Baseline data in the study on the tolerance and efficacy of peripheral defocus spectacles for the control of myopia progression in Argentina (Myofix Defocus Study)

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Conflict of interest
Abel Szeps, Martin de Tomas, Gabriel Martín and Rafael Iribarren are consultants of Novar and Opulens.

Members of the Group
The Defocus Study Group coordinators are Rafael Iribarren and Abel Szeps, and its members are Aldana Isilieri, Alejandro Armesto, Carlos Kotlik, Carolina Picotti, Constanza Bordón, Darío Busto, Dayana Trombetta, Diego Amado, Ernesto García, Fabiana Leiva, Florencia Cortínez, Gabriel Martín, Guillermo Saracco, Idamar León, Karina E. Villacorta, Leonardo Fernández Irigaray, María Julia Zunino, Marta Zardini, Martín de Tomás, Matías Acerbi, Ricardo Impagliazzo, Roberto Albertazzi, Rodolfo Aguirre, Romina Quercia, Sebastián Dankert, Susana Gamio, Valeria Bordese, Victoria Sánchez and Viviana Abudi.

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Abstract

Purpose: To evaluate the efficacy and tolerability of the use of a new model of spectacles designed to control the progression of myopia in childhood.
Methods: The Myofix Defocus Study is a longitudinal, prospective, interventional, non-randomized research study for myopia control spectacles. This field study includes 48 myopic children aged 8 to 15 years old without other ocular pathology, enrolled from June 2023 to April 2024. In this study, patients were offered the option of undergoing a treatment accessible in our region (compounded diluted atropine drops) or a possibly equally effective treatment with special glasses designed in our country. In the present study, a complete initial ophthalmological evaluation with objective refraction under cycloplegia was performed, with recording of axial length measurements and a survey on habits, lifestyle and family history of high myopia.
Initial data showed a mean age of 10.72 ± 2.48 years and that 23/48 of them were girls. Their mean spherical equivalent was -2.61 ± 1.12 dioptres in the right eye and -2.37 ± 1.12 dioptres in the left eye. The mean keratometry was 43.52 ± 1.32 dioptres in the right and left eye. The average axial length was 24.38 ± 0.79 mm for the right eye and 24.34 ± 0.79 mm for the left eye.
Conclusion: The initial data of the Myofix Defocus Study comprise a sample of myopic schoolchildren prone to progressive myopia according to their mean age.
Keywords: peripheral defocus spectacles, control of myopia, novel design.

Datos preliminares del estudio sobre la tolerancia y eficacia de las gafas de desenfoque periférico para el control de la progresión de la miopía en la Argentina (Estudio Myofix Defocus)

Resumen

Objetivo: Evaluar la eficacia y tolerabilidad del uso de un nuevo modelo de gafas diseñadas para controlar la progresión de la miopía en la infancia.
Materiales y métodos: El estudio Myofix Defocus es un estudio de investigación longitudinal, prospectivo, intervencionista y no aleatorizado para gafas de control de la miopía. Este estudio de campo incluye a 48 niños miopes de entre 8 y 15 años sin otra patología ocular inscritos desde junio de 2023 hasta abril de 2024. En este estudio se ofreció a los pacientes la opción de someterse a un tratamiento accesible en nuestra región (gotas de atropina diluidas compuestas) o a un tratamiento posiblemente igual de eficaz con gafas especiales diseñadas en nuestro país. En el presente estudio, se realizó una evaluación oftalmológica inicial completa con refracción objetiva bajo cicloplejía con registro de medidas de longitud axial y una encuesta sobre hábitos, estilo de vida y antecedentes familiares de alta miopía.
Resultados: Los datos iniciales mostraron una edad media de 10,72 ± 2,48 años y que 23/48 de ellos eran niñas. Su equivalente esférico medio era de -2,61 ± 1,12 dioptrías en el ojo derecho y de -2,37 ± 1,12 dioptrías en el ojo izquierdo. La queratometría media era de 43,52 ± 1,32 dioptrías en el ojo derecho y en el izquierdo. La longitud axial media fue de 24,38 ± 0,79 mm en el ojo derecho y de 24,34 ± 0,79 mm en el ojo izquierdo.
Conclusiones: Los datos iniciales del Estudio de Desenfoque Myofix comprenden una muestra de escolares miopes propensos a la miopía progresiva según su edad media.
Palabras clave: gafas de desenfoque periférico, control de la miopía, diseño novedoso.

Dados preliminares do estudo sobre a tolerância e eficácia dos oculos de desfoque periférico para o controle da progressao da miopia na Argentina (Estudio Myofix Defocus)

Resumo

Objetivo: Avalie a eficácia e a tolerabilidade do uso de um novo modelo de óculos projetado para controlar a progressão da miopia na infância.

Materiais e métodos: O estudo Myofix Defocus é um estudo de pesquisa longitudinal, prospectivo, intervencionista e não randomizado para óculos de controle de miopia. Este estudo de campo inclui 48 crianças míopes entre 8 e 15 anos sem outra patologia ocular registrada de junho de 2023 a abril de 2024. Neste estudo, os pacientes receberam a opção de submeter-se a tratamento acessível em nossa região (gotas de atropina diluída composta) ou a um tratamento possivelmente igualmente eficaz com óculos especiais projetados em nosso país. No presente estudo, uma avaliação oftalmológica inicial foi realizada com refração objetiva sob ciclismo com o registro de medidas de comprimento axial e uma pesquisa sobre hábitos, estilo de vida e histórico familiar de alta miopia.

Resultados: Os dados iniciais mostraram uma idade média de 10,72 ± 2,48 anos e que 23/48 deles eram meninas. Seu equivalente esférico médio foi de -2,61 ± 1,12 dioptrias no olho direito e -2,37 ± 1,12 dioptrias no olho esquerdo. A ceratometria média foi de 43,52 ± 1,32 dioptrias no olho direito e à esquerda. O comprimento axial médio foi de 24,38 ± 0,79 mm no olho direito e 24,34 ± 0,79 mm no olho esquerdo.

Conclusões: Os dados iniciais do estudo MyOfix Defocus compreendem uma amostra de crianças em idade escolar propensas a miopia progressiva de acordo com a idade média.

Palavras -chave: óculos de desfocagem periférica, controle de miopia, *design* novo.

Introduction

Refractive errors are considered the second leading cause in visual impairment worldwide[1]. Myopia prevalence has risen to 96.5% for Korea and other Asian countries in recent years due to environmental pressures involving changing lifestyle[2-4]. In Latin populations such as Brazil o Argentina, the prevalence in the adult population has been reported in the order of 15%-30% accounting for one third of the general population[5]. We have to bear in mind that myopia progression can trigger pathological changes in the eyeball that affect structures such as the lens, retina, choroid and macula[6]. These degenerative changes are the most common cause of irreversible vision loss with blindness and are associated with refractive values of more than 5-6 dioptres of myopia in adult life[7]. It has been suggested that the children with early onset are prone to high myopia and should be treated according to different consensus with atropine 0.01% or 0.05% to prevent such rapid progression[8-11]. Despite the high dilution, there are reservations among pediatric ophthalmogists about the toxic effect of a daily instilled drop from ages six to ten up to fifteen years old or more, and there is therefore interest in developing other, less invasive therapeutic methods. In this regard, different types of spectacles and peripheral defocus contact lenses have recently shown good effectiveness in several randomized controlled clinical trials against the natural history of myopia progression. These peripheral defocus lenses and peripheral contrast reduction lenses could replace normal spectacles for myopic children, as formal spectacles may promote myopia progression by producing peripheral hypermetropic defocus[12]. The following study has been designed to evaluate how myopia progression may be slowed with the daily use of nationally designed Defocus Spectacles[13], comparing this progression with two virtual control groups of similar age from similar locations in America. Here we present methods and baseline data of the ongoing study.

Material and methods

The Myofix Defocus Study is a longitudinal, prospective, interventional, non-randomized research study intended to evaluate the tolera-

bility and effectiveness of the use of spectacles with special design to control the progression of myopia during childhood. This field study included children aged 8 to 15 years old who voluntarily agreed to use the defocus spectacles for one year. Subjects were consecutive myopic children with no ocular pathology other than myopia, with spherical equivalent (sphere + 50% of the cylinder) between -0.50 D and -5.00 D, with astigmatism less than -2.00 D in each eye, with anisometropia less than -1.00 D, and with keratometry less than 47.00 D in the steepest meridian. Genetic syndromes and myopia with onset before age 6 were excluded. Subjects with history of any medical treatment for myopia apart from previous spectacle prescription, as diluted atropine, or any type of myopia control glasses or contact lenses, were excluded. A complete ophthalmological evaluation was performed including tonometry, fundus observation, subjective refraction and refraction under cycloplegia with two drops of 1% cyclopentolate instilled 5' apart and performed 40' after the last drop. The visual acuities of the subjective refraction were equal or better than 0.1 logmar (20/25 Snellen) in each eye. Axial length measurements with optical biometry were performed at enrollment and will be repeated at 6 and 12 months after, during follow-up visits. Cycloplegic refractions will also be repeated during follow-up visits. A survey of habits and family history, including reading, outdoors, use of ON-OFF contrast while reading, hours of schooling, age of first distance prescription, and family history of high myopia is routinely performed at each visit.

A pair of spectacles (Myofix, Novar, Argentina) with frames (Usual, Argentina) were provided free of charge to all children studied for one year with the special addendum of peripheral defocus treatment. Children were instructed to wear the glasses the whole day every day of the week including Saturdays and Sundays.

The Argentinian defocus spectacle lens design preserves the principle of the original design presented by Carly Lam[16], which consisted of a 9 mm central zone for distance correction and a +3.50 diopters defocus correction ring of lenslets laying between 9 and 32 mm diameter to act primarily on the para foveal zone that detects the defocus that governs the growth of the eye. Instead of micro peripheral defocus lenses in the 32 mm diameter ring zone with treatment, our model has a uniform peripheral +/+3.50 diopters power zone add. As it is known that 30-40 minutes of exposure to myopic defocus modifies the axial length (measured with Lenstar) by approximately 10-15 microns due to changes in choroidal thickness[19], the national design has been tested on 17 volunteer subjects showing a significant change of 11 microns shortening in the axial length of their eyes, such that that pilot study suggested the lenses could be effective in arresting the progression of myopia, as changes in the choroid are the first events in the retinal message that manages ocular growth[20]. A survey in La Pirámide Optics (Mendoza) gave good tolerance in 80% of the 45 volunteer myopic children who were fitted for one month with these spectacles (unpublished data). Respondents found it difficult to adapt the first two days, but after this period they tolerated them very well in closed environments by making small lateral head movements. Our intention is to perform a tolerance test on a larger sample in this prospective study.

There were 13 optical and 15 ophthalmological institutions accredited for this study. These institutions were involved once it was confirmed that their pediatric ophthalmologists were able to perform routine myopia screening (with cycloplegic autorrefractometry examination and optical biometry with Lenstar, Aladdin or Myah devices). Both ophthalmologists and opticians had 6 hours of training for learning how to follow the protocol of refraction, biometry and fitting of defocus spectacles. Ophthalmologists and opticians were trained in the process of filling the protocol in a special encrypted online website with the clinical history designed by Novar company were all the data were input. Special online training about centering of the spectacles was made for opticians including also the election of appropriate frames such that the peripheral treatment circular zone was taken on account to fit in the frame around the centered eye. One month after the eyeglasses were delivered, the professional conducted a telephone call to assess adherence.

The sample size was estimated at 40 subjects because the statistical calculation for a difference of 0.25 dioptres in progression with respect to the virtual controls, for a standard deviation of 0.50 dioptres gave an n = 31 subjects, and taking into account a 20% loss to follow-up the n should be equal to 38 subjects in each group.

For the virtual control group, data will be taken from refractive error measurement in 114 children followed with cycloplegia by the Pandemic Study Group during the years 2018-2019 with similar ages[14]. Besides another virtual control group in USA has published publicly available data on cycloplegic refractive error and biometry in a similar sample of myopic children with the natural history of myopia in the control group tested in a randomized study against super diluted atropine drops[15].

All consecutive patients of both genders who freely opted for the defocus spectacles were included in the present study. Patients may be excluded from the follow-up protocol if they show a progression of -0.50 diopters in 6 months while wearing defocus spectacles. These patients will be switched to super diluted atropine as suggested by the ethics committee.

The protocol was approved by the Ethics Committee of the Argentine Society of Ophthalmology and published in the list of approved protocols of Buenos Aries government website. The Declaration of Helsinki and its modifications, the Good Clinical Practice guidelines, and the resolution of the Ministry of Health 1480/11 will be observed and taken into account as guiding principles. Both parents were verbally informed of the objectives of the study and parents and children signed an informed consent for the study.

The anonymity of all participants will be preserved. Patients' names will be removed from the database for statistical analysis. It is noted that the principal investigator does not have any conflict of interest as the patenting of the defocus glasses is the responsibility of the sponsor's company.

The results of numerical variables are expressed as mean and standard deviation or median and interquartile range according to normal or skewed distribution, respectively. Nominal variables are expressed as absolute frequency and percentage. For the comparison of numerical variables, Student's *t*-test or Mann Whitney U-test will be used as appropriate. A p-value ≤ 0.05 will be taken as significant. Excel tables (Microsoft, USA) and SPSS 25 statistical software (IBM, USA) was used for the analysis.

Results

A total of 48 patients were enrolled from June 2023 to March 2024 with the Novar Myofix spectacle lens. Their mean age was 10.72 ± 2.48 years old and 23 of them were girls. Their mean spherical equivalent was -2.61 ± 1.12 dioptres in the right eye and -2.37 ± 1.12 dioptres in the left eye. The mean keratometry was 43.52 ± 1.32 dioptres in the right eye and there was not any significant difference with the left eye. The average axial length was 24.38 ± 0.79 mm for the right eye and 24.34 ± 0.79 mm for the left eye.

There were 8/48 cases of high myopic mother and 4/48 cases of father with high myopia. In all, 28/48 children went to school only 4 hours a day, and 24/48 children lived in houses with gardens and 10/48 lived in an apartment. The mean age of the first prescription of spectacles was 7.66 ± 1.5 years old. In all, 10/48 took tutorial extracurricular classes. Children spent about an hour and a half doing homework on weekdays or weekends and an hour and a half outdoors on weekdays and three and a half hours outdoors on the weekends. Finally, the children spent two and a half hours with the tablet or mobile phone on weekdays and three and a half hours on weekend days.

Discussion

The Myofix Defocus Study aims to report the tolerance and effectiveness of novel defocus spectacles developed in Argentina. At the 2022 International Myopia Conference in Rotterdam, Mark Bullimore and other researchers pointed out that it has become a problem to perform randomized controlled studies against natural history of myopia[21] because it is unethical to leave

children to their own progression when off-label treatment with 0.01% atropine is already accepted in various consensuses[9-11]. In this sense, several investigators at the conference showed that ongoing studies with a natural history control group saw their number of cases decline with follow-up as patients dropped out to seek medical care to prevent myopic progression with the means available today in neighboring ophthalmological centers. Considering possible virtual control groups, in the case of our country, there is already a control group of 114 children aged 12 years on average with myopia less than -4.00D who were followed with cycloplegia during the pre-pandemic years (2018-2019) and for whom it is known that the progression was -0.43 ± 0.52 dioptres in one year[14].

Thus the present study proposed to carry out a prospective clinical study in 40 children who were enrolled in the usual consultation for their spectacle control while being still virgin of any treatment. At this opportunity, they were offered to choose between the treatment available to them in their city location (the super diluted atropine drops) or to be involved a treatment that may possibly be equally effective with special spectacles designed in our country. We hope to have a similar effect on progression because the lens is based on the defocus principles of spectacles and contact lenses already proven by the international industry. Our lens has the characteristic of being much simpler in its carving and construction, and is accessible in our country where it has already been presented from a theoretical point of view showing increases in choroidal thickness under its use.

On the other hand, the special spectacle for myopia control lacks the possible toxic effects of a drop instilled in the eye for many years until emerging adulthood. To avoid including children who may have rapid progressions to high myopia, treatment will only be offered to children over the age 8. In our environment, where children spend plenty of time outdoors[22], the progression is slower than in Asian countries rounding -0.50 dioptres per year, as mentioned above[14]. Thus, children included in this project are expected to progress -0.25 dioptres in six months (the resolution limit of the measurement method).

The study is projected for one year with periodical examinations every six months. One year has passed since enrollment began in June 2023, and no adverse effects have been reported to date with good tolerance for everyday life. In time, the six months and one year follow up are expected to be reported.

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