing Committee of the Congress expresses sincere gratitude to all participants of the Congress, speakers and moderators of scientific sessions, wishes creative success in the scientific rationale of safety criteria for the visual analyzer in the conditions of the modern light environment and display civilization therefore to effectively prevent and treat children's eye pathologies.

Organizing Committee of the Congress

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