



About Scientific Results of the 3rd Global Pediatric Ophthalmology Congress (London 2018)

Ivan N Koshits^{1*}, Olga Svetlova², Marina Guseva³, Maksat Egemberdiev⁴ and Janek Masian²

¹Petersom-Networks / Management Systems Consulting Group Cl. Corporation, Russia

²Department of ophthalmology, Mechnikov North Western State Medical University, Russia

³City diagnostic medical center "Vodokanal of St. Petersburg", Clinic Doctor Lenses SPb., Russia

⁴Department of Ophthalmology, Chuy Region United Hospital, Kyrgyzstan

***Corresponding author:** Dr. Koshits Ivan Nikolaevich, Petercom-Network Management System / Consulting Grope Close Corporation, General Director, Saint-Petersburg, Russia, E-mail: petercomink@bk.ru

Received Date: June 29, 2018; **Published Date:** August 07, 2018

Abstract

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

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

Abbreviations

MTAM: Metabolic Theory of Adaptive Myopia; TCRD: Theory of Change of Retinal Defocus; AM: Adaptive Myopia; CM: Ciliary Muscle; IRDT: Incremental Retinal Defocus Theory; EROC: Early Rational Optical Correction; IVA: Individual Visual Acuity

Introduction

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 ocular

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 very important.

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]. Chaired 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

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

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

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 capsulo rexis 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.

Statistical Study on Cornea Profile 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 preferably 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.

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 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.

Analytical Review: Light-Biological Safety and Risks of Eye Diseases among School Child in Classrooms with Led Light Sources [6]

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.

Theory: Physiological and Biomechanical Features of the Inter Connected 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 [8]

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 [9], and also on the slides of the presentation below.

Physiology and biomechanics of the eye

The fundamental principle of development of all biological systems


Minimization of the energy consumption to perform the required work.

Therefore, the development of the anatomical structure in nature always goes on the way of **energy conservation**.

And below we will see how this key principle is performed in the eye.

Part 1. Eye how interconnected system

The main drawback of the detection system in humans



In the lens there are no nerve endings!

Therefore, the brain is not able to understand what changes have occurred in the lens with age. To reverse presbyopia the brain will try to image insert some corrections on the retina using a system of accommodation. But this system has a limited range.

The ciliary muscle is the servant of the three gentlemen: accommodation, production and outflow

- Obviously, at the functional level in a coherent work of these systems lies the objective contradiction.
- For example, to increase the outflow of ocular liquid in the trabecular pathway, we must strain our ciliary muscle.
- But the same moment seen away the Tiger, we will need to relax the muscle ciliary.

Which commands will be implemented?

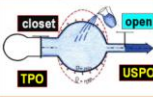
- Of course, the accommodation, because your life depends on it!

The first and the main principle of the eyes work


Absolute priority of the accommodation system over the management of outflow system

Regulation of the pathways to outflow through the muscle ciliary

Norm **No accommodation:** The trabecular pathway outflow (TPO) is closed



Norm **Near accommodation:** The Uveoscleral pathway outflow (USPO) is closed



In fact the muscle ciliary acts as a switchman on the pathways, and the uveoscleral pathway of the outflow is closed only when we are to see near

Regulation of the outflow pathways through the ciliary muscle

In the works for the exploration of the human eye accommodation in vivo using modern high resolution biomicroscope Stachos G. et al.(2002,2003) brought out the most important clinical fact:

- The scleral spur moves posteriorly only when the tone of the ciliary muscle is above average and has not shifted posteriorly with a lower tone.

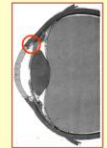
NB! Mechanism of TOP is included it is in moments of near vision, discovering this path as an additional outflow.

Functioning of the outflow pathways of aqueous humor depending on the phase of accommodation

Name of outflow pathways of intraocular fluid	The «completely near» phase of accommodation. Ciliary muscle tonus is maximal.	The «partially near» and «partially afar» phases of accommodation. Ciliary muscle tonus is average.	No accommodation. Ciliary muscle tonus is minimal.
Trabecular outflow pathway through trabeculae (TPO)	Opened	Closed	Closed
Uveoscleral outflow pathway through the matrix of the ciliary muscle and then through the sclera (USPO)	Closed	Maximally opened	Partially opened

In fact, the ciliary muscle regulates the intensity of the outflow pathways of intraocular fluid

The trabecular outflow pathway is an additional way of outflow, which allows the eye to work for a long time at near sight



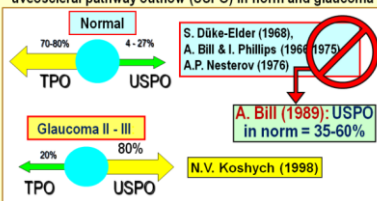
We now can understand why a person and four species of highly evolved monkeys developed an additional trabecular outflow pathway.

After all, in most representatives of the animal world there is only one way the outflow – the uveoscleral pathway.

In the evolution of our ancestors work at close range have become more and more important
And at this point, the USOP is closed!

Part 2. MECHANISMS OF SCLERA NUTRITION

Interaction the trabecular pathway outflow (TPO) with the uveoscleral pathway outflow (USPO) in norm and glaucoma



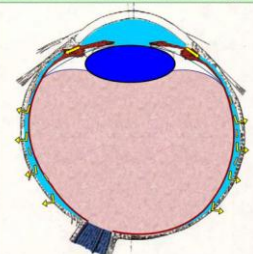
Normal: TPO 70-80%, USPO 4-27%

Glaucoma II - III: TPO 20%, USPO 80%

These data suggest that USPO is the main pathway outflow!

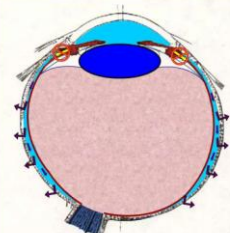
Citations: S. Duke-Elder (1968), A. Bill & I. Phillips (1966, 1975), A.P. Nesterov (1976), A. Bill (1989): USPO in norm = 35-60%, N.V. Koshych (1998)

The delivery of ingredients for collagen in the middle and posterior parts of the sclera in mammals is provided to a large extent, through the USPO



And this path is open only when the ciliary muscle have the average or minimum tone.

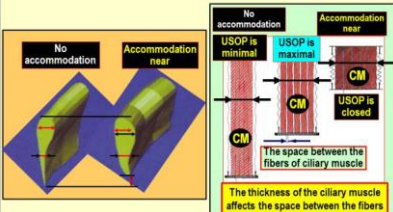
The second way of delivery of ingredients to the middle and posterior parts of the sclera in mammals is provided by the work of the mechanism of ultrafiltration of intraocular water from vessels choroid.



In the absence of accommodation, this mechanism is ineffective.

However, even with the intense visual work at near this mechanism does not provide full maintenance metabolism in the sclera.

The USOP regulation mechanism



No accommodation: USOP is minimal

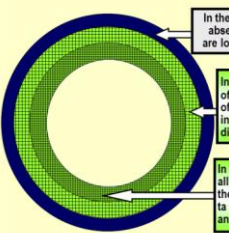
Accommodation near: USOP is maximal

The space between the fibers of ciliary muscle

The thickness of the ciliary muscle affects the space between the fibers

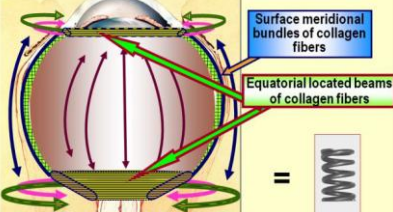
Extreme phases the accommodation mechanism are unfavorable for USPO

Location of bundles of collagen fibers on the thickness of the sclera



- In the surface layer elastic fibers are absent. Bundles of collagen fibers are located in a meridional direction.
- In the middle layer there is ~30% of all elastic fibers. The bundles of the collagen fibers are located in a meridional and oblique directions.
- In the inner layer there is ~70% of all elastic fibers. The bundles of the collagen fibers are located in a layer structure in a meridional and oblique directions.

Location of collagen fibers on the segments and on the surface of the sclera



- Surface meridional bundles of collagen fibers
- Equatorial located beams of collagen fibers

Anatomy of the pole of sclera in the form of a spring allows to easily adjust the length of the optical axis of the eye.

Part 3.

our own metabolic theory of the adaptive myopia

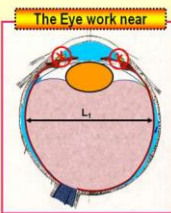
Hypothesis:

- In the eyes of mammals the mechanism for selecting length of the optical axis of the eye under continuous visual load can be associated with a temporary interruption of the uveoscleral outflow pathways (USOP).
- Physiologically well-founded selection of length of the optical axis enables lower power consumption of the eye.

The root cause of myopia on the load type.

Look completely near

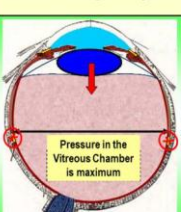
The root cause of the progression of myopia of the load type – is physiological: while working at the close distance the USOP is overlapping and disrupting nutrition of the posterior part of the sclera.



The Eye work near

The root causes of myopia by the unloading type.

Look fully away.



1. The space between the fibers of the ciliary muscle is minimum.
2. Blood flow to the eye and production of the intraocular water decrease in three times.
3. Equator Vitreous Chamber blocks the access of the intraocular water to the posterior part of the sclera.

Pressure in the Vitreous Chamber is maximum

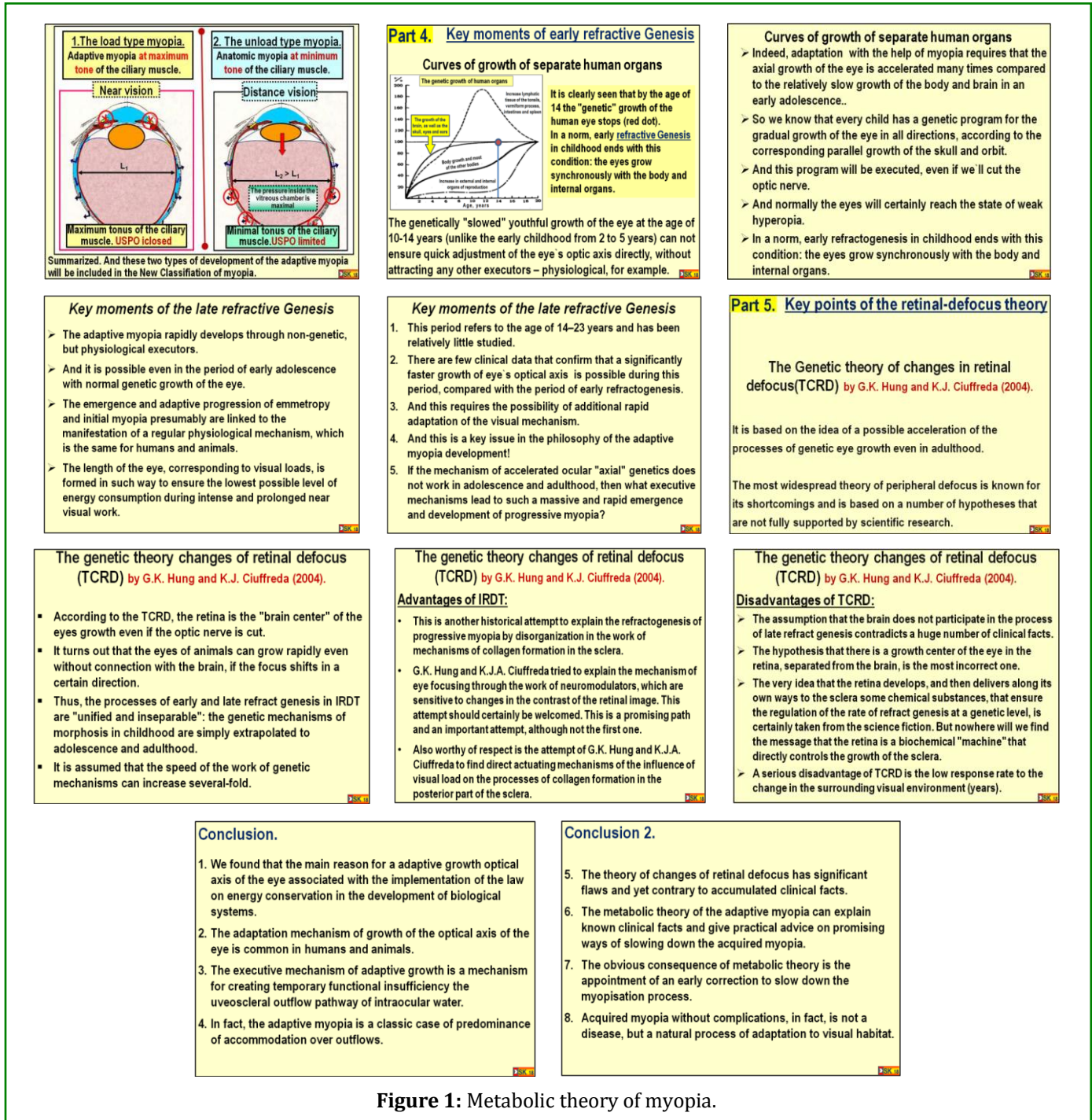


Figure 1: Metabolic theory of myopia.

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 (EROC) 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 EROC. 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 [9], and also on the slides of the presentation below.

Reference point. Difficult questions.

1. The acquired myopia is a disease or adaptation.
2. What physiological mechanisms and visual loads lead to the development of adaptation myopia in eyes of animals and humans.
3. Do we have a generally accepted effective theory of adaptation myopia (AM)?
4. Do we have objective criteria for video security loads?
5. In which country were developed the state regulations on the safety Visual work in conditions of the Display civilization and artificial light sources.

We will try to answer these questions.

Reference point.

- Today in the world there is no generally accepted theory of adaptive myopia. Safe criteria for Visual work are not developed. This does not allow to successfully combat adaptive myopia.
- Number of people with adaptive myopia is growing rapidly all over the world. In 2050 year on Earth will be 50 billion people with myopia. In fact, we are faced with a pandemic of myopia.
- We struggle with the investigation and not with the cause of adaptive myopia.

Our point of view.

- **Adaptive myopia** is not a disease, but common in animals and in human physiological mechanism for adapting the length of the eyes with prolonged loads in individual environments.
- **Adaptive myopia** is the classical case of the predominance of accommodation is by outflow.

The goal of the normal Adaptive myopia (AM)

1. The all biological systems on Earth develops on **the principle of energy conservation** – It is the fundamental principle of adaptation to the environment.
2. The main goals **to reduce the energy consumption** of the eye during prolonged intensive Visual work.

Examples.

Animals. Highly developed monkeys, living by collecting and looking at small objects. Cats and dogs in conditions of limited space often have myopia.

People. Myopia often has crews of nuclear submarines the nuclear submarines due to long-term in closed environments where space is limited. The military and civilian pilots often become a myopia in 35-45 years due to intensive work with displays in the dark and confined space cabin. Myopia is often observed among accountants and bank employees.

The goal of the normal Adaptive myopia (AM)

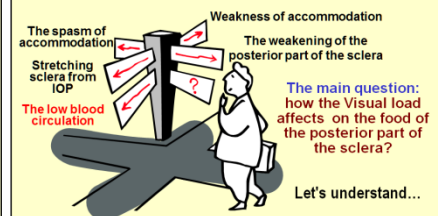
2. The **second goal** of the development of the AM - so adjust to Visual Habitat Wednesday to ensure execution **of the visual comfort**, improve competitiveness and survival of the species.

AM develops in children and adults!

This important finding confirms a lot of research:

- ✓ Employees in my company "Vodokanal of St. Petersburg", myopia weak degree evolved almost 35% of healthy patients after 5-7 years due to work with the computer about 8:00 per day.
- ✓ When working with the microscope, the staff develops unilateral myopia.
- ✓ The Inuit of North America have myopia above 1.0 (D) aged 21 to 25 years when often using display.
- ✓ However, the Inuit of North America over 50 years do not have myopia, because few enjoy displays. **There is no reason, no adaptation!**

What is the reason for «the optical defiance of the eye and is often not at all a disease»? (E.S. Avetisov, 2001)



The rapid growth of the number of myopias says that we do not yet have truly working and practically applicable theory of myopia.

Practical advances in the search for the root causes of the pathogenesis of myopia can be represented in the form of such happy drawing:



Vitruvian Man

Virtual Man

Leonardo da Vinci.

Search for the "golden section" in the pathogenesis of myopia about 1490-2018

The key principles of the work of the eye

- **Uveoscleral path** of the outflow (USPO) of aqueous humor is the only way the outflow in animals, which is closed when the intense work of the eye to near vision.
- To provide opportunities to work around in the course of evolution in humans and 4 species advanced monkeys formed a second additional outflow path – **trabecular path**.
- Trabecular path of the outflow (TPO) of aqueous humor is only open when the ciliary muscle tone above average.
- This additional way to churn allows long-term work near when USPO is closed or not effective.
- USPO - the main path of outflow from working the eye for medium and long distances.

The key principles of the work of the eye

- As we already know, the muscle ciliary is "servant of the three Lords": accommodation, products and outflow. Each of these systems should be ranking in order of importance for species survival.
- The main physiological principle of functional interaction of intraocular systems was first found in 1994 by researchers Ivan Koshits and Olga Svetlova (Russia).
- This principle is: **in the eye has absolute priority accommodation system over system outflow.**
- This is a key principle of the eye work: the team at accommodation will always be a matter of priority, as it directly affects the survival of the species.
- Even when developed stages of myopia the Muscle Ciliary (MC) can use all its functional volume of accommodation.
- And we can support this functional ability of ciliary muscles due to rational correction.

The last three basic theories of myopia

1. **The Genetics-physiological three-component myopia theory** by E.S. Avetisov (1999): Heredity + weakness accommodation + near vision + weakened sclera + IOP = increase the optical axis of the eye. **This theory is an important stage in the development of an adequate theory of myopia.**
2. **The genetic theory of retinal defocus changes** by G.K. Hung and K.J. Ciuffreda (2004). It is based on the idea of a possible acceleration of the processes of genetic eye growth even in adulthood. 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.
3. **Physiological metabolic adaptation theory myopia** by I.N. Koshits and O.V. Svetlova (2001). Acquired myopia is represented in this theory not as a disease but as a natural adaptive process to reduce the energy consumption of the eyes in animals and in humans during prolonged intensive work near. This theory allowed to explain the results of clinical observations, provided the theoretical basis for prevention correction and pharmacotherapy. Only a high degree of myopia and myopia with complications are considered of the disease.

Actuating mechanisms in the metabolic theory

- Initially the child's eye has a weak hyperopia refraction. This leads to tension the ciliary muscle during prolonged viewing near objects.
- In these moments the outflow of aqueous humor along the USPO deteriorates or overlaps (O. Stachs et al., 2002, 2003). The delivery of the ingredients is temporarily deteriorating the middle and posterior parts of the sclera.
- Reproduction of collagen in the middle and posterior parts of the sclera in these moments is getting worse, frame made of collagen fibers is weakened, that leads to a response increase eye axis due to the actions of the IOP (I.N. Koshits, O.V. Svetlova, 2001, 2006).
- The focus of the eye is moved into position in front of the retina. This reduces the tone of the work of the muscle ciliary and lower power consumption in the eye when working near.
- The eye has adapted to comfortable work near.
- The Executive mechanism that creates a temporary functional insufficiency USPO is common in humans and animals.

The advantages of rational correction

1. **Rational correction** is a physiological possibility off natural adaptation mechanism of growth of the optical axis of the eye due to retention of the ciliary muscle in the average tone using optical effects.
2. This is an opportunity to make full use of the functional range of the work of the muscle ciliary.
3. It is possible to apply gentle optical correction due to full use of the physiological capabilities of retina, that is taking into account the individual Visual acuity.
4. This is an opportunity to provide quality metabolism in middle and posterior parts of the eyes due to activation of the USPO.
5. This is an opportunity to ensure prevention of opportunistic diseases offset directional optac regulation of the outflow of aqueous humor.

Our new concept in optometry

➤ **Rational correction** is a portable optical correction of human visual system that does not affect the metabolism of each eye and allows you to use the full functional volume accommodation binocular work.

➤ **Comfortable conditions of Visual work** is such individual physiological conditions, when Visual work can be carried out without voltage for a long time, and when this physiological prerequisites for the development of myopia in the eye will be absent

Our research goals during studies over 3, 5, 7 years

- To confirm the adaptive origin of acquired myopia based on the results of comparative studies on the effectiveness of late or early optical correction.
- Reaffirm the need for mandatory accounting of individual Visual acuity the patient to improve the braking performance of acquired myopia.
- To conduct in-depth study on the comparative effectiveness of application of the basic traditional and modern means of optical correction in the light of the metabolic adaptation theory myopia by I.N. Koshits and O.V. Svetlova.

Research objectives.

- To develop principles of stabilization of acquired myopia using early rational optical correction, allowing the slow functioning of the adaptation executive mechanism of the axial growth of the eye.
- To investigate the explore effectiveness of stabilization of acquired myopia way early rational correction with modern glasses and contact lenses compared to late traditional insufficient correction for distains vision.
- To identify the ability of early rational optical correction to tap in the eye the whole functional volume of the accommodation, delete the long work of the muscle ciliary in the extreme phases of accommodation.
- To develop a practical recommendations for the use of early rational correction of acquired myopia with the help o fthe modern glasses and contact lenses. With consideration of individual Visual acuity to restore the eye level accommodation response and normalization of muscular balance.

Objectives of the study were the following

- To compare the effectiveness of the traditional method of incomplete optical correction with the rational optical correction method when you use eyeglass or contact lens of contemporary design.
- Show benefits of choosing less strong rational correction when the individual Visual acuity more 1.
- Show the advantage of early AM correction using MAMT hypothesis that adaptation myopia is not a disease, but a normal adaptive reaction to visual conditions Wednesday in humans and animals
- Justify the physiological principles of prevention AM using the rational optical correction method and give practical advice to doctors and optometrists.

Material and methods:

- Clinical studies have been at 3546 patients with all degrees of myopia aged 7 to 37 years.
- Duration of observation in comparable groups amounted to 3, 5 and 7 years.
- Applied two ways optical correction of myopia: traditional not complete correction (NC) for distance and near and early rational correction (ERC).
- ERC has two main goals: utilize the full functional range of the ciliary muscle (CM) and choose a CM tone, which interrupts or doesn't reduce the uveoscleral path outflow of intraocular liquid (USPO).
- ERC provides for such optical correction, which excludes the ciliary muscle work under maximum or minimum tone.

Material and methods:

- Therefore, for sight distance ERC uses portable location focus behind the macula to a (+) 0.12-0.25 D.
- For patients not busy Visual work focus for near accurately have that's right in the macula (0.0 D), and for patients, performing a stressful and lengthy Visual display work - before the macula value (-) 0.5 - 0.75 D for near.
- Those patients who used orthokeratological lenses of night wearing (OK-lens) focus is always placed behind the macula - at the value (+) 0.25-0.75D in the morning with a gradual change of focus location in front of the retina to a value (-) 0.25 - 0.5 D in the evening.

Optical correction tools:

- Monofocal glasses** (comparison group with correction to IA = 0.8-1.0, without determining the individual acuity),
- Bifocal glasses** with stage + 2.0 d (comparison group with correction to IA = 0.8-1.0, without determining the individual acuity),
- Monofocal glasses of modern design** with a distance vision: emmetropia or weak hyperopia + 0.25 D, with a close: gipocorrectia + 0.5 ... + 0.75 D,
- Orthokeratology lens** with distance correction + 0.25 D, i near correction - 0.5 D,
- Mono focal soft contact lenses**, providing giper correction + 0.25 D in combination with the optical power +0.5 -0.75 D; glasses that provides a common gipocorrectia -0.5 0.25 D when working near.

Progression of acquired myopia in both age groups depending on the source of Visual acuity in patients and means of optical correction during the observation period 5 years

Age, years	The average height of the refraction static eye patients in year observation period 5 years	The control group		Early rational correction						
		Glasses of traditional designs		Glasses of modern Lenses of modern design						
		With monofocal (MF) or bifocal Optics (BF)		With progressive Optics (PO) or with special optics design (SD)	Soft contact lenses (SL) in combination with prophylactic glasses (PG) and OK-lenses					
7-9	Individual	0.8	1.08	1.13						
	Visual acuity (VA)	1.0	0.84	0.75	0.90	0.29	0.24	0.12		
10-12	Individual	0.8	1.12	1.17						
	Visual acuity (VA)	1.0	0.78	0.82	0.54	0.34	0.26	0.14		
13-20	Individual	0.8	1.02	0.79						
	Visual acuity (VA)	1.0	0.72	0.64	0.48	0.28	0.18	0.10		
7-20	Individual	0.8	1.07	0.82						
	Visual acuity (VA)	1.0	0.68	0.71	0.90	0.30	0.23	0.12		
	Individual	1.25-1.5			0.21	0.17	0.13	0.07		

P < 0.01

Results.

- It has been established that the appointment early rational optical correction can be a more efficient method of braking, stabilization and prevention of progressive AM compared to later optical correction. Clinically confirmed the usefulness and effectiveness of early optical correction of adaptive myopia (p < 0.01).
- In patients with myopia has been proven in practice, the effectiveness of the method does not complete the minimum correction for near (-) 0.5 - 0.75 D and complete the minimum optical correction for distance (+) 0.12 - 0.25 - 0.75 D compared to the widespread way not complete correction of myopia for sight near and far (p < 0.001).

Results.

- Individual Visual acuity as a physiological parameter describing the capabilities of a retina has a significant impact on the progression of the AM: the higher Visual acuity, the greater the braking effect. Clinically proven need for reliable detection and counting of individual Visual acuity to assign more comfortable ERC (p < 0.01).
- When timing observation 3, 5 and 7 years again confirmed in practice, the maximum efficiency of use of OK-lenses for inhibition of AM compared with other modern non-surgical methods of optical correction (p < 0.001). This apparently happens because OK-lenses provide the minimum permanent focal inference for macula on size of (+) 0.12 - 0.25 - 0.75 D In the morning and refraction change throughout the day with focal location in front of the retina on (-) 0.12 - 0.25 - 0.5 D in the evening.

Practical advice:

- Optical correction should be early, begin with 0.5 diopters at any age.
- Optical correction should be as follows:

View fully distance :

- Weak overcorrection on the + (0.12...0.25) D for patients with exophoria,
- Complete correction with orthophoria and with individual acuity 0.8 - 1.0,
- With individual acuity 1.25 - 1.5 display focus on the retina.

View fully near:

- If exophoria weak overcorrection.
- With orthophoria and with individual acuity 0.8 - 1.0 prevention glasses +0.5-0.75D.
- With individual acuity 1,25 - 1,5 display focus on the retina.
- At exophoria use progressive lenses with degress +0,75-1,25 D or soft contact lenses with prophylactic prescription glasses for short distances + 0,75 -1,25 D.

Conclusion:

- The minimum focal location for macula allows you to exclude the state functional insufficiency USPO. This ensures the normal delivery of metabolites for the reproduction of collagen in the middle and posterior parts of the sclera, even with intense prolonged Visual work.
- Traditional is not complete correction for distance and near clinically not confirmed its braking performance AM compared with the ERC, which excludes the work of ciliary muscle at maximum or minimum tone and allows you to use the full functional volume of accommodation. Identified effective prevention and inhibition AM due to activation of the USPO using ERC.
- Hypothesis of the Koshits-Svetlova metabolic adaptation myopia theory first reliably confirmed in practice. Research opportunities the way of the early rational optical correction have revealed the possibility of effective prevention AM using OK-lens and contact lenses of contemporary design when combined with preventive glasses.

Figure 2: 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.

Theory: Actuating Mechanisms of Accommodation and Development of the Theory of Accommodation by Helmholtz [11]

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 [9], and also on the slides of the presentation below.

THE MECHANISM OF THE LENS ACCOMMODATION

Helmholtz view that in the eye has a single mechanism of accommodation - accommodation through the lens - is traditionally considered an axiom. However, this is not the complete picture.

THE MECHANISM OF THE LENS ACCOMMODATION

According to traditional views, the Executive mechanism of accommodation are: muscle ciliary, zonula and lens.
Vitreous Chamber and choroid are not included in these arrangements.

DEVELOPMENT OF THE THEORY OF ACCOMMODATION

Traditionally, lens secured in the eye only using zonula. And during view near portions of fibers of the zonula ostensibly relax. But then there is no mechanical structures that hold the lens in position!
It should also be noted that the lens moves along the optic axis of the eyes during accommodation. But this is not taken into account.

DEVELOPMENT OF THE THEORY OF ACCOMMODATION

Actuators lens accommodation	
By H. Helmholtz (1855), J. Rothen (1969), R. Schachar (1999,2000), etc.	By O. Svetlova, I. Koshits, K. Kottlyar (1998,1999)
The only adjustment mechanism:	The basic mechanism of accommodation:
<ul style="list-style-type: none"> Active ciliary muscle Zonula fibers Capsule of lens 	<ul style="list-style-type: none"> Active ciliary muscle Zonula fibers Capsule of lens Choroid Vitreous Chamber
Do not participate:	Also involved additional mechanisms of the accommodation in the eye
<ul style="list-style-type: none"> Choroid Vitreous Chamber 	

Our new presentation develop an evolutionary theory of the lens accommodation by Helmholtz. In the eye has a lot of adjustment mechanisms. Their presence confirms the fact of maintaining accommodation in volume up to 2.5 D in eyes with intraocular lenses.

The joint work of the zonula fibers and Vitreous Chambers during accommodation

- Using a zonula fibers lens remains pressed against the Vitreous Chamber in all phases of accommodation.
- The zonula fibers never relax fully.
- When we are looking into the distance the lens is maximum pressed into the surface of the Vitreous Chamber.

When optical correction held not entirely, ciliary muscle relaxes, zonula fibers are stretched as much as possible, and the pressure in the Vitreous Chamber also becomes the maximum. This is increases the volume of the excavation by the some patients.

Actuators of the lens accommodation, which are consistent with the laws of mechanics

Increased tonus of the muscle ciliary moves anteriorly rack line of the choroid, weakens the tension of zonula fibers, allowing lens capsule become more circular and displaced anteriorly.
The zonula fibers never relax fully. In all phases of accommodation lens pinned to the Vitreous Chamber. This allows have amortize oscillations of the lens and to ensure his reliable anchoring in the eye.

Anatomical structure of the Zonula apparatus

Traditional attitudes today are such features. The zonula apparatus is involved in the process of accommodation as follows:

- The zonula fibers are attached to the muscle ciliary, which stretches through them, the capsule of the lens when performing visual work at a distance.
- Front portion of the zonula fibers and rear portion of the Zonula fibers intersect each other.
- When you run a Visual work at close range the Zonula fibers is relax and even experiencing sagging.
- Vitreous Chamber and Choroid did not participate in the accommodation.

All of these views are not inconsistent with the laws of mechanics.

Decussation of the zonula fibers. It is traditionally but erroneous view. This view is still used for mechanical and optical calculations of intraocular lenses.

The intersection portions of the fibers. Lens held in elastic suspension. When the fibers were relaxation this Lens practically not fixed in the eye! Entrenchment of the lens in the eye is contrary to the laws of mechanics.
The wrong view!

Scanning electron microscopic studies of the zonular apparatus in human and monkey eyes. The intersection of fibers of the zonular apparatus is missing.

Correct knowledge about the location and course of the fibers of the zonular apparatus without crossing.

Anatomy of the zonular apparatus in human and monkey eyes allows to provide accommodation, as well as the uneven level of astigmatism.

Anterior portion of the zonula fibers attached to the lens capsule in the form of individual segments. This allows the eye to partially reverse the astigmatism, and also provides the possibility of uneven accommodation in different meridians.

Own presentation on the work of the zonula apparatus of the eye. They are fully adequate to the laws of mechanics

- Front and rear portions of the zonula fibers are powerful and able to withstand heavy shock loads.
- These portions of fibers attached to the rear of the dentate line of the choroid, and attached to the front lens bag.
- These portions of fibers not attached directly to the muscle ciliary.
- Anterior portion of the zonula fibers withheld using very fine efferent fibers between spikes of the muscle ciliary, providing them with the necessary anatomical distortion.
- The rear portion of the zonula fibers cover the Vitreous Chamber in the form of a glassy Web, creating mechanical system with high resistance to dynamic loads.
- The thin Equatorial fibers located on Equator of the lens capsule and attached between spikes of the muscle ciliary. They evenly stretch the lens capsule during minimum tonus muscle ciliary. These fibers do not work on accommodation, and are designed to hold the weight of the movable lens centered on the optical axis.

Own presentation on the work of the zonula apparatus of the eye. They are fully adequate to the laws of mechanics

It is now possible to understand why the theory of accommodation R. Rothen and R. Shaha are not adequate laws of mechanics.
Kotliar K.E., Svetlova O.V., Skoblikov A.S., Smolnikov B.A. Biomechanical modeling of the accommodative system based on some contemporary conceptions of lens supporting apparatus functioning. Vision Science and Its Applications, Santa Fe, Optical Society of America, 1999, p. 156-162

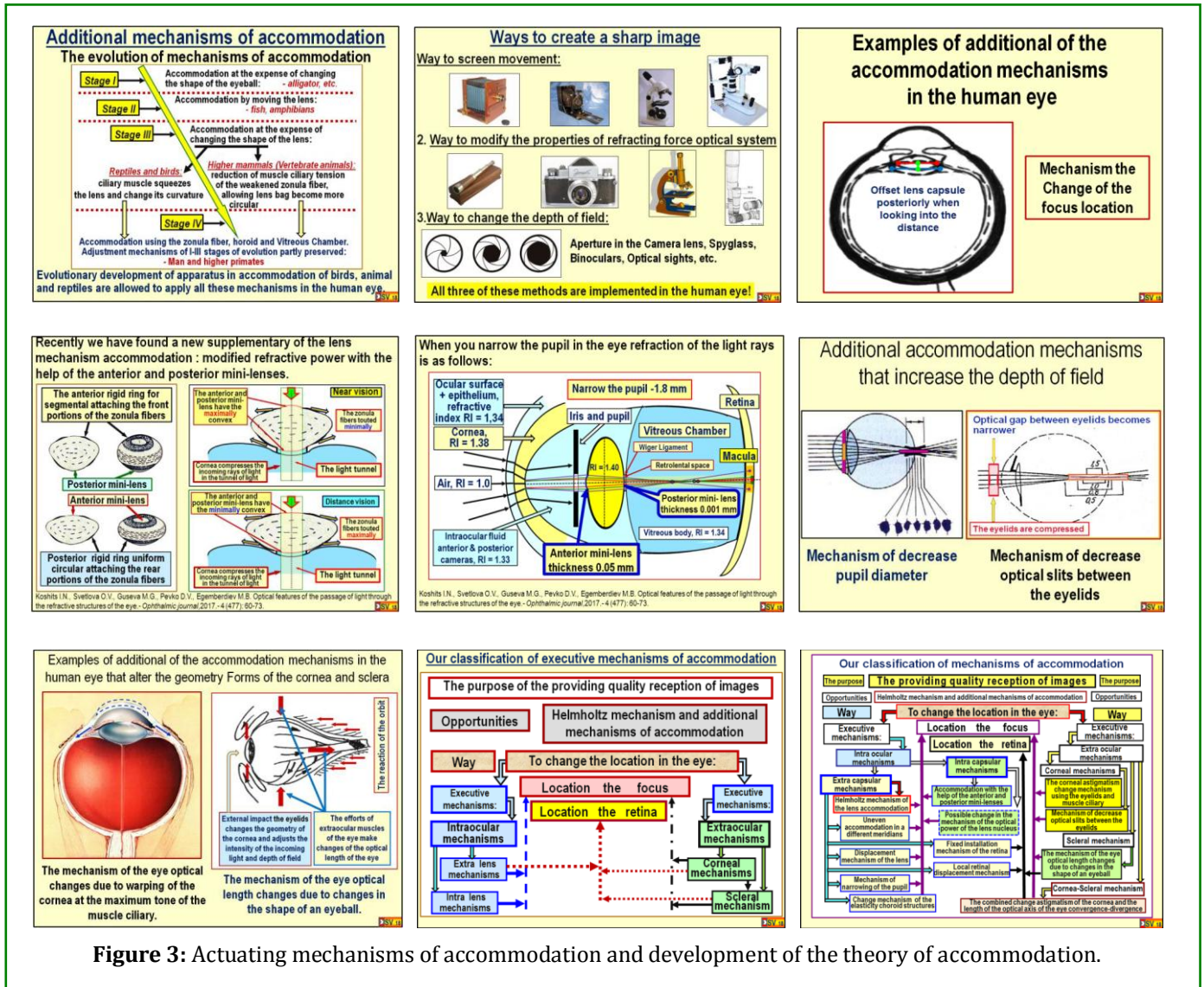


Figure 3: Actuating mechanisms of accommodation and development of the theory of accommodation.

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 [9], and also on the slides of the presentation below.

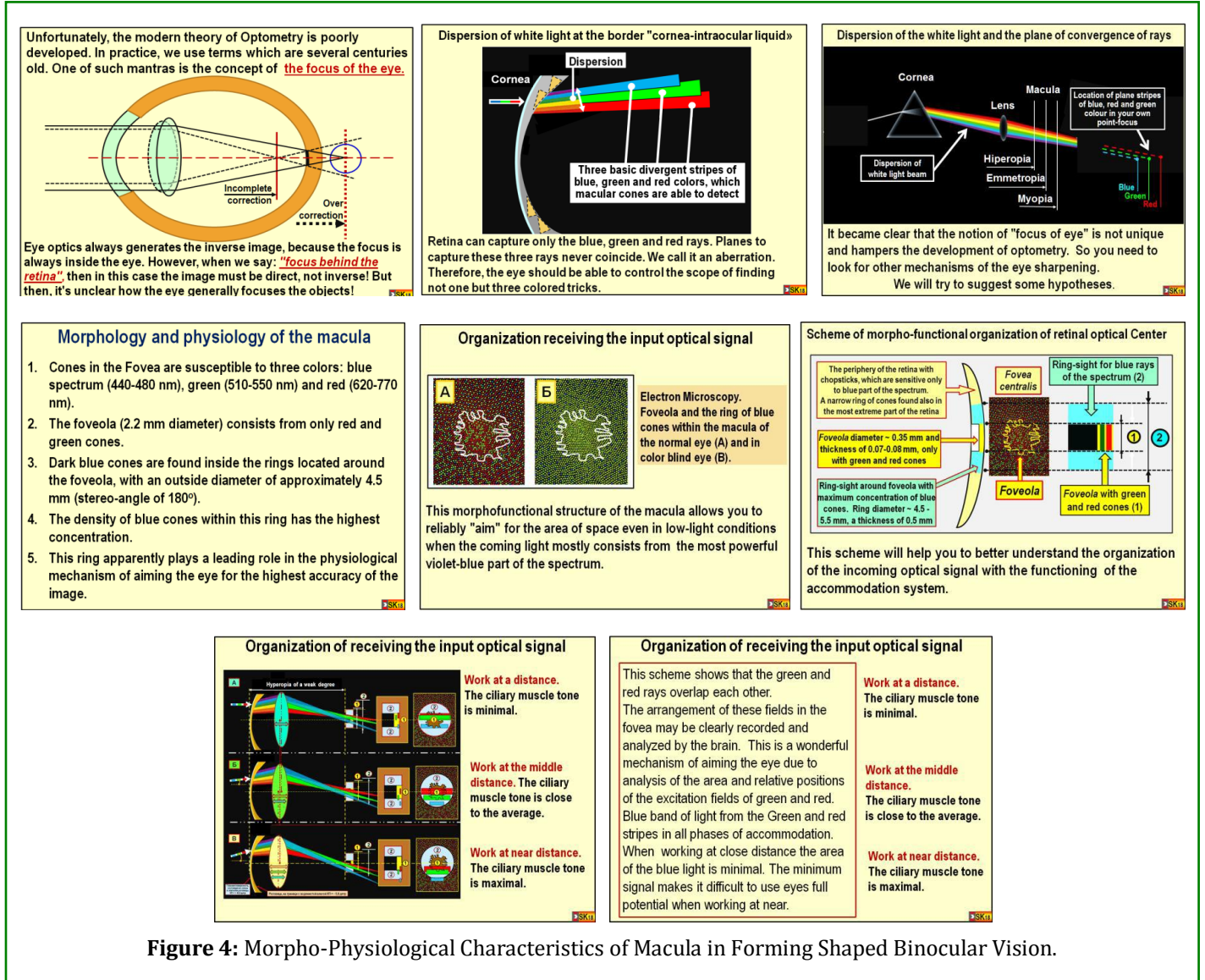


Figure 4: Morpho-Physiological Characteristics of Macula in Forming Shaped Binocular Vision.

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.

- 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.

- 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 performing 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 excluding the work of the ciliary muscle in the maximal and minimal tone, ensuring an effective outflow of aqueous humor through the uveoscleral path, normalizing the natural metabolic processes in the eye and ensuring 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 exophoria.

- iii. 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.

- iv. 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.
- v. 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.

References

1. Pediatric Ophthalmology Conferences 2019.
2. Yizhi Liu (2018) Lens regeneration using endogenous stem cells for treatment of congenital cataract. Proceedings of 3rd Global Pediatric Ophthalmology Congress, London, Uk. J Clin Exp Ophthalmol 9: 84.
3. Haveri T, Meco M, Kojqiqi C (2018) Statistical study on cornea profile and parameters between generations in Albania; Is there a prediction for future keratoconus? Proceedings of 3rd Global Pediatric

- Ophthalmology Congress, London, UK. J Clin Exp Ophthalmol 9: 91-92.
4. Vira S, Igor V (2018) Modified device for investigation of accommodation; irregular accommodation. Proceedings of 3rd Global Pediatric Ophthalmology Congress, London, Uk. J Clin Exp Ophthalmol 9: 71.
 5. Serdiuchenko VI, Viasovsky IA (1997) The new device for determination of absolute accommodation volume of the eye. Ophthalmol 1: 12-15.
 6. Serdiuchenko VI and Viasovsky IA (2004) The study of accommodation in various meridians of the eye and a modified method of treatment of its disorders in hypermetropic amblyopia. Conference proceedings: "Biomechanics of the eye - 2004". Moscow, Russia, p. 33-37.
 7. Alexandrovich KV, Deynego VN (2018) Analytical review: Light-biological safety and risks of eye diseases among school child in classrooms with led light sources. Proceedings of 3rd Global Pediatric Ophthalmology Congress London, UK. J Clin Exp Ophthalmol 9: 58-59.
 8. Koshits I, Svetlova O, Egemberdiev M (2018) Theory- Physiological and biomechanical features of the interconnected functioning of the systems of accommodation, and aqueous humor production and outflow systems. Hypotheses and executive mechanisms of the growth of the eye's optical axis in the metabolic theory of adaptive myopia and in the theory of retinal defocus. Proceedings of 3rd Global Pediatric Ophthalmology Congress, London, UK. J Clin Exp Ophthalmol 9: 44-51.
 9. Final resolution of the 3rd Global Pediatric Congress, London 2018. 3rd Global Pediatric Congress notes the significant achievements of recent years in pediatric ophthalmology and considers it necessary to note the following.
 10. Guseva M, Makarovskaia O, Masian J (2018) 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. Proceedings of 3rd Global Pediatric Ophthalmology Congress, London, UK. J Clin Exp Ophthalmol 9: 52-53.
 11. Svetlova O, Koshits I (2018) Theory- Actuating mechanisms of accommodation and development of the theory of accommodation by Helmholtz. Proceedings of 3rd Global Pediatric Ophthalmology Congress, London, UK. J Clin Exp Ophthalmol 9: 66-70.