MYOPIA CONTROL PRODUCTS & COMPANIES

EYECELERATOR@AAO • NOV. 11, 2021

MICHAEL E. LACHMAN

EyeQ Research

MYOPIA CONTROL PRODUCT CATEGORIES

Pharmaceutical, Optical, and Digital

PHARMACEUTICAL

OPTICAL

SPECTACLES

CONTACT LENSES

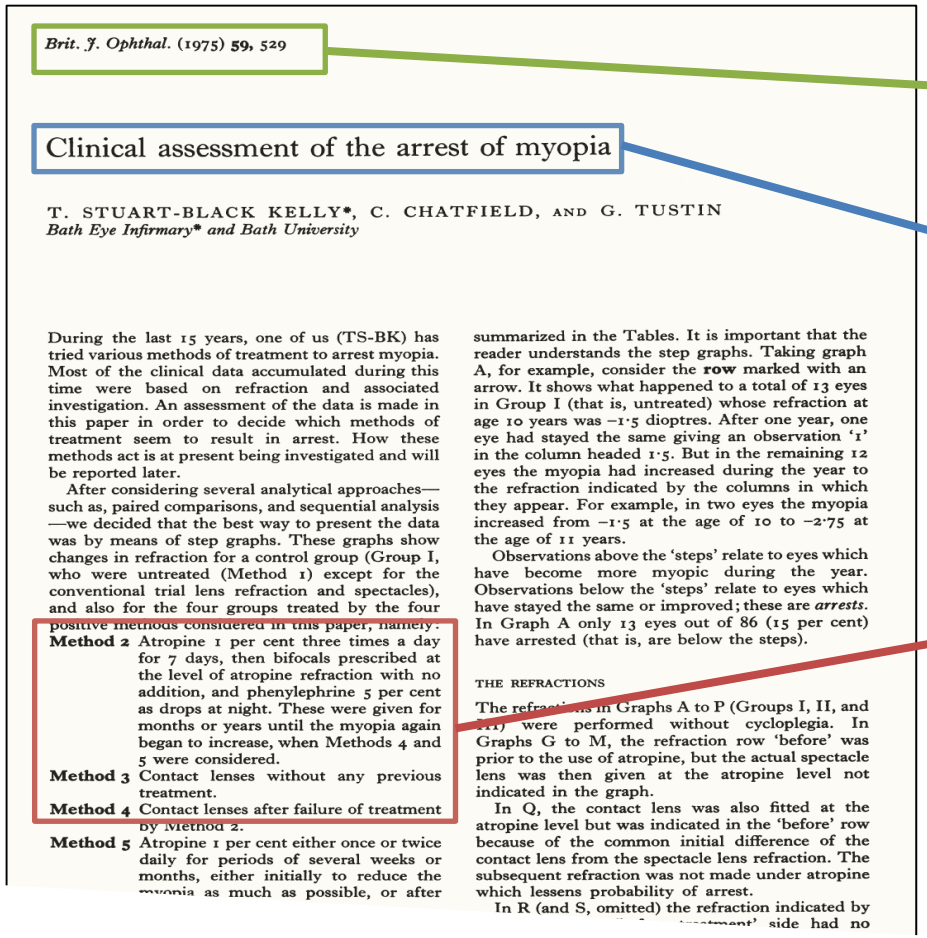
ORTHO-K WITH RGP LENSES

MULTIFOCAL SOFT CONTACTS

DIGITAL

LONG HISTORY OF MYOPIA CONTROL PRODUCTS

Pharmaceuticals, Spectacles, and Contact Lenses



Brit. J. Ophthal. (1975) **59**, 529

Clinical assessment of the arrest of myopia

T. STUART-BLACK KELLY*, C. CHATFIELD, AND G. TUSTIN
Bath Eye Infirmary and Bath University*

During the last 15 years, one of us (TS-BK) has tried various methods of treatment to arrest myopia. Most of the clinical data accumulated during this time were based on refraction and associated investigation. An assessment of the data is made in this paper in order to decide which methods of treatment seem to result in arrest. How these methods act is at present being investigated and will be reported later.

After considering several analytical approaches—such as, paired comparisons, and sequential analysis—we decided that the best way to present the data was by means of step graphs. These graphs show changes in refraction for a control group (Group I, who were untreated (Method 1) except for the conventional trial lens refraction and spectacles), and also for the four groups treated by the four positive methods considered in this paper, namely:

Method 2 Atropine 1 per cent three times a day for 7 days, then bifocals prescribed at the level of atropine refraction with no addition, and phenylephrine 5 per cent as drops at night. These were given for months or years until the myopia again began to increase, when Methods 4 and 5 were considered.

Method 3 Contact lenses without any previous treatment.

Method 4 Contact lenses after failure of treatment by Method 2.

Method 5 Atropine 1 per cent either once or twice daily for periods of several weeks or months, either initially to reduce the myopia as much as possible, or after

summarized in the Tables. It is important that the reader understands the step graphs. Taking graph A, for example, consider the **row** marked with an arrow. It shows what happened to a total of 13 eyes in Group I (that is, untreated) whose refraction at age 10 years was −1·5 dioptres. After one year, one eye had stayed the same giving an observation '1' in the column headed 1·5. But in the remaining 12 eyes the myopia had increased during the year to the refraction indicated by the columns in which they appear. For example, in two eyes the myopia increased from −1·5 at the age of 10 to −2·75 at the age of 11 years.

Observations above the 'steps' relate to eyes which have become more myopic during the year. Observations below the 'steps' relate to eyes which have stayed the same or improved; these are *arrests*. In Graph A only 13 eyes out of 86 (15 per cent) have arrested (that is, are below the steps).

THE REFRACTIONS

The refractions in Graphs A to P (Groups I, II, and III) were performed without cycloplegia. In Graphs G to M, the refraction row 'before' was prior to the use of atropine, but the actual spectacle lens was then given at the atropine level not indicated in the graph.

In Q, the contact lens was also fitted at the atropine level but was indicated in the 'before' row because of the common initial difference of the contact lens from the spectacle lens refraction. The subsequent refraction was not made under atropine which lessens probability of arrest.

In R (and S, omitted) the refraction indicated by

'treatment' side had no

***Brit. J. Ophthal.* (1975) 59, 529**

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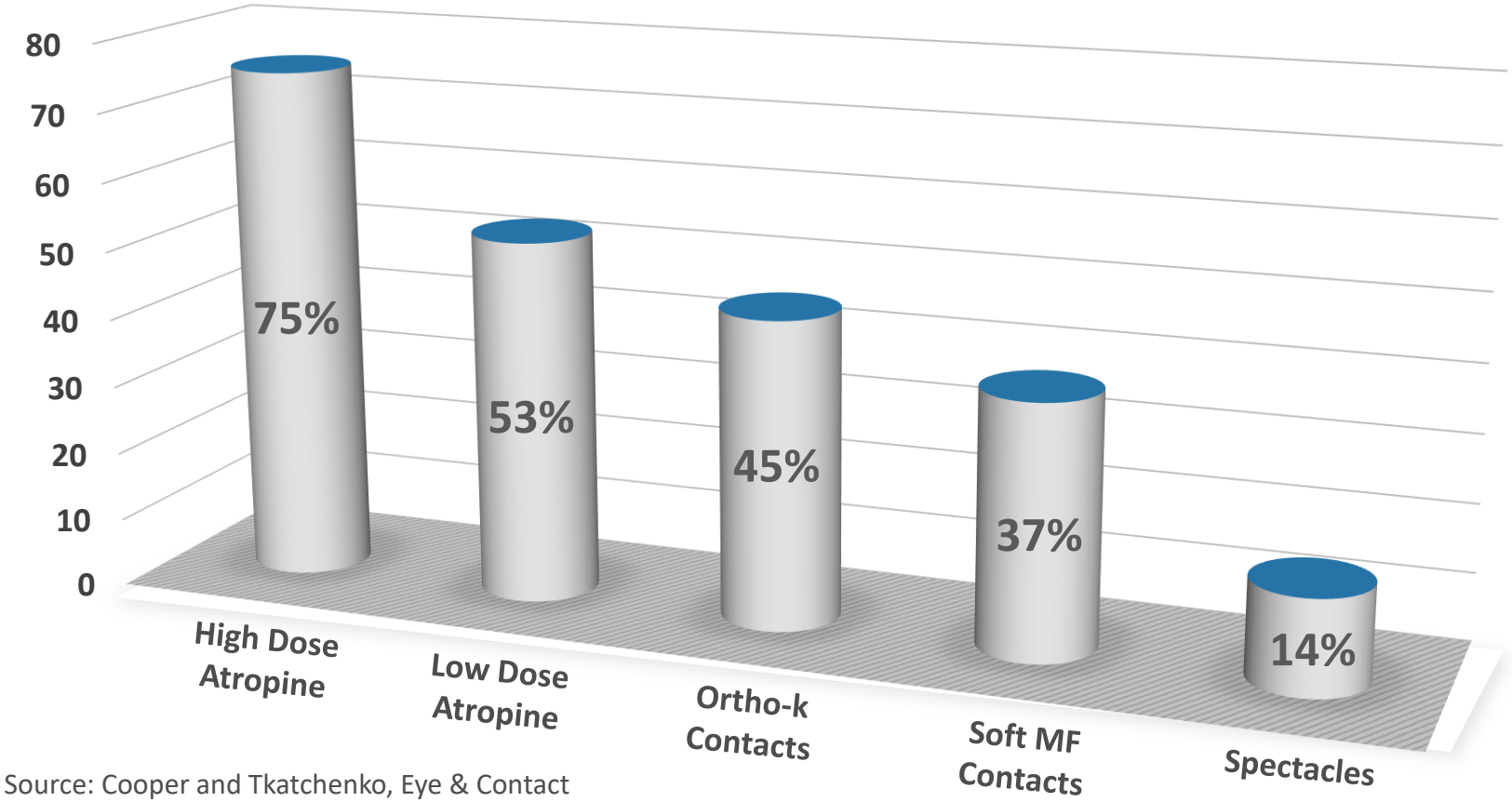
RELATIVE EFFICACY OF COMPETING TECHNOLOGIES

Percentage of Reduction of Myopia Progression with Various Treatments



Source: Cooper and Tkatchenko, Eye & Contact Lens: Science & Clinical Practice: July 2018

FROM META-ANALYSES

Average results from two meta-analyses:

- Huang et al., Ophthalmology, 2016.
- Cooper et al., Optometry, 2012.

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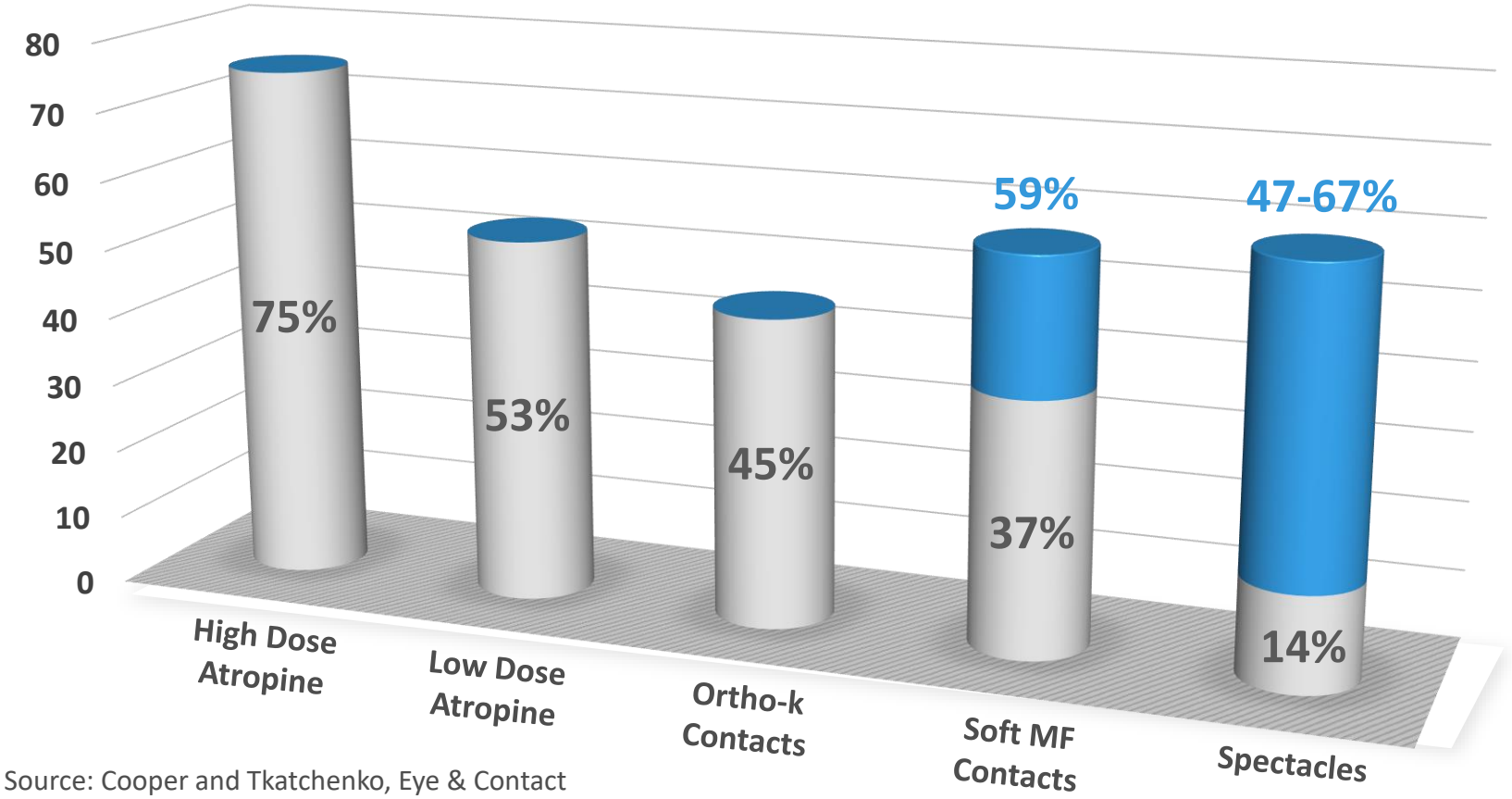

Source: Cooper and Tkatchenko, Eye & Contact Lens: Science & Clinical Practice: July 2018

NEW TECHNOLOGIES

- Soft contact lenses: CooperVision MiSight
- Spectacles: Hoya MiYOSMART, Essilor Stellest, SightGlass Vision

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ATROPINE: PROGRESS TOWARD MYOPIA INDICATION

Very Low Doses Provide Best Risk/Benefit Ratio for Myopia Progression

Optejet microdosing dispenser from Eyenovia

Off-label for myopia; very low concentrations appear optimal

- 1% dosage used historically (pupil dilation).
- Lower doses (0.5%, 0.1%, 0.01%) tested in ATOM2 study (2006).
- Lowest doses: Best risk/benefit ratio; best balance between efficacy and rebound effect.
- Today, 0.01% to 0.05% available from compounding pharmacies.

Mechanism of action not well understood

Four atropine formulations in Phase III myopia trials

- Long trials: Three years to primary endpoint + fourth year of additional follow-up.

LOW DOSE ATROPINE IN PHASE III DEVELOPMENT

Four Programs with Potential FDA Approval Between 2024-2027

Company	Dosages	Trial Enrollment	Potential FDA Approval	Unique Features
Vyluma	0.01% & 0.02%	483	2024	Preservative free formulation
Sydnexis	0.01% & 0.03%	840	2025	Higher pH formulation designed for improved tolerability and stability
Eyenovia (with Bausch + Lomb)	0.01% & 0.1%	420	2026	Optejet microdosing dispenser
Ocumension	0.01%	678	2027	

- Additional low-dose atropine product in Phase II/III in Asia and Japan from Santen

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NON-ATROPINE PRODUCTS IN EARLY DEVELOPMENT

At Least Three New Drugs for Myopia in Phase I/II or Preclinical Development

Brien Holden Vision Institute

- Undisclosed drugs (BHVI1, BHVI2, BHVI3) in phase I/II studies.
- Alone and in combination with 0.02% atropine.

Santen

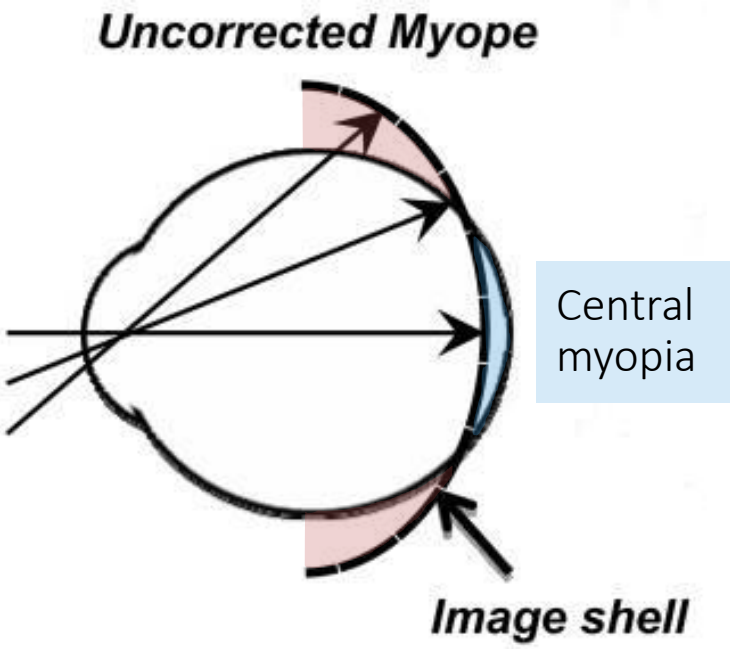
- Recently initiated phase I study of a selective muscarinic M2 antagonist.

iVeena

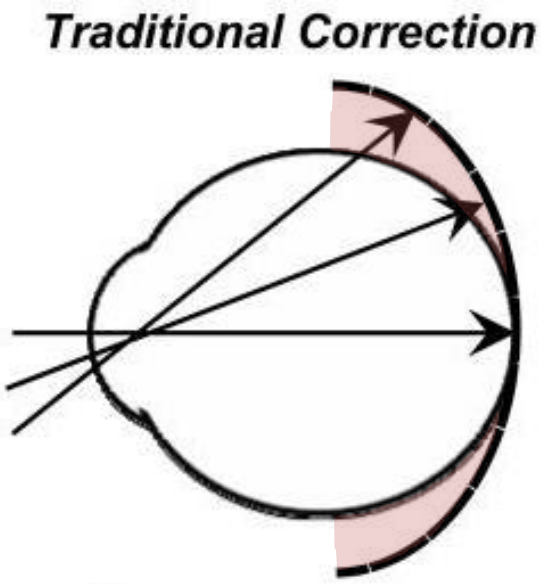
- Developing a daily eye drop that strengthens scleral and corneal collagen crosslinks through LOX activation, potentially leading to a decrease in the rate of axial elongation.
- Preclinical; expected to begin Phase I/II clinical study in progressive pediatric myopia in 2022.

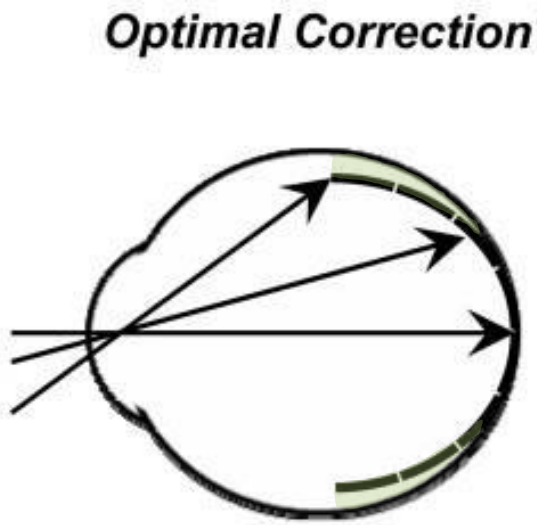
OVERALL OPTICAL APPROACH & MECHANISM OF ACTION

Applicable to Most Spectacle Lens and Contact Lens Products for Myopia Progression



Central myopia





Images from Earl L. Smith III, OD; Optometry and Vision Science. 2011 Sep; 88(9): 1029-1044.

Peripheral hyperopic defocus: Strong signal for axial eye growth

Peripheral myopic defocus: Signal to reduce or halt axial eye growth

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SPECTACLE LENSES FOR MYOPIA MANAGEMENT

From Traditional Bifocals and PALs to New Lenses Designed Specifically for Myopia Control

Image from American Association for Pediatric Ophthalmology & Strabismus

Over 70 years of history

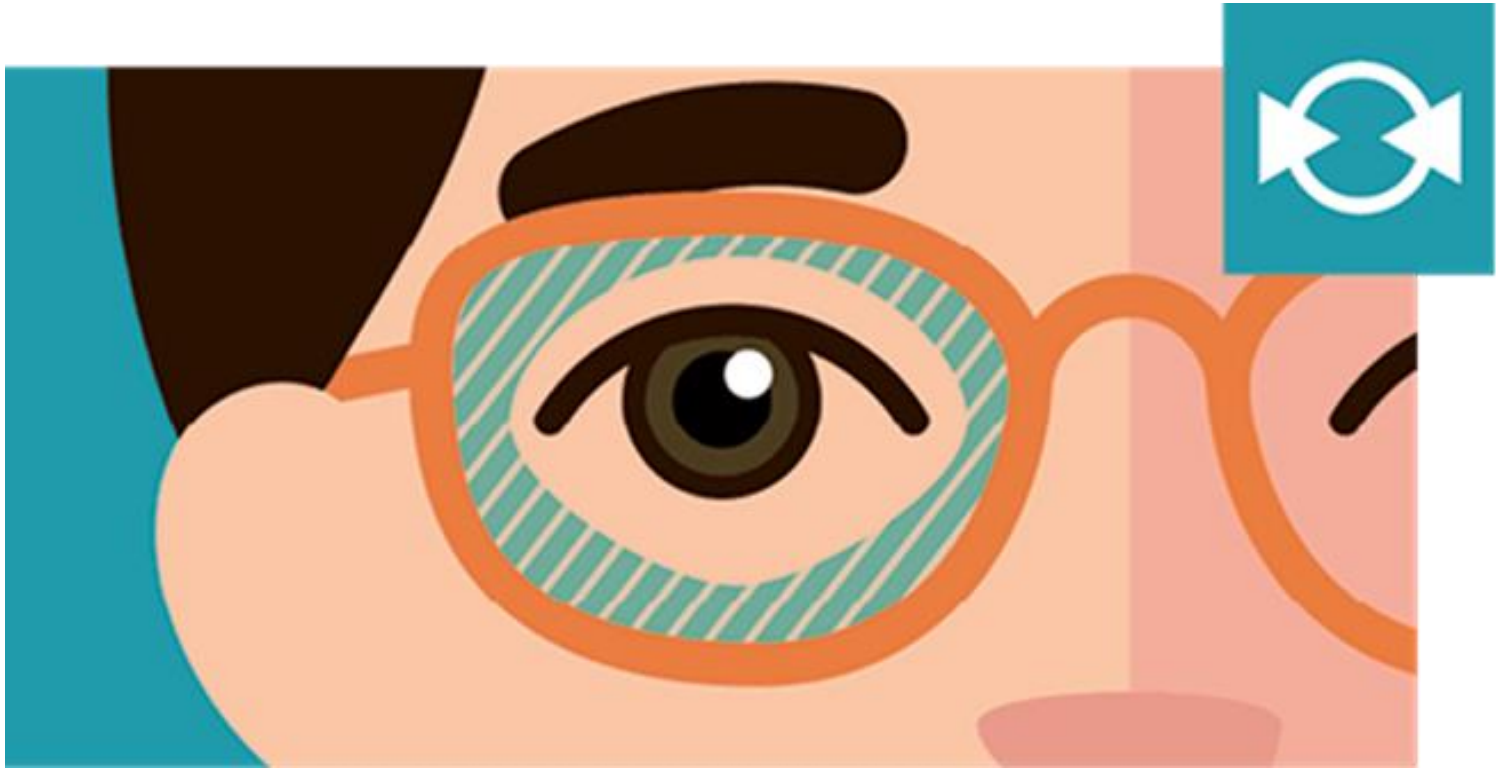
- Bifocal lenses have been used for myopia since the 1940s.
- Off-label use – no FDA approvals for myopia progression.

Bifocals and PALs: Limited efficacy in slowing myopia progression

- COMET Trial (NEI/NIH, 1997-98): Progressive addition lenses (PALs) had statistically significant but clinically insignificant efficacy over three years.
- "The small magnitude of the effect does not warrant a change in clinical practice."

ZEISS MYOVISION PRO LENS

First Generation Spectacle Lens for Myopia Management

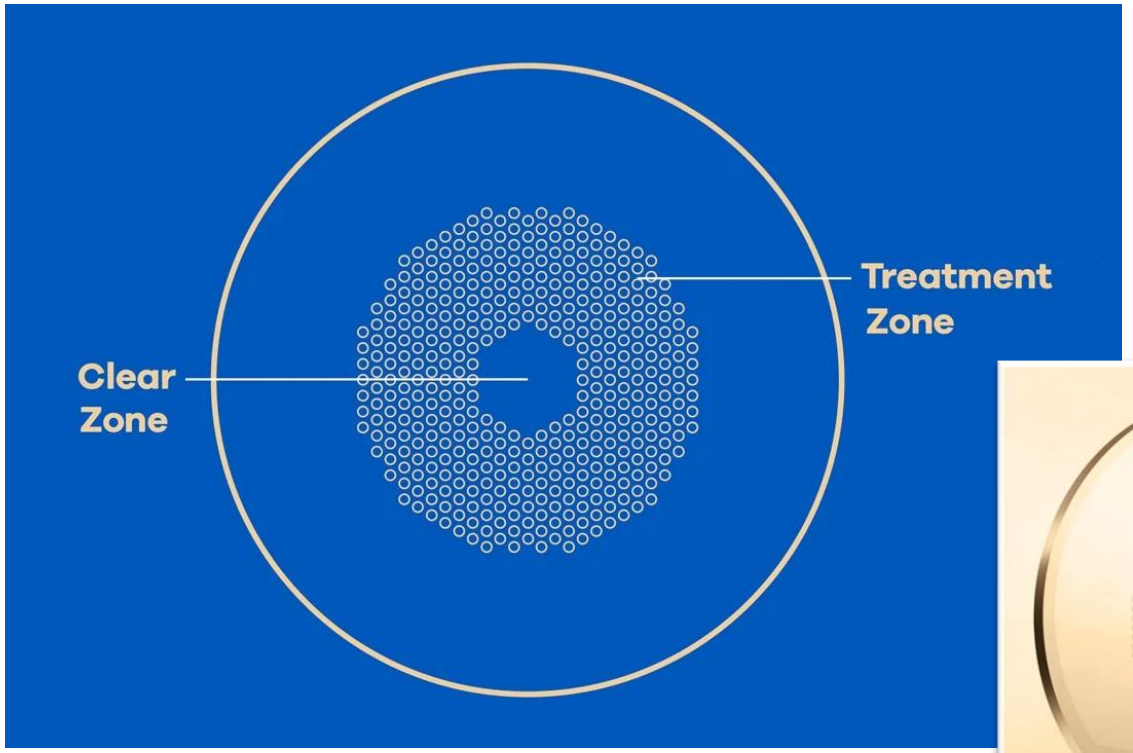


ZEISS MYOVISION PRO

- Distance correction at center, with continuous asymmetric shift to about +2.0D at the periphery.
- Launched in Asia 2011-2012.
- Limited efficacy in clinical trial.

HOYA MiYOSMART LENS WITH D.I.M.S. TECHNOLOGY

Second Generation Spectacle Lens for Myopia Management



HOYA MiYOSMART

- D.I.M.S.: Defocus Incorporated Multiple Segments
- 396 tiny lens segments create a -3.50D myopic defocus plane in front of the retina.
- Simultaneous in-focus and myopic defocus information, regardless of gaze direction
- Launched in 2020-21 in Canada, UK, Australia, Asian countries.
- 60% reduction in myopia progression.

ESSILOR STELLEST LENS WITH H.A.L.T. TECHNOLOGY

Second Generation Spectacle Lens for Myopia Management

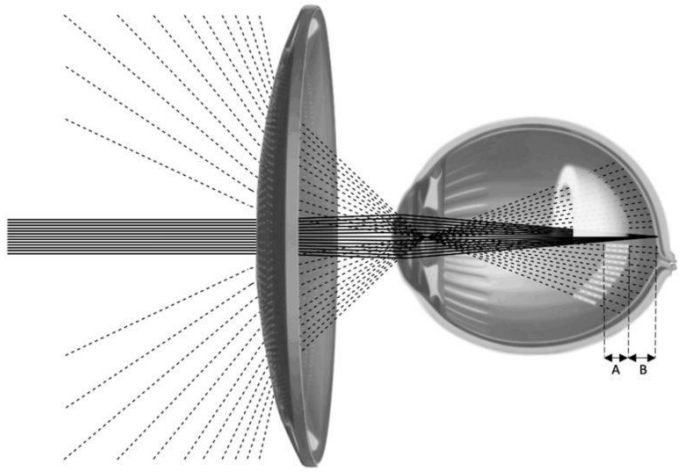
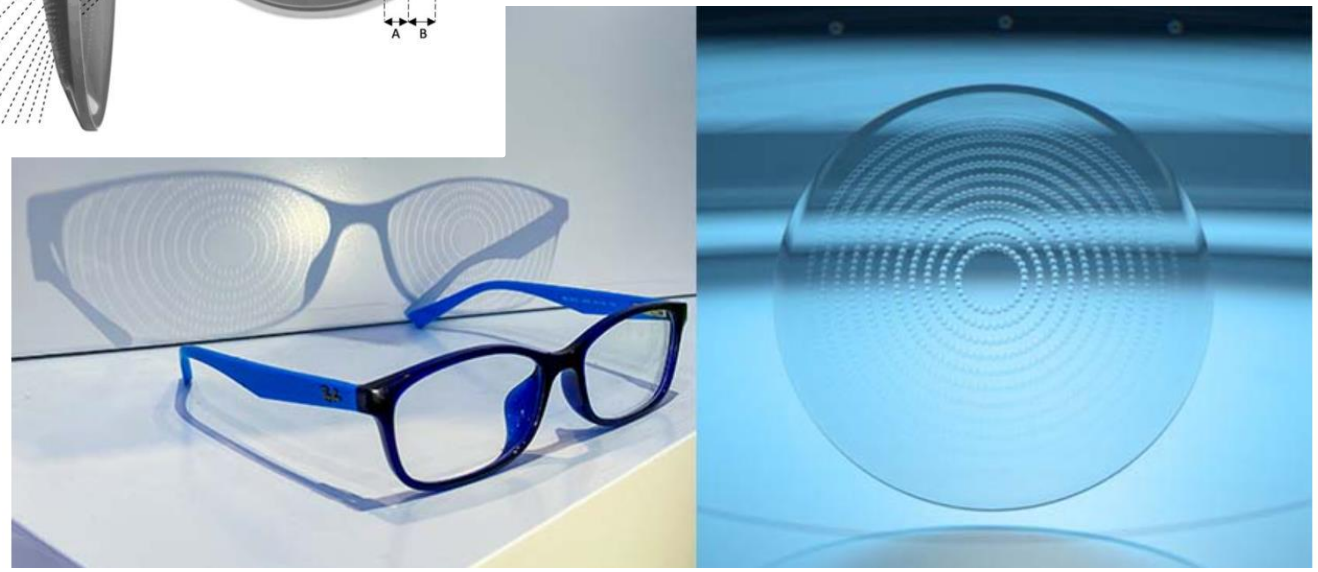


Image at left: Jinhua Bao et al., Br J Ophthalmol 2020
Images below: Wenzhou Medical University



ESSILOR STELLEST

- H.A.L.T.: Highly Aspherical Lenslet Target
- Similar to D.I.M.S. but creates a 3-D “volume of myopic defocus” of varying dioptric power in front of the retina.
- Launched in China and other countries in 2020.
- FDA “Breakthrough Device” designation in May 2021.
- 60% to 67% reduction in myopia progression.

SIGHTGLASS VISION WITH DIFFUSION OPTICS TECHNOLOGY

Third Generation Spectacle Lens for Myopia Management

Powered by Diffusion Optics Technology™

SIGHTGLASS VISION

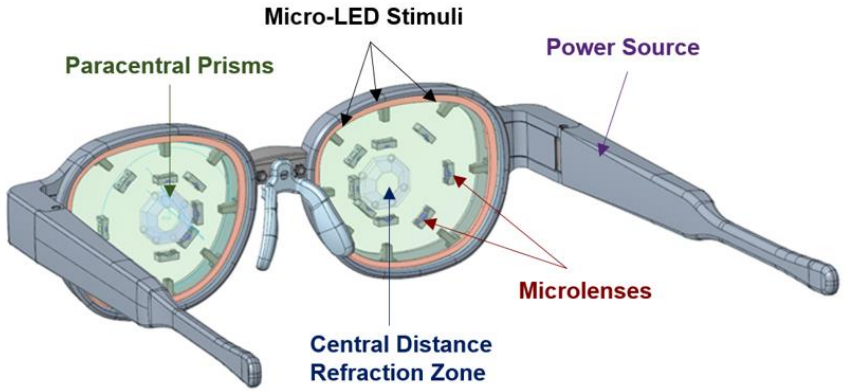
- Hypothesis: High retinal contrast signals the eye to grow.
- Uses optical diffusion/scattering to create zones of lower contrast on the retina at all distances, near and far, minimizing the impact on visual acuity.
- CE mark for slowing progression of myopia in June 2020.
- CYPRESS study: 36-month follow-up by 2022; potential FDA approval by 2023 (no company guidance on timing).
- In February 2021, CooperCompanies and EssilorLuxottica announced an agreement to create a joint venture for the acquisition of SightGlass Vision.
- CYPRESS two-year results: 59% reduction in myopia progression with full-time wear (47% overall reduction).

FUTURE DIRECTIONS IN SPECTACLE LENSES FOR MYOPIA

Incorporating Eye Tracking, Pixelated Lenses, Nanotechnology, and Augmented Reality

KUBOTA VISION

- Kubota Glass technology
- Augmented reality-based system: projects peripherally defocused images to actively stimulate the retina.
- Defocused images can vary in size, location, luminance, duration, and dioptric magnitude.
- Proof-of-concept trial in 2020.



NOVASIGHT ACTIVEGLASS

- Utilizes standard approach of peripheral myopic defocus.
- Miniature cameras continually track eye position.
- Digital pixelated active lens maintains clear vision along line of sight and myopic defocus on the peripheral retina.
- Early R&D phase; potential pilot study in 2022.

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ORTHO-K WITH RGP CONTACTS FOR MYOPIA CONTROL

Over 50 Years of Off-Label Use Prior to First CE Mark in 2019 and FDA Approval in 2021

Over 50 years of history

- Practiced off-label in the US since the 1960s.

Combined mechanism of action: Mechanical + Optical

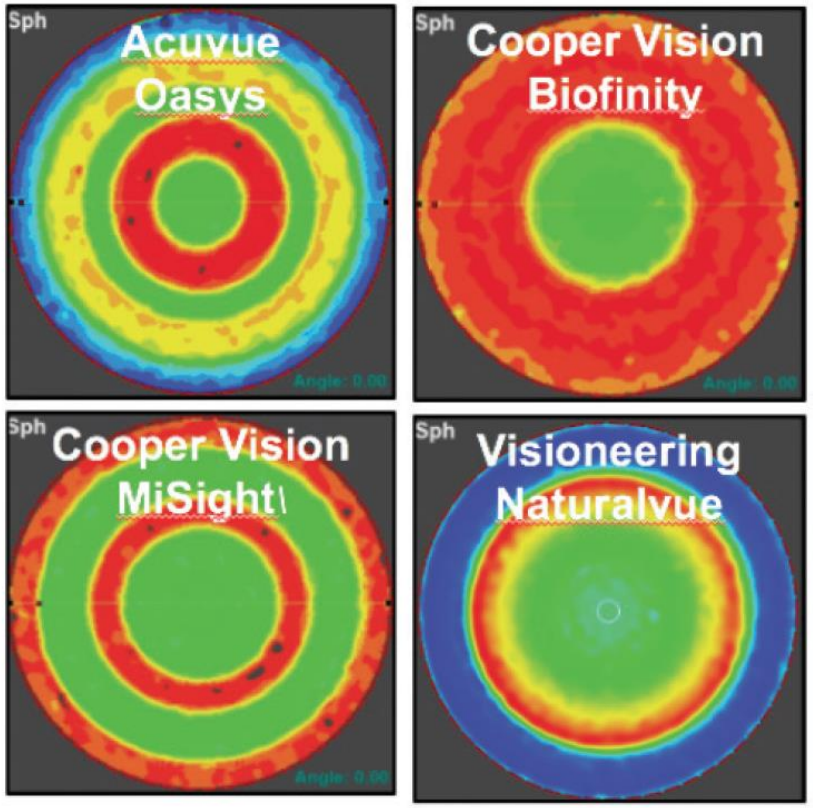
- Temporary change in corneal curvature to induce peripheral myopic defocus, decreasing stimulus for eye growth.

First FDA approval in 2021; CE mark in 2019

- Johnson & Johnson Vision ACUVUE Abiliti Overnight Therapeutic Lenses – FDA approved May 2021, in collaboration with Menicon Co., Ltd. (Japan).
- Lenses with CE mark from CooperVision and Menicon.

MULTIFOCAL SOFT CONTACTS FOR MYOPIA CONTROL

Using Center-Distance, Peripheral-Near Lens Designs to Provide Peripheral Myopic Defocus



Images from Pacific University College of Optometry
Modern Optometry, May/June 2020

Over a decade of clinical use

- Promising results in the clinical literature over the past 10 years, based on center-distance multifocal lenses.

Available lenses used off-label in US for myopia control

- CooperVision: Biofinity D and Proclear D
- Johnson & Johnson Vision: ACUVUE OASYS for Presbyopia
- Visioneering Technologies: NaturalVue Multifocal (EDOF) Lens

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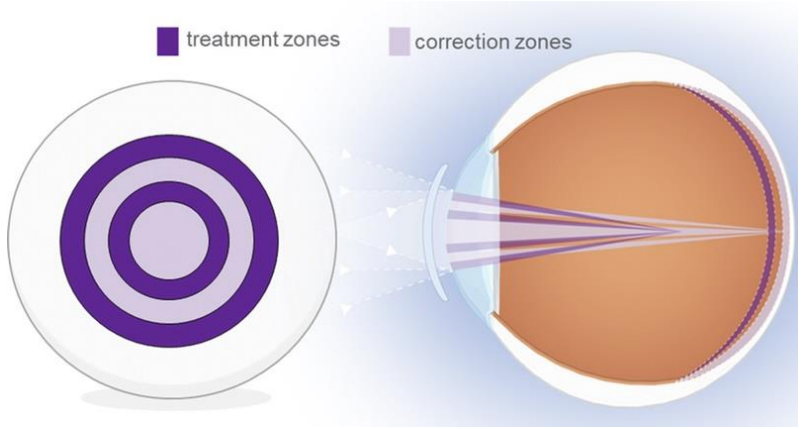
APPROVED SOFT CONTACTS FOR MYOPIA PROGRESSION

One FDA-Approved Product and Others Available Outside the US



From Optometry and Vision Science: August 2019 - Volume 96 - Issue 8

FDA-approved in US for myopia management

CooperVision MiSight 1 Day contact lens:

- Approved by FDA in November 2019 (CE mark 2008)
- 3-year results: 59% reduction in myopia progression

Lenses approved OUS for myopia management

- Visioneering Technologies NaturalVue Multifocal (EDOF) – CE mark 2018; also approved in Canada and Asia
- J&J Acuvue Abiliti 1-Day Soft Therapeutic Lenses for Myopia Management – approved in Canada, Sept. 2021

DIGITAL PRODUCTS FOR MYOPIA MANAGEMENT

Apps for Patient Monitoring, Data Tracking, Training, and Education

Smartphone usage monitoring – with alerts, reminders, and parental controls

- Screen time and screen-to-face distance
- Low ambient light detection; outdoor activity tracking

Connecting with eye care professionals

- Product order reminders and tracking
- Appointment reminders
- Personal data tracking – progression and patient journey

Spectacle and contact lens wear reminders

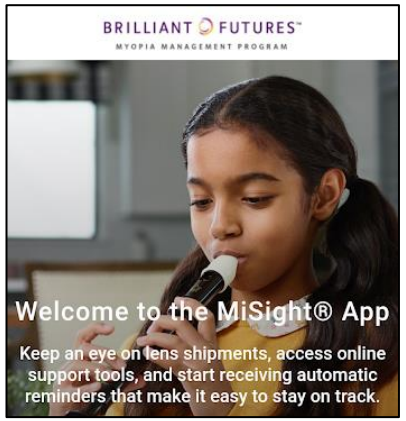
Educational resources, including treatment alternatives

Vision training and active interventions

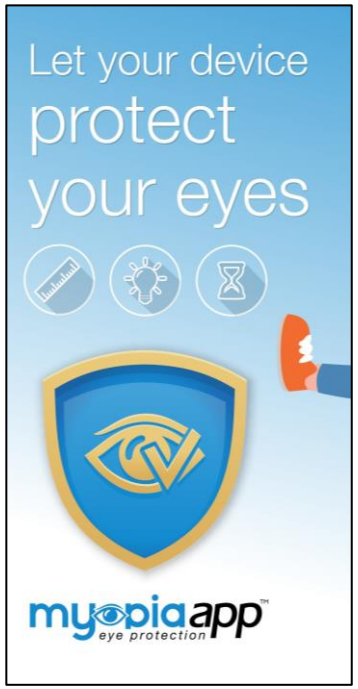
DIGITAL PRODUCTS FOR MYOPIA MANAGEMENT

Apps for Patient Monitoring, Data Tracking, Training, and Education

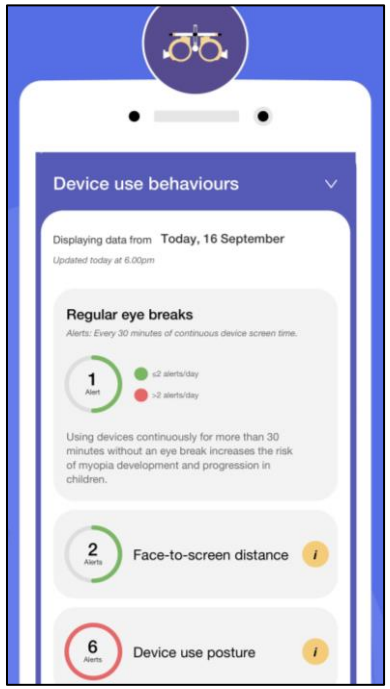
SUPPLIERS



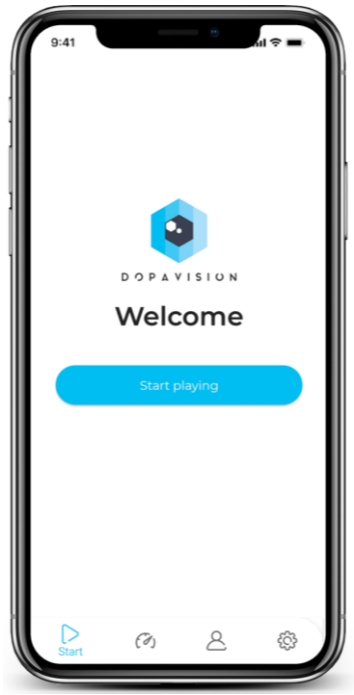
INDEPENDENT SMARTPHONE APPS



myopia.app from VisionApp (Spain)



planoApp from Plano (Singapore)



MyopiaX treatment from Dopavision (Germany)

MYOPIA CALCULATOR

Myappia and MyoCalc myopia calculator from Myopia.Care (France)

THANK YOU

MICHAEL E. LACHMAN
michael@EyeQResearch.com
(925) 876-1257
www.EyeQResearch.com

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