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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

Statement of the Problem: Fighting adaptive myopia (AM) will only be effective when truly working theory of myopia is developed and confirmed by clinical trials. The pandemic of myopia confirms the absence of a theory that can explain all known clinical facts and give physiologically approved practical recommendations. And as practice has shown, unfortunately, the incremental retinal-defocus theory (IRDT) is no exception. The hypothesis of this theory not always corresponds to the known clinical facts about the physiology of the eye taking into consideration interconnected operation of accommodation and aqueous humor production and outflow systems [1]. However, in 2001 Russian authors Ivan Koshits (biomechanics) and Olga Svetlova (ophthalmologist) proposed a metabolic theory of adaptive myopia (MTAM), which was based on a profound long-term interdisciplinary analysis of modern clinical facts in such fields like morphology, physiology, biomechanics and accommodative mechanisms of the eye [1]. MTAM not only explains known clinical facts, but also gives an opportunity to develop the theory of Optometry in teachings on «Rational optical correction» and « Visual comfort» [2,3]. To verify practical application of MTAM a long term clinical trials were planned. The results of these studies are presented below. Objectives of the study were following. 1) To compare the effectiveness of traditional use of incomplete optical correction with the rational optical correction method using eyeglasses or contact lenses of modern design. 2) To show benefits of choosing lesser rational correction when the individual visual acuity is more than 1.0. 3) To show the advantages of early AM correction using MTAM hypothesis which implies that adaptive myopia is not a disease, but a natural adaptive reaction to certain visual conditions in humans and animals [5]. 4) To justify the physiological principles of prevention of AM using the rational optical correction method and give practical advices to doctors and optometrists [6,7].

Materials and methods: Clinical studies have been conducted by ophthalmologist Marina Guseva with 3546 patients with all degrees of myopia aged 14-37 years. Duration of observation in comparable groups amounted to 3, 5 and 7 years. Two ways of optical correction of myopia were applied: traditional incomplete correction (TIC) for far and near sight and early rational correction (ERC). ERC has two main goals: to utilize the full functional range of the ciliary muscle (CM) and choose a particular CM tension, which doesn't interrupt or reduce the uveoscleral outflow pathway of aqueous humor (USOP). ERC implies such optical correction, which excludes the CM work under maximum or minimum tension. Therefore, for far sight ERC uses transpositional location of image transferring it behind the macula by a 0.25-0.5 D. For patients without excessive visual work - image was place right in the macula (0.0 D), and for patients, performing a stressful and lengthy visual work on displays - before the macula value 0.5 - 0.75 D. Those patients who used orthokeratological lenses (OK-lens) focus was always placed behind the macula at the value 0.25-0.75 D during work day. The following means of modern optical correction were used: 1) glasses of traditional designs with monofocal or bifocal optics; 2) glasses of modern design with progressive optics or special optical design (for example glasses anti fatigue and nulux active); 3) OK- lenses and lenses of modern design – soft contact lenses combined with preventive glasses.

Results: 1. It has been established that use of ERC can be more efficient method of slowing, stabilizing and preventing progression of AM compared to late optical correction. Clinical trials confirmed usefulness and effectiveness of early optical correction in

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adaptive myopia ($p < 0.01$). 2. It was practically proven in clinical trials that the minimum incomplete correction (plus 0.25 - 0.75 D) is the most effective method for work at near sight while most effective correction for far sight was complete minimum optical correction (minus 0.25 - 0.5 D) in comparison to incomplete correction of myopia for near and far sight ($p < 0.001$). 3. Individual visual acuity as a physiological parameter describes the capabilities of a retina and has a significant impact on the progression of the AM: the higher the visual acuity, the greater effect of slowing the progression of myopia with rational optical correction. It was clinically proven for the need of reliable measurement of individual visual acuity to assign more comfortable ERC ($p < 0.01$). 4. During the time of observation for 3, 5 and 7 years it was confirmed that OK-lenses had the maximum efficiency in slowing progression 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 displacement behind macula for 0.25 - 0.75 D. The minimum focusing image displacement behind macula allows you to exclude functional insufficiency of USOP. 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.

Conclusion: Traditional incomplete correction for far and near sight clinically didn't confirm slowing the progression of AM in comparison with the ERC, which excludes the work of ciliary muscle at maximum or minimum tone and allows you to use full functional volume of accommodation. Identified effective prevention and inhibition of AM due to activation of the USOP using ERC. Hypothesis of the Koshits-Svetlova metabolic theory of adaptive myopia [1,5] first reliably confirmed in practice. Research opportunities of early rational optical correction have revealed the possibilities of effective prevention of AM using OK-lens and contact lenses of modern design when combined with preventive glasses.

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Biography

Marina G. Guseva: From 2003 to 2011 Chief doctor-ophthalmologist of 54 urban centers "Nevskaya Optics holding", with 2011 Chief ophthalmologist «Sfera» LTD, with 2012 ophthalmologist in Medical city center "Vodokanal of St. Petersburg". Have 9 international certificates for optometry. Author of 34 publications, co-author of two chapters in the book "Ophthalmology" (St. Petersburg: Military-medical Academy, 2010). Co-author and developer of the modern way of rational optical correction and specialized training manual "Physiological principles of rational optical correction. Practical recommendations. Normal physiology.

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