

Effectiveness of Anti-Fatigue Contact Lens in Visual Display Terminals User with Digital Eye Strain

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Abstract:

Introduction: In this digital era, extensive screen use leads to digital eye strain, characterized by symptoms such as eye fatigue, dryness, and blurred vision. This study evaluates the effectiveness of Biofinity Energy's anti-fatigue contact lenses in mitigating these symptoms and improving visual comfort.

Methodology: Patients with digital eyes strain were assessed for their visual functions before and after a 3 weeks trial period with the Anti-fatigue lenses. The Computer Vision Syndrome Questionnaire (CVS-Q) scores, amplitude of accommodation, and accommodative facility were performed on the patient. Schirmer's test was also performed to evaluate tear production to ensure accurate assessment of dry eye conditions.

Results: Sixty nine participants aged between 18 to 35 years were included in the study out of which 33 were male (47.82%) and 36 were female (52.17%). The results indicated a significant reduction in CVS-Q scores from a mean of 9.15 before lens use to 6.98 after use of anti-fatigue lenses, highlighting improved symptom relief ($p < 0.01$). The accommodative facility (OU) increased from 6.14 to 6.65 cycles per minute, suggesting enhanced focusing ease ($p < 0.01$). However, the amplitude of accommodation showed minimal change, with an average increase from 9.69 to 9.95+ Dioptres ($p < 0.01$). These findings suggest that while the Biofinity Energys lenses modestly improve accommodative facility and visual comfort but their effect on amplitude of accommodation is minimal. The observed improvement in CVS-Q scores underscores the lenses efficacy in alleviating discomfort associated with prolonged digital device use.

Conclusions: The results support the use of anti-fatigue lenses for reducing digital eye strain and enhancing visual ergonomics, although

the impact on accommodative range remains limited.

Keywords: Biofinity Energys, digital eye strain, anti-fatigue lenses, Computer Vision Syndrome

1. Introduction

The modern world is dominated by extensive use of digital devices where people spend countless hours in front of screens either at work or school or other entertaining activities. Consequently, increased screen time has resulted in an increased condition known as digital eye strain, or Computer Vision Syndrome (CVS), a group of ocular symptoms and signs associated with prolonged near work (Pavel, 2023), (Rosenfield 2011). This understanding of the CVS mechanisms can be helpful in developing appropriate interventions. The mechanisms involved include excessive accommodation demands, reduced blink rate leading to instability and dryness of the tear film and blue light emitted from digital screens. (Wolffsohn, 2023) Prolonged accommodation results in ciliary muscle fatigue, thereby affecting the amplitude and facility of accommodation. (Iribarren, 2001)

Several studies have been conducted on interventions for reducing digital eye strain. These involve behavioural adjustments such as the 20-20-20 rule, meaning taking a look at something 20 feet away every 20 minutes, every 20 minutes to reduce digital eye strain; making sure your workstation ergonomics is optimized; and artificial tears. (Turgut, 2018) More recently, attention has been paid to optical solutions: blue light filtering glasses and anti-fatigue lenses. Anti-fatigue lenses typically contain an added plus power in the bottom half of the lens to aid in accommodation thereby theoretically providing a reduction in ciliary muscle tension. While some studies have reported positive effects of anti-fatigue lenses on subjective symptoms and accommodative function, others have shown mixed results (Yeo, 2017), (Alionis, 2020). A recent meta-analysis by Mataftsi et al. (9) highlighted the need for more robust studies with standardized methodologies to evaluate the efficacy of these lenses. Specifically, there's a need for research that objectively assesses both subjective symptoms using validated questionnaires like the CVS-Q and objective measures of accommodation, such as amplitude and facility. This study aims to evaluate the effectiveness of Biofinity Energys anti-fatigue contact lenses in mitigating digital eye strain. This study will provide valuable insights into the potential benefits of anti-fatigue contact lenses for individuals experiencing digital eye strain.

2. Literature Review

This study investigates the effectiveness of Biofinity Energys anti-fatigue contact lenses in mitigating digital eye strain.

2.1 Accommodation and Visual Fatigue:

A change in focus is required to see objects at varying fixation distances. According to Atchison and Charman Potterfield in 1738 was credited with the term 'accommodation' to describe the focusing ability of the human eye over a range of distances. In recent times, accommodation is defined in

various ways, Grosvenor defines accommodation as 'the process by which the crystalline lens varies its focal length in response to changes in the vergence of incident light. Glasser defines accommodation as a 'dynamic, optical change in the dioptric power of the eye allowing the point of focus of the eye to be changed from distance to near objects. These definitions are consistent in indicating that a change in the

dioptric power of the crystalline lens is implicated in the process of accommodation. (Ovenseri-Ogbomo, 2015)

Several theories attempt to explain the mechanisms underlying visual fatigue. The "ciliary muscle fatigue" hypothesis, as mentioned above, posits that prolonged contraction of the ciliary muscle leads to physiological fatigue, impairing its ability to function effectively. (Dainoff, 2012). Imbalances in the autonomic nervous system can contribute to dry eye, another common symptom of digital eye strain, by affecting tear film stability and tear production. (Huang, 2022) The "cognitive load" theory suggests that demanding visual tasks, such as reading small text on a screen, can increase cognitive workload, indirectly contributing to visual fatigue. (Carroll, 2023) These theories are not mutually exclusive and likely interact in complex ways to contribute to the overall experience of digital eye strain.

2.2 Digital Eye Strain (Computer Vision Syndrome):

Digital eye strain, also known as Computer Vision Syndrome (CVS), is a broad term encompassing a range of ocular and visual symptoms associated with prolonged digital device use. The prevalence of CVS has increased dramatically with the widespread adoption of digital technologies. Symptoms of CVS can include eye fatigue, dryness, blurred vision, headaches, neck and shoulder pain, and difficulty focusing (Pavel, 2023), (Rosenfield 2011). The underlying causes of CVS are multifactorial, including excessive accommodation demands, reduced blink rate leading to dry eye, glare from digital screens, and poor ergonomic setup. The cumulative effect of these factors can significantly impact visual comfort, productivity, and quality of life. (Wolffsohn, 2023)

2.3 Anti-Fatigue Lenses and their Proposed Mechanism:

Anti-fatigue lenses are designed to alleviate some of the accommodative burden associated with prolonged near work. They typically incorporate a small amount of plus power in the lower portion of the lens, which effectively reduces the amount of accommodation required for near tasks. (Lamanuzzi, 2023). Koh et al. (2020) performed a study about Quantification of accommodative response and visual performance in non-presbyopes wearing low-add contact lenses. Sixteen subjects aged 20–39 years were enrolled in the study. A daily disposable low-add bifocal design lens (low-add CL) was tested. It employs a centre-distance optical zone and peripheral zone with the added power of +0.50 D to support near vision. Refractive state and accommodation were measured using an open-field autorefractor with three target vergences. Quantification of accommodative response and visual performance demonstrated that using low-add CLs alleviated the accommodation under the near-vision condition, without sacrificing distance vision, in non-presbyopes. Mazuze et al. (2021) conducted a study about Impact of Soft Contact Lenses for Digital Devices on Visual Performance, Tear Film, Accommodative Response and Dehydration in young

adult. This study was a comparative, prospective, randomized controlled clinical trial, single - masked, crossover study in young adult subjects who binocularly wore three different contact lenses: Biofinity Energys soft contact lens, Bausch & Lomb ULTRA soft contact lens and Biofinity Monofocal. Each one of the lenses was used for 1 week with wash-out period of two days. The findings of this study suggest that soft CLs for digital devices offer similar visual quality outcomes and clinical performance compared to the Control lens. Importantly, change in tear film stability, comfort score were not statistically significant, but were clinically significant.

However, the efficacy of anti-fatigue lenses remains a topic of ongoing research, with some studies reporting positive effects while others have shown mixed results.

3. Research Methodology

This study focuses on the effectiveness of Biofinity Energys contact lenses in treating digital eye strain. Anti-fatigue lenses are a progressive technology that is built with a slight and subtle boost within lens for near vision work which helps to relieve visual fatigue. With this same mechanism Cooper Vision launched Biofinity Energys contact lens which is having DIGITAL ZONE OPTICS (+0.3d) lens design to reduce stress on the eye muscles. The free form Anti-Fatigue contact lens helps the user by reducing eye strain and eye fatigue that generally occurs due to long hours of reading or working on the digital devices. These lenses have a mild addition (+0.3 D) provide visual comfort for day-to-day activities. They are beneficial for eyestrain, caused by long hours of desk & office work. These contact lenses are new generation of single vision lenses this optimized everyday lenses provides enhanced vision acuity in all situations and at all distances (Lamanuzzi, 2023).

Schirmer's test is used to assess aqueous tear production and dry eye conditions, with tests measuring basic and reflex tears. The study targets individuals aged 18 to 35 who use digital devices for approximately five hours daily. Participants must have clear refractive media and not have inflammation, ocular surface disorders, or presbyopic patients.

Exclusion criteria include participants with inflammation, ocular or systemic diseases, ocular surgery, one-eyed patients, amblyopia, or severe dry eye conditions. A comprehensive eye examination is conducted, including motor functions, accommodative function, and Near Point of Accommodation (NPA), Amplitude of Accommodation (AA), and Accommodation Facility measurements. Data collected from these tests are analyzed to assess the effectiveness of the Biofinity Energys lenses in mitigating symptoms associated with digital eye strain.

After a four-week period with the anti-fatigue contact lenses, all participants returned for follow-up assessments. The same diagnostic tests, including binocular assessments and accommodative evaluations, were repeated to determine the lenses' impact on visual comfort. The Computer Vision Syndrome Questionnaire (CVS-Q) scores were reassessed to measure any changes in symptoms related to digital eye strain. This follow-up aimed to identify improvements in tear production, visual function, and overall reduction in CVS symptoms, evaluating the efficacy of the anti-fatigue lenses in alleviating digital eye strain.

4. Results and Discussion

4.1 Results

Subjective Demographic:

The study's subject demographics had a mean age of 26.96 ± 2.97 years, Participants typically wore the anti- fatigue contact lenses for an average of 5.7 ± 1.06 hours per day. Sixty nine participants aged between 18 to 35 years were included in the study out of which 33 were male (47.82%) and 36 were female (52.17%).

CVS-Q score before and after using anti-fatigue Contact Lens:

Prior to using the contact lenses, participants had a mean CVS-Q score of 9.15, indicating a higher level of symptoms related to digital eye strain. After a 3 weeks trial period with the anti-fatigue lenses, the mean CVS-Q score decreased to 6.98. A paired samples t-test showed that the subjects' CVS-Q score decreased after lens use ($p < 0.001$). The patients observed a notable improvement in their digital strain symptoms, suggesting that the anti- fatigue lenses effectively helped in some of the discomfort associated with their prolonged screen use.

Change in Amplitude of Accommodation before and after using anti-fatigue Contact Lens:

Before the trial, the average amplitude of accommodation (AOA) was 9.69 diopters. After using the anti-fatigue lenses for a 3 weeks period, this value increased slightly to 9.95 diopters. A paired samples t-test showed that the subjects' AOA decreased after lens use ($p < 0.001$). This modest improvement indicates that the contact lenses may have contributed to a slight enhancement in the participants' focusing ability.

Accommodative Facility before and after using anti-fatigue Contact Lens:

Prior to using the lenses, the average accommodative facility (AF) score was 6.14 cycles per minute. Following a 3 weeks period of wearing the anti-fatigue lenses, this score improved to 6.65 cycles per minute. This increase indicates that the contact lenses may have enhanced the participants' ability to rapidly and effectively adjust their focus. (Figure 1)

These results indicate that Anti-fatigue lens had a mild impact on Amplitude of accommodation and Accommodative facility. Also CVS-Q score shows better results with these CL.

4.2 Discussion

This study investigated the effectiveness of Biofinity Energys anti-fatigue contact lenses in mitigating digital eye strain in a young adult population with substantial daily screen time. The results provide strong support for the lenses' positive impact on both subjective symptoms and aspects of accommodative function. Extended use of digital devices, typically lasting five hours or more, often results in excessive accommodative demands, which can lead to a decrease in the Near Point of Accommodation (NPA), accommodative facility, and amplitude of accommodation (AA). Our study, examined the impact of Biofinity Energys contact lenses on these visual functions. The findings indicate that the contact lenses provide effective relief from accommodative stress.

Specifically, there was a slight increase in accommodative facility after using the lenses. This improvement is attributed to the Digital Zone Optics design, which alleviates stress on the eye muscles by optimizing focus adjustments (Kajita, 2020), (Lamanuzzi, 2023), (Koh, 2020).

Additionally, the Computer Vision Syndrome Questionnaire (CVS-Q) scores showed a significant improvement following the use of these lenses. This enhancement is likely due to the digital boost technology incorporated into the lenses, which supports more comfortable and efficient use of digital devices. However, despite the improvements in accommodative facility and CVS-Q scores, no significant changes were observed in amplitude of accommodation.

In summary, the findings of this study suggest that Biofinity Energys anti-fatigue contact lenses offer a valuable approach for mitigating digital eye strain. While their impact on the overall range of focusing power appears limited, the lenses demonstrably reduce subjective symptoms and improve the speed and efficiency of focusing. These combined benefits suggest that the lenses primarily enhance the comfort and functionality of the focusing system, rather than dramatically increasing its capacity. These results contribute to the growing body of evidence supporting the use of anti-fatigue lenses for individuals experiencing digital eye strain, particularly young adults with significant screen time.

6. Conclusions

The study found that anti-fatigue lenses improve amplitude of accommodation and accommodative facility, with accommodative facility showing a noticeable increase due to Digital Zone Optics design. These lenses also improve Computer Vision Syndrome Questionnaire scores.

Future research with larger and more diverse populations could further explore the long-term effects of these lenses on visual function and symptom burden, and compare these findings with other interventions aimed at reducing digital eye strain.

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Figure 1. Graph depicting Accommodative Facility before and after Contact lens use

