SUMMARY OF APPENDIX –
EMERGING TECHNOLOGIES IN MYOPIA CONTROL

EXPLANATION

This appendix includes emerging technologies that have published data in peer reviewed journals but not 2 years or more follow up.

1. Blue Light Therapy:

- **Protective Effect of Light:** Exposure to ambient light, particularly outdoor light with its higher blue light component, is recognized for its protective effect against myopia development and progression. A "positive dose-response relationship" between time spent outdoors and myopia prevention is suggested.
- **Blue Light and Axial Length:** Evidence suggests blue light can influence axial length and choroidal thickness, both considered relevant to retarding myopic progression. An experimental study demonstrated that "short-term exposure to blue light resulted in a significant reduction in axial length" in both defocused and non-defocused eyes.
- **Mechanisms of Action:** Proposed non-chromatic mechanisms for blue light's effect include the role of blue cone-mediated ON-pathways, reduced retinoic acid levels, intrinsically photosensitive retinal ganglion cells (ipRGCs), and increased depth of focus due to decreased pupillary size.
- **Choroidal Thickening:** A study using blue flickering light on the blind spots of emmetropes and myopes found "significant choroidal thickening after blue light stimulation occurred in emmetropes but not in myopes," suggesting a potential impact on eye growth.
- **Artificial Blue Light:** While natural blue light from sunlight appears beneficial, the impact of artificial blue light from digital screens on myopia development "remains unclear."
- **Clinical Trials:** Clinical trials, such as one using a smartphone inserted into a virtual reality headset (MyopiaX, Dopavision: NCT04967287), are underway to test the longer-term effects of blue light therapy.

2. Emerging Spectacle Lens Technologies (Technologies of Competing Defocus):

- **Principle of Myopic Defocus:** These lenses utilize the principle of inducing myopic defocus in the peripheral retina while correcting central vision. This is thought to inhibit the axial elongation that contributes to myopia progression.

- **ZEISS MyoCare Technology:**Integrates two concepts: a central zone for vision correction and a surrounding treatment zone with Cylindrical Annular Refractive Elements (C.A.R.E).
- C.A.R.E elements have relatively more positive power and are arranged in concentric rings to create a "blended distribution of myopic defocus in front of the retina."
- Features a non-spherical back surface design (ZEISS ClearFocus) to minimize aberrations and maintain myopic defocus across all gaze directions, contrasting with traditional single vision lenses where myopic eyes experience hyperopic defocus in the periphery.
- Two design variants exist: MyoCare (7 mm central zone, +9.2D nominal power of C.A.R.E elements, +4.6D mean relative surface power) and MyoCare S (9 mm central zone, +7.6D nominal power, +3.8D mean relative surface power).
- Multiple trials are ongoing in Asia and Europe to assess safety, efficacy, and subjective performance.
- Interim data from a trial in China involving 240 children showed "all children reported adaptation to their lenses within a day."
- At 3 months, "97.5% or more of children wearing MyoCare or MyoCare S reported their vision for distance, near, during sporting activities, perception of moving objects and going up and down stairs to be very good."
- 12-month interim analysis showed both designs slowed eye growth across all ages assessed, using the "emmetropic progression ratio" metric. MyoCare showed a 63% ratio in 7-9 year olds, and MyoCare S showed an 86% ratio in 10-12 year olds.
- **Important Note:** The results published by Liu et al. [8] "do not refer to or reflect the performance of ZEISS MyoCare or MyoCare S," as that article refers to an earlier prototype.
- **Shamir Myopia Control Lenses (Focus flow technology):**Utilizes a unique back surface design with a "U-shape" defocus pattern.
- Creates a "clear central vertical canal" for optimal central vision and continuous defocus toward the periphery.
- The relative positive power gradually increases from approximately 0.5 D at the canal's edge to 3.00 D at 17.5 mm from the center horizontally and 1.50 D at 16 mm from the center inferiorly.
- A 12-month randomized trial (126 participants, aged 6-13) compared Shamir lenses to standard single-vision lenses. At 12 months, the Shamir group showed lower adjusted mean progression in axial length (0.21 mm vs 0.32 mm in the control group) and spherical equivalent (0.48 D vs 0.64 D).
- A statistically significant effect was found in axial length progression, but not in spherical equivalent progression overall, although "more statistically significant differences were obtained" in younger children (6-10 years) and those with two myopic parents.
- Overall, the lenses "slowed axial progression by 35% and spherical error progression of 25% as compared to the control group."
- Mentioned ergonomic advantages, minimizing stress on the child’s head, neck, and upper body muscles.

- **Asymmetric Myopic Defocus Lenses (MPDL, MyoLess®, IOT, Madrid, Spain):**Designed to correct central refractive error while inducing myopic defocus "up to 1.5-2.0D in the peripheral retina."
- Achieved through a specific distribution of positive power at the lens periphery, tailored to myopic eye characteristics.
- A 12-month randomized trial in Spain compared MPDL to standard single-vision lenses.
- After one year, MPDL wearers exhibited a mean axial length elongation of 0.14 ± 0.14 mm, compared to 0.23 ± 0.15 mm in the control group.
- This represents a "39% reduction in absolute AL growth for the MPDL group compared to controls," a statistically significant difference (p = 0.014).

3. Emerging Contact Lens Technology:

- **Concentric annular zones with noncoaxial relative plus power (RingBoost™ technology):** Differs from typical coaxial dual-focus or multifocal soft contact lenses.
- Generates a "ring focus that falls in front of the retina but off the line of sight," allowing for a larger treatment zone and higher add power while maintaining visual performance.
- A multisite randomized clinical trial compared two prototypes with a dual-focus contact lens and a single-vision contact lens.
- Both prototypes feature two concentric, annular treatment zones of +7.00 D non-coaxial plus power. The EE (enhance efficiency) design has the plus power closer to centration and includes an additional +10 D coaxial treatment zone for greater efficacy without compromising visual acuity.
- At 6 months, the EE lens (commercialized as Johnson and Johnson Vision ACUVUE AbilitiTM) "produced the most significant effect with a mean difference in axial length elongation being 0.11mm compared with the control."

Conclusion:

The provided sources indicate significant advancements in emerging therapies for myopia progression control. Blue light, particularly from outdoor exposure, shows promise in slowing axial elongation. Novel spectacle and contact lens designs leveraging the principle of competing myopic defocus are demonstrating encouraging results in clinical trials, showing a reduction in both axial length and spherical equivalent progression compared to standard single-vision lenses. Ongoing research and clinical trials are crucial to further validate the long-term safety and efficacy of these emerging technologies.