Athletes as an Ideal Target Population for Orthokeratology

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Introduction

Since its inception in the United States in 2002, following FDA approval for overnight wear, Orthokeratology (Ortho-K) has been used as a corrective method for refractive error. Multiple studies have since shown that Ortho-K is a promising method for controlling and slowing progression of myopia. Ortho-K lenses flatten the cornea overnight while the patient is asleep. When the patient wakes and removes the lenses, the cornea maintains the flattened shape throughout the day minimizing, and in most cases, completely eliminating their refractive error for up to two full days. Recent findings suggest that around 90% of adults in some East Asian countries are myopic, steadily increasing since 1996. As a result of this myopic epidemic, Ortho-K has gained popularity as a non-invasive method in Asian populations worldwide. Despite many studies on populations in East Asia, very little research has been conducted to show the increasing prevalence of myopia in Western countries. One study shows that the prevalence of myopia in the United States has increased from 25% in the 1970s to over 40% today. Young people whose parents are high myopes are at much higher risk for developing high myopia. Ortho-K has been successful in combating this problem by drastically slowing myopia progression in those patients. Ortho-K can gain momentum in Western populations while these numbers are still relatively low, it may be possible to outpace the problem before it becomes an epidemic.

Aside from myopia control, Ortho-K has many other benefits that make it an ideal corrective option for a wide array of patients. The secondary benefits of Ortho-K tend to be overlooked by both optometrists and patients. One population that would benefit largely from Ortho-K are athletes or any patients who regularly take part in recreational activities. Alternative options for correction of refractive error pose certain limitations and complications for athletes. Ortho-K lenses would slow progression of myopia in athletes while also eliminating many of the problems that they experience with other corrective methods. Due to the fact that young people are the ones at risk for becoming myopic and many of those young patients participate in sports, athletes are ideal candidates for Ortho-K.

Our primary purpose is to highlight athletes as an ideal population for the use of Ortho-K. By pointing out the benefits to the athletes, our secondary goal is to accentuate the advantage to optometrists of prescribing Ortho-K.

Methods

There were three methods by which our study was conducted:

- An online survey approved by the Institutional Review Board (IRB) administered to optometrists who are currently practicing in the United States and Canada. A total of 49 responses were obtained. The survey requested information regarding patient demographics, the use of Ortho-K, as well as the benefits and reasons for use, with an emphasis on athletes.
- An interview with Dr. Curtis Frank, an optometrist and Ortho-K provider located in downtown Boston.
- Interview with a young Ortho-K wearer who participates in sports.

Results

Over half of the optometrists surveyed reported that “25% of their patients are between the ages of 5 and 21. As shown in Figure 2, a majority of the optometrists surveyed (94%) stated that Ortho-K was a good option for athletes as shown in Figure 3. According to the data shown in Figure 4, the two most common reasons for orthometrists to use Ortho-K is to slow the progression of myopia in children and teens (51%) and for patients who desire spectacle and/or contact lens correction (49%).

Patient Interview:

We interviewed a 22-year-old male who has worn Ortho-K lenses for twelve years. His original prescription, at ten years old, was OD -1.25 and OS -1.00 and it has not progressed since he began using Ortho-K lenses. “I played soccer so my parents recommended it because getting dirt or grass in my eyes with contacts required taking them out and attempting to clean them back in without conditions. Sports glasses are not ‘cool’ to wear.”

Discussion

Although only 55% of optometrists use Ortho-K, 75.5% think Ortho-K is a good option for athletes. Some doctors reported not using it in their practices due to lack of a corneal topographer and lack of training. When asked whether it is profitable for optometrists to purchase a topographer in order to prescribe Ortho-K, many optometrists said that the benefits far outweigh the costs and that training is quick and inexpensive. However, it is important to note that the demand for Ortho-K is dependent on the demographics specific to each practice. Of the optometrists surveyed, many reported a large portion of their patient population is between the ages of 5 and 21. In this age range participate in sports either competitively or for recreation. For young people who require correction, glasses and contacts pose certain problems with performance and comfort while doing activities. Some of these complications are outlined in Table 2 below. Many sports including archery, soccer, baseball, and golf demand critical precision and 20/20 visual acuity. Positions such as sprinter and baseball catcher require clear peripheral vision, which is not attainable with corrective lenses. Additionally, he indicated that his patients that are young athletes receive a protective benefit from Ortho-K use, avoiding potential complications caused using other corrective methods. He specifically mentioned that swimmers, baseball players and hockey players all benefit in this way. Furthermore, the patient has no experience with other corrective methods. Due to the fact that young people are the ones at risk for becoming myopic and many of those young patients participate in sports, athletes are ideal candidates for Ortho-K.

Conclusions

Research proves that there is a definite need for control of myopia in the U.S. and that Ortho-K is an ideal method to treat the problem. The results of our survey suggest there is large room for growth with regards to Ortho-K providers in the U.S. In addition, there shows is a large population that could benefit from Ortho-K within most orthometric practices. Nearly all optometrists surveyed reported having a wide array of athletes as patients, but only a small portion of them recommend Ortho-K for sports specifically. First and foremost, we hope that patients at risk for or who currently have myopia are made aware of Ortho-K as an option. By educating younger athletes and their parents about the benefits of Ortho-K, optometrists have the opportunity to both profit and lead the fight against myopia. Subsequently, if young people are able to decrease their chances of developing myopia while making their daily tasks and hobbies more enjoyable by using Ortho-K lenses, they will be more successful in their present and future endeavors.

Conclusion - cont'd

Table 2: Disadvantages of Alternative Options

<table>
<thead>
<tr>
<th>Sports</th>
<th>Disadvantages of Alternative Options</th>
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<tbody>
<tr>
<td>Swimming</td>
<td>- Cannot wear glasses/CL during activity</td>
</tr>
<tr>
<td>- Risk of infection with contact lenses</td>
<td>- Requires prescription goggles</td>
</tr>
<tr>
<td>Baseball</td>
<td>- Poor peripheral vision with glasses</td>
</tr>
<tr>
<td>- Risk of injury with glasses</td>
<td>- On-field vision under contact lenses</td>
</tr>
<tr>
<td>Soccer</td>
<td>- Poor peripheral vision with glasses</td>
</tr>
<tr>
<td>- Risk of injury with glasses</td>
<td>- Dirt under CL causing irritation or infection</td>
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</table>

Discussion - cont'd

Table 1: Optometrists were surveyed about reasons why patients have continued or discontinued use of Ortho-K. Percentages for each reason are shown.

<table>
<thead>
<tr>
<th>Results - cont'd</th>
<th>Results - cont'd</th>
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<tbody>
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<td>- con't</td>
<td>- con't</td>
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<tr>
<td>Containment Treatment</td>
<td>Discarding Treatment</td>
</tr>
<tr>
<td>Good adherence to CL/Glasses: 44.7%</td>
<td>Good adherence to CL/Glasses: 13.2%</td>
</tr>
<tr>
<td>Easy to wear: 14.9%</td>
<td>Easy to wear: 12.3%</td>
</tr>
<tr>
<td>Greatly increased vision: 18.9%</td>
<td>Greatly increased vision: 26.6%</td>
</tr>
<tr>
<td>Comfortable: 32.5%</td>
<td>Comfortable: 32.5%</td>
</tr>
<tr>
<td>30% of optometrists believe that Ortho-K was a good option for athletes</td>
<td></td>
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</tbody>
</table>

Figure 1: Orthokeratology treatment mechanism.

Figure 2: Patient interview:

Figure 3: 75.5% of optometrists surveyed believe that Ortho-K was a good option for athletes.

Figure 4: This graph demonstrates the reasons optometrists typically prescribe Ortho-K. The optometrists were able to check all that apply.

Figure 5: Complications that can result from playing sports with glasses or contacts; sarcosomatis keratitis, bacterial infection from swimming with contact lenses (left); broken lenses after clear vision (center); corneal ulcer secondary to dirt under contact lens (right).
Keratoconus: Improving Quality of Life Through Advancements in Detection and Treatment

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Introduction

Keratoconus is a corneal dystrophy in which the cornea progressively thins centrally and becomes cone-shaped. This condition affects women and men equally. If left untreated, the disease can result in loss of vision. However, recent advancements in detection and treatment have significantly improved the quality of life for those affected by keratoconus.

Methods

Two individuals were interviewed to gain insight into the most current treatments for keratoconus and what it is like living with the disease. Dr. Denise Roddy is one of the foremost doctors in the treatment of keratoconus in the United States, and her knowledge on corneal cross-linking (CXL) is invaluable to this project. Robert Flynt, a keratoconus patient, provided the group with information on what it is like to live with keratoconus, in addition to discussing how treatment has changed since he was initially diagnosed. Both patients were interviewed gracious enough to grant permission to incorporate his or her conversations into our project. In addition to the personal interviews, research was conducted regarding keratoconus, genetic testing, collagen cross-linking, and other treatment options.

Results

There is evidence of keratoconus being genetically linked. Most prominently, individuals with genetic anomalies such as Down Syndrome or Leber's congenital amaurosis may show signs of this condition. Recently, there have been advancements in genome-wide studies to provide insight into keratoconus susceptibility. The first locus found was within the D2S391 region on chromosome 2p24 in 60% of the tested families with an LOD score of 3.29. While limited to a single family, this finding provided a new putative locus for keratoconus. The linkage was found in 3.29. While limited to a single family, this finding provided a new putative locus for keratoconus. The linkage was found in

A new form of treatment for keratoconus, corneal collagen cross-linking (CXL), is currently in phase III clinical trials across the United States. The FDA has approved several registral corneal collagen cross-linking studies that have either been completed or are in progress. The traditional procedure for collagen cross-linking involves:

1. Administer topical anesthetic (proxymetacaine 0.5%).
2. Removal of the corneal epithelium via mechanical debridement.
3. Administer photosensitizer riboflavin (0.1% in 20% dextran T500 solution) over 30 minutes in contact with the corneal stroma.

A significant finding is that keratoconus is associated with retinitis pigmentosa, retinopathy of prematurity, and vernal conjunctivitis; and there is compelling evidence in the literature stating that the earlier keratoconus is detected and treated, the better the quality of life. For this reason, keratoconus poses a much greater public health danger than its prevalence would seem to indicate.

Discussion

Dr. Denise Roddy is an expert in optometry in Tulsa, OK and currently manages over 400 keratoconus patients. She is widely recognized as an expert in both keratoconus and the use of specialty contact lenses. She states that the best available approach for early keratoconus is still the use of corneal topography on all patients with a family history of the disease. Approximately 80% of her keratoconus patients are successfully fit with Synergeyes lenses. Dr. Roddy has referred several patients in collagen cross linking in Tulsa with consistent success in stabilizing the patients' corneas. Dr. Roddy has been active in the effort to bring CXL to the United States and does not understand why the procedure has not yet received FDA approval. Despite not being approved by the FDA in the US, the correlating collagen cross-linking is currently being performed since the procedure simply involves riboflavin (vitamin B2) and UVA light. Unfortunately, without being FDA approved, the treatment is not covered by insurance so patients are required to pay out of pocket. CXL costs about $2,500 per eye in the US.

Robert Flynt was diagnosed with keratoconus in his late 20s. At the time he was diagnosed, there wasn’t much known about treatments. The doctor mentioned the possibility of getting a corneal transplant but was apprehensive of the many complications and possibility of blindness. So, Robert was treated with rigid gas permeable lenses. When Robert was diagnosed with keratoconus, it had already established that the child had been aware of the importance of preventive medicine he would have gone to the doctor earlier. He also said that the doctor caught his keratoconus in its progressive stage, hence there was collateral damage. If Robert had had it diagnosed at the time, he would not have gotten a corneal transplant as it was too late. The disease worsened over a short amount of time. Robert has no known genetic links to keratoconus but said that if he did, he would have considered genetic testing because knowing of his risk would have allowed him to seek care earlier. The patients have allowed the doctors to potentially catch the condition early and treat it in such a way so as to not hinder the quality of his life. With the shift toward preventative care and advancements in treatment, keratoconus can be detected earlier and be treated with improved procedures and outcomes. One of the potential methods for early detection of keratoconus could involve genetic testing.

While there are genetic tests for other ocular conditions such as Age-Related Macular Degeneration, there is no genetic test available for familial keratoconus patients. There have been multiple studies conducted that have shown genetic linkages in families with familial keratoconus. Several studies have found a linkage on chromosome 1q34-q35 with an Italian family, a linkage on chromosome 5q14.3-q21.214. This locus had previously been identified in a single family. This study provided a new putative locus for keratoconus.

Results - con’t

Keratoconus is a disease that is different from many other eye diseases due to its early onset in life. The fact that it typically begins to affect vision during young adulthood can have a major impact on an individual's career and financial development, and ultimately quality of life. For this reason, keratoconus poses a much greater public health danger than its prevalence would seem to indicate. The technology used to detect and diagnose diseases such as keratoconus has continued to improve, including advancements in techniques such as topography and corneal coherence tomography (OCT). In addition to improvements in early detection methods, new technology in contact lens designs including hybrid and scleral lenses, has provided keratoconus patients and their caregivers with effective options for improving comfort and functional vision. While, however, capable of improving function and quality of life, these advancements do not offer a means of halting the progression of the disease. Collagen cross-linking is changing that. This procedure could prove to be the most important development in the treatment of keratoconus as it offers the opportunity to stabilize the patient and prevent further loss of vision. This ability to stop the disease progression combined with early detection methods already in place could eventually result in very few keratoconus patients suffering substantial loss in functional vision.

As there is no genetic test for diagnosing keratoconus, preventive care methods such as ophthalmic screening will continue to be critical in detecting changes in the cornea before significant vision loss has occurred. Securing FDA approval for CXL treatment will make the procedure affordable for most patients, equipping eye care providers with the tools necessary to reduce or eliminate a considerable public health concern.

Conclusion

Keratoconus, or “keratoconus” as it is also known, is a rare disease characterized by progressive thinning of the cornea, leading to the development of a cone-shaped protrusion. The condition typically affects both eyes and can result in loss of vision if left untreated. However, recent advancements in detection and treatment have significantly improved the quality of life for those affected by keratoconus.

References

Establishing a Gold Standard for Dry Eye Diagnosis

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Introduction

Dry eye is a multifactorial disease that affects the ocular surface and affects the quality and quantity of tears. The tear film is composed of three layers: a lipid layer, an aqueous layer, and a mucin layer. The lipid layer is produced by meibomian glands and slides across the ocular surface, forming a hydrophobic layer and allowing even distribution of the tear film. The mucin layer is also associated with various symptoms of ocular discomfort, such as foreign body sensations, redness, and more. Dry eye syndrome is usually due to tear deficiency or excessive tear evaporation which cause damage to the corneal epithelial surface. Dry eye is found most commonly in women, and the prevalence increases with age. The lack of uniformity in its definition and the inability of a single diagnostic tool confirm or rule out the condition. Because of this undefined characteristic, the reported prevalence of dry eye is diverse, with questionnaire based surveys documenting rates ranging from 14% to 37% of the population sampled. The current available methods of diagnosing dry eyes, which include Schirmer’s test, tear breakup time using fluorophores, and other ocular surface staining like Lissamine Green and Rose Bengal, are the same being the perfect diagnostic tool for many reasons. Although optometrists are familiar with these conventional methods, diagnosing dry eye is still a challenge.

Purpose

This is currently no gold standard established for diagnosing dry eye. The purpose of our study was to establish whether tests for diagnosing dry eye are most commonly performed by optometrists in a variety of different types of optometric practices. We then compared the tests available to establish which was preferred when diagnosing dry eye in their practice and identify the advantages and disadvantages. This helped to assess their general efficacy to help doctors establish which methods would be best for our gold standard.

Method

• Interview practitioners from different areas across the country to ask what methods they preferred when diagnosing dry eye in their practice
• Compared a variety of methods based on criteria:
   • Ability to detect the severity of symptoms
   • Time it takes to administer the test
   • Cost to the practice
   • Demographic information of the patient
• Analyze resources available to doctors and patients to better communicate the etiology of dry eye

Diagnostic Tests

Tear Break Up Time: Use of fluorescein and cobalt filter to evaluate tear film stability of the tear film. It is used to confirm the presence of abnormality. It is a test that can be done with anesthetic to control reflex tearing and can be performed in adults and children.

Phenol Red Thread: Stain desiccated and dying cells on the ocular surface. It takes 15 seconds to conduct and causes significantly less reflex tearing than other methods.

Lissamine Green/Rose Bengal: Stain desiccated and dying cells on the ocular surface. It is used to check the integrity of the mucin layer and to detect abnormalities. It is a test that can be done with anesthetic to control reflex tearing and can be performed in adults and children.

Schirmer’s Test: A strip of paper is placed in the lower cul-de-sac of the inferior lid and the amount of wetting is measured for 5 minutes.

Data

<table>
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<th>Response</th>
<th>Norms:</th>
<th>Cost/Box</th>
<th>Cost/Pt</th>
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<td>$108/month</td>
<td>&lt;10mm</td>
<td>Moderate Dry Eye</td>
<td></td>
</tr>
<tr>
<td>Lissamine Green/Rose Bengal</td>
<td>$308/month</td>
<td>20mm</td>
<td>Severe Dry Eye</td>
<td></td>
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<td>Phentol Red (Tests the osmolarity of the tear film using 50nL of tear film)</td>
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<td>≥10sec</td>
<td>Severe Dry Eye</td>
<td></td>
</tr>
<tr>
<td>Phenol Red Thread</td>
<td>$108/month</td>
<td>&gt;20mm</td>
<td>Norms:</td>
<td></td>
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<tr>
<td>Schirmer Test</td>
<td>$108/month</td>
<td>≥15</td>
<td>Norms:</td>
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</table>

Discussion

Dry eye syndrome can occur as a result of environmental factors, medications, occupational factors, or emotional stress. It can negatively impact visual acuity and cause discomfort for a patient daily activities. Currently there is no “gold standard” for testing dry eye syndrome. The purpose of this study was to analyze available tests. There are four classes of gold standard for diagnosing dry eye.

1. Phenol Red Thread Test using Lissamine Green/Rose Bengal stain to differentiate between no dry eye and mucin layer deficiency. If Phenol Red Thread Test is negative, there is no evidence of dry eye. If Positive, the patient is a good candidate for further testing.

2. Schirmer Test: A strip of paper is placed in the lower cul-de-sac of the inferior lid and the amount of wetting is measured for 5 minutes. It can be done with or without anesthetic. A Schirmer test ≥10mm is considered normal tear production. A Schirmer test ≤7mm is considered dry eye.

3. TearLab: Tests the osmolarity of the tear film using 50nL of tear film. It only takes 15 seconds to conduct and causes significantly less reflex tearing than other methods.

4. Lissamine Green: Stain desiccated and dying cells on the ocular surface. Tests the lacrimal glands and helps to assess the patient’s general efficacy.

Discussion cont.

There is currently no established protocol for optometrists to follow regarding the diagnosis of dry eye. The proposed five for dry eye diagnosis could be a universal standard for patients in the future. Whether or not this is possible, the information and data provided can help us to determine what type of dry eye the patient is afflicted with. From this, optometrists can prescribe treatments that are specific to the patient’s dry eye abnormality.

Conclusions

Dry eye syndrome is a multifactorial disease that affects the ocular surface and affects the quality and quantity of tears. The tear film is composed of three layers: a lipid layer, an aqueous layer, and a mucin layer. The lipid layer is produced by meibomian glands and slides across the ocular surface, forming a hydrophobic layer and allowing even distribution of the tear film. The mucin layer is also associated with various symptoms of ocular discomfort, such as foreign body sensations, redness, and more. Dry eye syndrome is usually due to tear deficiency or excessive tear evaporation which cause damage to the corneal epithelial surface. Dry eye is found most commonly in women, and the prevalence increases with age. The lack of uniformity in its definition and the inability of a single diagnostic tool confirm or rule out the condition. Because of this undefined characteristic, the reported prevalence of dry eye is diverse, with questionnaire based surveys documenting rates ranging from 14% to 37% of the population sampled. The current available methods of diagnosing dry eyes, which include Schirmer’s test, tear breakup time using fluorophores, and other ocular surface staining like Lissamine Green and Rose Bengal, are the same being the perfect diagnostic tool for many reasons. Although optometrists are familiar with these conventional methods, diagnosing dry eye is still a challenge.

References


Acknowledgment

We would like to thank the following optometrists for their contributions: Dr. Michele Logarino, Dr. Louise Gibson, Dr. Michelle Hausmann, Dr. Julie Lee, Dr. Robert Tyszko, Dr. Crystal Johnson, Dr. Joseph Bazemore, Dr. Brian Choo, Dr. Karen Kita, and Dr. Karl Lovenstein.
Introduction

The leading cause of preventable death worldwide is obesity. Obesity is a disorder characterized by excessive amounts of body fat that have been shown to increase the risk of diseases and health problems. It is identified by using height and weight to calculate an individual's "body mass index," or BMI, a commonly used indication of body fat distribution (See Table 1). In 2011-2012, more than 34% of US adults were considered obese (Ogden et al., 2014). This figure is expected to reach nearly 42% by 2020 (Finkelstein et al., 2012).

The most challenging aspect of treating obesity is overcoming the external stigma that is embedded throughout many cultures. All healthcare providers need to advocate for healthier lifestyles, but often don’t know how to approach the topic. Given obesity’s prevalence and its many ocular manifestations, it is perhaps more imperative than ever for the condition to be handled in conjunction with patients’ eye health to reduce the risk of eight-threatening pathologies.

Methods

A survey created on SurveyMonkey was administered to optometrists throughout the United States and Canada. Questions addressed each doctor’s opinion on the importance of BMI as a risk factor for ocular complications and the risks that come with it, the importance of having strong communication between primary eye care providers and other physicians for obese patients, and the frequency with which each doctor correlates other physicians in reference to obese patients. This information was supported by research found on ocular manifestations of systemic conditions associated with obesity and cooperative care models.

Results and Interpretations

Almost all of the doctors surveyed noted that obesity is a risk factor for diabetic retinopathy, a complication of diabetes mellitus that can lead to substantial visual loss (Kumar, 2007). Obesity and increased BMI levels have been linked with diabetic retinopathy due to the associated risk factors of diabetics complications such as poor glycemic control, hypertension, and elevated serum lipid levels (Senthil, 2007). However, less than half of those surveyed believed that obesity can cause other ocular complications such as cataracts, ARMH, and pseudotumor cerebri, despite there being studies indicating obesity as an independent risk factor for these conditions.

For example, a longitudinal study by the Framingham Eye Study found an independent association between greater BMI and higher incidence of cortical and posterior subcapsular cataracts (Podgor et al., 1998). It has been found that obese patients are more likely to exhibit high levels of leptin, a protein hormone produced by adipose tissues. Leptin increased systemic levels of reactive oxygen species, which is postulated to play an important pathogenic role in cataract formation (Harding, 1997).

The Physicians’ Health Study found that dry ARMH was highest in obese men and lowest in men with a normal BMI (Schumacher et al., 2001). As previously discussed, obesity may increase systemic oxidative stress. In response to ROS, RPE cells may release leptin, which has been hypothesized to contribute to increased intracellular pressure due to an increase in subretinal fluid pressure (Brasts et al., 1998). Weight gain is considered to be the main risk factor for this condition, as obesity increases the risk of pseudotumor cerebri by 20% (Lin, 2009). The condition is most commonly associated with obese women of reproductive age (DePuyt and Lively, 2011). However, only 2 of the doctors surveyed mentioned obesity as a risk factor for pseudotumor cerebri.

Pathways to reduce obesity include lifestyle changes (Koh and Koh, 2008), education, and services such as drug therapy treatments or surgery. For example, a longitudinal study by the Framingham Eye Study found an independent association between greater BMI and higher incidence of cortical and posterior subcapsular cataracts (Podgor et al., 1998). For the condition to be reduced, lifestyle changes must be made along with medical intervention.

Patient Intervention

Obesity is a major public health issue and early intervention is key to helping the patient prevent additional diseases and prolong life. Optometrists who are able to guide their patients to healthy lifestyles and manage obesity upon consultation will be the most influential. Individuals may be more motivated to lose weight and kick unhealthy eating habits to save their vision if they are better informed of the risk for vision-threatening conditions related to obesity. More communication means more comprehensive care and prevention, which in turn means lower healthcare costs and better quality of life.

Tips for Optometrists on How to Discuss Weight with Patients

• Ask permission to discuss the patient’s weight
• Maintain a professional and respectful tone
• Ask open-ended questions
• Make sure the patient is comfortable and does not feel pressured

Purpose

This project seeks to examine the current state of interdisciplinary communication between primary care optometrists and other physicians with regards to obese patients. Twenty optometrists were surveyed about current communication received and provided for such patients.

Cooperative Practice

The move towards collaborative healthcare is one that the US is slowly but surely making. According to the American Medical Association, one of the two greatest challenges facing US health care is “care that is fragmented, poorly coordinated with little accountability for the outcomes of care.” The Affordable Care Act looks to address this concern by creating Accountable Care Organizations. This involves groups of doctors with different specialties working together to provide the most comprehensive and cooperative care possible for their patients. While the Affordable Care Act only specifies the needs for ACOs for Medicare patients, this model is truly becoming the future of health care. The Institute of Medicine is in favor of interprofessional education for healthcare workers to work together in collaboration and care. The conference on Autonomous Agents and Multiagent Systems (AAMAS), which teaches all professions about collaborative work for their benefit, even included a workshop on collaborative care and practice. The conference on Autonomous Agents and Multiagent Systems (AAMAS), which teaches all professions about collaborative work for their benefit, even included a workshop on collaborative care and practice. The conference on Autonomous Agents and Multiagent Systems (AAMAS), which teaches all professions about collaborative work for their benefit, even included a workshop on collaborative care and practice.

Collaborative care models are more than just theory. Many studies have been conducted showing that collaborative care for a variety of patients improves overall health and outcomes. In 2012, a study was published detailing care for patients with multiple long-term disorders. Focused on a Scottish population, the study found that 42.8% of all patients had one or more disorders and that providing fragmented care from different doctors for each individual disorder is not enough and suggests that “diligent clinician take responsibility for coordination” (Hunt et al., 2012). They also that the existing single-disease approach is “increasingly inappropriate.” Likewise, another study tested collaborative care for patients that have diseases linked to obesity - diabetes mellitus and/or coronary heart disease – as well as depression with the aim “to evaluate cost-effectiveness of a multidisciplinary collaborative treatment program.” The study found that not only did patients only have depression-free days with a team-based approach, but also that HbA1C, systolic blood pressure, and LDL-C levels improved and outpatient health care costs significantly decreased (Katon et al., 2012).

Interprofessional Intervention

Many optometrists in the survey noted that primary care physicians rarely initiate correspondence in reference to obese patients. As such, it is essential that optometrists be the one to continue advocating for improved communication with PCPs. This can be done in two ways. The first way is for optometrists to normalize communication for obese patients. There are already certain conditions that necessitate optometric reports to PCPs (depending on the state). If optometrists send these reports for all obese patients as well as diabetic patients or patients who already have ocular conditions, then the care is already a bit more cooperative. The second way, which would complement the first, would be for optometrists to personally reach out to PCPs in their area. A simple e-mail could look like this:

Hey [PCP’s Name],

I thought I would reach out to you regarding a patient I recently saw in my practice. [Patient’s name] is a [age, gender] patient with [condition(s)]. They were recently diagnosed with [condition(s)] and are seeing [other doctor’s name(s)] for [condition(s)].

I noticed that their BMI was [insert BMI] and thought that it might be something you would be interested in discussing as well.

I would love to hear your thoughts on this and see if there is anything you would like to add. Please don’t hesitate to contact me at [your contact info].

Best regards,
[Your Name]
Case Study

The Role of Nutrition and Diet in Dry Eye Syndrome

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Introduction – The Problem

Many patients are unaware of the massive impact their diet is having on their eyes. The steady increase of polyunsaturated fatty acids in the American diet is leading to more health problems, especially chronic diseases. The United States healthcare program has recently begun taking more preventative stance, and it is time the optometric and ophthalmic communities take diet as seriously as eye issues.

Dry eye syndrome has become the most common eye condition in the United States, occurring in approximately 30% in every seven Americans.1 The lack of understanding of the etiology of dry eye has made dry eye syndrome difficult for clinicians to diagnose. Since the FDA approval of Restasis, the patient education of dry eye syndrome has not met the standards needed for patients to understand what is actually happening to their eyes. Instead of education and prevention, the reliance on drugs has become one of the primary solutions—causing patients more confusion and significant extra monetary cost. Dry eye syndrome can be asymptomatic or symptomatic, with the most prevalent symptoms being burning, itching, stinging, and a foreign body sensation.2 Unfortunately, due to the difficult diagnosis of dry eye syndrome, it has also become the most under diagnosedocular condition as well; it is uncommon for these symptoms to go untreated or treated insufficiently. Adding to its complexity is the fact that dry eye syndrome can be caused by a wide array of factors.

There are three layers to the tear film: lipid, aqueous, and mucin.1 The evaporative form of dry eye syndrome has become the most frequent cause, which is due to the tears being lipid deficient and thus evaporating faster than the normal rate.3 This is typically caused by meibomian gland dysfunction (MGD), “a chronic, diffuse abnormality of the Meibomian glands” due to a breakdown or quality of the oil produced.4

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The Role of Nutrition and Diet in Dry Eye Syndrome

Omega 6 versus Omega 3

Omega-6s and omega-3s are considered polyunsaturated fatty acids, because, with double bonds, the human body does not have the ability to produce them, therefore, they must be ingested in foods. Omega-6s are typically found in the form of food and other dietary supplements.5 Unlike other fats or lipids that we may absorb from food, these essential fatty acids are highly bioactive and have a direct role in regulating body functions, including blood clotting and inflammatory response.6

Omega-6s and omega-3s have contradictory effects on the body; omega-6s are inflammatory and omega-3s are anti-inflammatory.7 Both are necessary to keep our bodies healthy because Inflammation reactions are vital in protecting the body from injury or infection, however, excessive inflammation, can contribute to disease, including dry eye syndrome.8 Omega-6 fatty acids are found in processed foods, shortening, corn oil, soy oil, or margarine.9,10 Also, cattle that are grain fed have been found to worsen the omega-6 to omega-3 ratio.11

A diet high in omega-6s, but low in omega-3s, increases inflammatory, while a balanced diet of both fatty acids keeps the body at an optimal ratio. A healthy omega-6:omega-3 ratio should be around 1:1.5 The problem with today’s society is the excess consumption of omega-6s compared to omega-3s,12 which leads to a ratio around 18:1 or 17:1. This ratio is much higher than what humans are genetically adapted to, and can contribute to the cause of many inflammatory systemic diseases.

Inexpensive Treatments

• Theories range from omega-3 fatty acids changing the quality and secretion of the meibomian gland lipids.6 Scrubbing the lids with a diluted baby shampoo solution may provide temporary relief of symptoms.13

• The Role of Nutrition and Diet in Dry Eye Syndrome

Dry eye syndrome is caused by a combination of factors including age, sex, race, and allergies.10 There are three layers to the tear film: lipid, aqueous, and mucin.4 The evaporative form of dry eye syndrome has become the most frequent cause, which is due to the tears being lipid deficient and thus evaporating faster than the normal rate.3 This is typically caused by meibomian gland dysfunction (MGD), “a chronic, diffuse abnormality of the Meibomian glands” due to a breakdown or quality of the oil produced.4

The purpose of “A randomized controlled trial of omega-3 fatty acids in dry eye syndrome” by Bhargava et. al. is to examine the effect of omega-3 fatty acid supplements and dry eye symptom relief, limitations in the study included a small sample size, lack of controls, and a short follow up (two days post treatment).14 This is a pilot study to determine if omega-3 fatty acids can lead to a decrease in dry eye symptoms.

Method

Researchers randomly assigned patients based on the pre-disposition to dry eye syndrome. The selected patients were randomly assigned either to the placebo or experimental group. The assignment were done via computer software to remove any bias.9

In the experimental group (Group 1) received omega-3 fatty acid supplements while the control group (Group 2) received a placebo pill. The two types of capsules were similar to one another to remove bias.

Researchers chose to use a 500mg capsule taken twice daily. The 500mg was selected in order to lower the risk of safety concerns and decrease the risk for side effects. Researchers chose to use a 500mg capsule taken twice daily. The 500mg was selected in order to lower the risk of safety concerns and decrease the risk for side effects.

Results

At the end of three months, the researchers constructed two different sets of data: primary and secondary outcome measures. The primary outcome measures were the subjective relief of dry eye symptoms felt by the patient. At the end of the trial, 9% of symptomatic patients in Group 1 were asymptomatic, while 35% had a moderate improvement in symptoms. Though it is not statistically significant. For the objective exams, the difference between the groups reached statistical significance. Between Groups 1 and 2, the difference in symptoms felt by the patients was statistically significant. For the objective exams, the difference between the groups reached statistical significance. Between Groups 1 and 2, the difference in symptoms felt by the patients was statistically significant.

Conclusion

Though the researchers were able to find a strong correlation between essential fatty acid supplements and dry eye symptom relief, limitations in the study prevented strong conclusions from being made at this point.

• The reason for the positive effect of omega-3 fatty acids on dry eye symptoms is still very much unknown, partially due to the complex etiology of dry eye syndrome.

• Theories range from omega-3 fatty acids changing the quality and secretion of the meibomian gland lipids to omega-3s reducing ocular inflammation resulting in a more stable tear film.

Discussion – The Solution

Empowering patient education on the topic of dry eye syndrome is the foundation of the solution to solving this growing problem. With better patient understanding, comes better patient compliance; allowing the prevention of dry eye syndrome, rather than simply treating the disease with medications. This will improve patients’ overall health and will also significantly lower healthcare costs. This can be accomplished through lifestyle and dietary changes, specifically by reaching a 1:1 ratio of omega-6s to omega-3s consumption. Lowering processed food intake would yield the most direct results. Below is a table illustrating meal options for specific diets that are closer to the optimal 1:1 ratio.

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Sports Related Concussions in Adolescent Athletes: How Aware Are You?

New England College of Optometry, Boston, MA

Introduction

Participation in sports drastically increases the risk of a concussion and therefore it is imperative that both participants and athletic trainers are aware of the signs of a concussion. It is estimated that 300,000 sports-related concussions (SRC) involving loss of consciousness occur annually among youth athletes in the United States. However, this is not a true estimate of the number of concussions that occur during sporting events, as loss of consciousness occurs in less than 10% of concussions. This highlights the issue of underreporting of SRCs which is largely due to the lack of awareness and recognition of the injury. Increasing concussion education and awareness will increase the number of concussion diagnosed and treated.

A concussion is defined as “a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces”. A concussion occurs when rotational or angular acceleration forces are applied to the brain, resulting in shear strain of the underlying neural elements. The signs and symptoms of a concussion depend on its severity and are identified in Table 1.

Table 1. Signs and symptoms of a concussion

<table>
<thead>
<tr>
<th>Visual</th>
<th>Mental</th>
<th>Balance</th>
<th>Physical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertigo</td>
<td>Difficulty</td>
<td>Impairment</td>
<td>Tinnitus</td>
</tr>
<tr>
<td>Dizziness</td>
<td>Nausea</td>
<td>Imbalance</td>
<td>Headache</td>
</tr>
<tr>
<td>Photophobia</td>
<td>Vertigo</td>
<td>Impairment</td>
<td>Headache</td>
</tr>
<tr>
<td>Photopsia</td>
<td>Difficulty</td>
<td>Impairment</td>
<td>Headache</td>
</tr>
</tbody>
</table>

Visual disturbance following concussion occurs in 30% to 85% of reported cases. Symptoms associated with vision include problems with accommodation, version, vergence, photosensitivity, visual field integrity, and ocular health. Common complaints of patients who have sustained a concussion are headaches, blurring of words, eye strain, as well as “losing one’s place while reading”.

Only 43% of athletes are aware of sports related concussions and less than half of athletes understand the potential problems associated with them. Twenty-eight percent of athletes continued to play after a blow to the head that caused dizziness alluding to the pressures athletes face from coaches, parents or teammates to continue playing, as well as personal desire. If an individual sustains head trauma post-concussion before recovery, there may be complications, including brain herniation and compression, which can cause coma and death.

It is imperative that concussion is accurately identified when an athlete sustains a head injury. Ideally, this would be done by a medical doctor by using digital imaging and other neurological exams. However, most youth athletic teams do not have medical doctors, highlighting the need to implement a program to educate parents and coaches to perform testing on the sidelines.

Testing

In the event where an athlete obtains a head injury, it is vitally important to screen for a concussion to determine if immediate medical aid is necessary regardless of any reporting from the athlete. There have been many protocols and tests developed that can be done in a clinical setting, computer lab, or even the sidelines during sporting events. These tests include the King-Devick (K-D) Test and the ImPACT test.

The K-D Test can be performed on the sidelines if an athlete experiences a head injury. This test examines attention, concentration, speech and language abnormalities, ocular movements, and other brain pathways. Administering the test takes less than two minutes and involves the athlete reciting a series of numbers from four plates as fast and accurately as possible. Times recorded post-injury are compared to normal times determined for that age group.

The K-D Test only tests saccadic eye movements and does not evaluate other areas of oculomotor function such as “pursuit, convergence, or accommodation, all of which have been implicated in mild traumatic brain injury”. The K-D Test is designed so that it can be administered by anyone.

The ImPACT test is performed at a computer lab in the preseason, post-injury, and postseason. Diagnostic test questions are designed to elicit feedback regarding the athlete’s memory, attention, and other brain pathways specifically related to their attention, memory, verbal recognition, visual working memory, response processing speed, reaction time, and impulse control. This test has been shown to have a sensitivity of 82%, a specificity of 89%, and an overall correct classification rate of 85%.

Out of the parents and coaches interviewed 83.5% had no concussion training. The majority of responses (96%) indicated that concussion training needs to be improved as well as increasing the awareness about the impacts of a concussion (Table 2). The most common answer from parents and coaches was to return to athletes to the game after one or two weeks. 31.5% thought athletes should be returned to the game after one week, 30% responded after two weeks, 27% responded after three or more weeks. The least popular responses to return to play were after three to five days (11%) and no one thought the athletes should return within one to two days of the initial injury.

Results

The results of the survey confirm that there is a lack of thorough understanding of concussions in adolescent athletes. The responses indicate that parents and coaches have not had appropriate training in concussion management. There is a need for improvement in concussion awareness as responses were incorrect for the amount of time an athlete should be required to sit out before they can safely return to the game. A recent study by Huran and colleagues (2015) has validated our data. It was found that 42% of concussive injuries from organized sports were not managed according to recommended guidelines. Even though the majority of parents and coaches indicated that they have never had any concussion training, they still believe they can recognize the signs of a concussion. To avoid any discrepancies in the initial diagnosis of the athletes’ head injury, a standardized protocol needs to be established.

Sports are risk factors for concussions and based on our findings it is evident that there is a lack of awareness of their signs and symptoms. Sports clubs and school boards should be required to implement mandatory concussion training and policies.

Conclusion

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Introduction

It is well known that exposure to visible UV (UV) radiation can cause eye disorders and skin cancer. A strong motivator for tanning bed use is to increase physical appearance and to prevent age-related skin damage. While some tanning bed users may be motivated by the desire to increase their physical appearance, others may use tanning beds to prevent the effects of sunlight on their skin. Therefore, it is important to understand the potential risks associated with tanning bed use.

Excessive UV radiation can cause irreversible damage to the eye. Damage can either be short-term or long-term. Short-term effects include photosensitivity, conjunctival hyperemia, and photokeratitis (sunburn of the eye). Long-term effects include cataract formation and skin cancer. Cataracts involve long-term damage of the eye from UV exposure. Pterygia are fibrovascular growths on the conjunctiva due to excessive UV exposure. They can grow and cause discomfort, pain, and vision loss. Both pterygium and conjunctiva problems are similar to sunburn on the eye. Symptoms include pain, discomfort, and vision loss.

These are a few examples of current FDA approved methods of preventing eye damage. The FDA regulates the labeling and facilities and devices are state determined. The Massachusetts State Public Health Law Section 209 requires that tanning facilities provide every customer with a written statement of warning and post the warning in any area that tanning device is used. The warning statement is shown in Figure 1. Every time a new customer uses a tanning facility an employee must ensure that the customer signs a written statement that acknowledges they have read this warning. Section 210 states that tanning facilities must have an employee present during all operating hours to assist customers with proper use of the tanning device. This includes providing protective eye wear and ensuring that no person shall use a tanning device without protective eyewear. These regulations were designed to reduce the prevalence of youth tanning facility usage and in consequence limit the detrimental effects UV exposure has on the eyes. It is the responsibility of tanning facilities to follow the regulations regardless of customer satisfaction.

Results

The survey conducted found that many of these laws are not being followed by tanning facilities in the Boston area. 29.4% of the tanning facilities do not provide customers with a written statement of warning. The incidence of UV exposure and the use of the tanning facilities is not protected by the warning visible near all tanning devices. When asked if the tanning facilities require that all customers wear eye protection while tanning, 70.8% responded yes. However, when asked if they actually require a customer to wear protective eyewear, only 29.4% said yes. This indicates that the tanning facilities do not strictly enforce the regulations. The only regulations that tanning facilities were in regulation with is not allowing people under 14 to use. If these laws were being properly obeyed there would be a decrease in the incidence of preventable eye disorders. It is important for the states to enforce these laws so that all customers are obeying all the regulations. This is a concern because there is the possibility that customers are not wearing the correct eyewear in order to prevent avoidable ocular damage. The tanning facilities are failing to do this.

A larger public health study, Enforcement of State Indoor Tanning Laws in the United States, was conducted to evaluate the compliance of tanning safety regulations in 28 states using representative cities. It was found that 32% of the cities did not impact tanning facilities for the compliance. Another 32% performed inspections less than annually. Just under half of the cities that did perform inspections penalized noncompliance.

We propose that there needs to be stricter enforcement of the state regulations at the tanning facilities. The state should penalize the facilities more closely and have a larger financial penalty if the laws are not being followed. Section 211 states that the board of health, local health agent, or department shall have access at all reasonable times to any tanning facility for the purpose of inspecting said facility. Section 214 dictates that facilities in violation of any of the regulations will receive a fine between $200 and $2,000 depending on the extent of the violation. However, it is apparent that these inspections and fines are not being utilized to their fullest potential. We suggest that the frequency of unannounced inspections should be increased. Additionally, inspections should be performed undercover.

As demonstrated by the first and fast questions of the survey, tanning facility employees will say they follow regulations unless caught off guard. If tanning facilities are found to be in violation of the regulations, fines should be more severe. Repeated offenses should be penalized more heavily. For these reasons, the state should increase the consequences of noncompliance. This will greatly reduce the frequency of preventable eye damage.

Discussion

Methods

An IRB approved survey was given to 32 tanning facilities in and around the Boston area. These salons were selected randomly and the responses were recorded anonymously. Participants were called over the phone and the experimenter was not aware of which salon contained the participant. The salons were selected randomly and the responses were recorded anonymously. An IRB approved survey was given to 32 tanning facilities in and around the Boston area. The facility names were selected randomly and the responses were recorded anonymously. Participants were called over the phone and the experimenter was not aware of which salon contained the participant. The salons were selected randomly and the responses were recorded anonymously. These were a few examples of current FDA approved methods of preventing eye damage.
Responses were obtained from 34 community health centers across the United States in both quantitative and qualitative format. As these questions were underscoring for specifically, descriptive responses dominate results in qualitative format. Findings of the survey were used to report the latest numbers of patient encounters per center to help in the assessment of the number of patient encounters, the percentage of diabetic patients at each center also obtained. The percentage of diabetic patients was expanded to include 21%, while the average percentage of diabetic patients was 18%. Of the 23 centers responding to the funding question, 78% felt vision services were available at health centers prior to receiving Expansion Services funding, 35 responses were obtained. Of these 33 centers surveyed, 22 centers did not have vision services prior to funding (67%) and 11 centers (33%) did have vision services. Of centers plans to utilize the funding, there were a variety of responses. The majority of responses included funding being used for new ophthalmic equipment (47%), hiring an optometrist (42%), purchasing an optical shop (38%), and mixed (24%).

"Why did you want a vision care clinic?" Community health centers explained their need for wanting a clinic to meet the demand of their patients and provide complete care, including responses that expressed the existence of a significant diabetic population that was in need of eye care. If offering vision services, it was then inquired whether or not the center would require a second location for the vision services. 21 centers responded in favor of this option, including 15 (71%) that would require a second location for vision services. Of the 23 centers responding to the funding question, 60% felt vision services would be included in the definition of primary care. Lastly, an open-ended opinion question was asked of representatives, asking if they believed vision services should be included in the definition of primary care. Of the 32 representatives that were asked the question and answered, all expressed that vision services should be included in primary care.

In summary, Expansion Services funding has proven beneficial to meet the needs of the community; however, several centers expressed the funding they received was not enough to meet the demand of services. Lastly, an open-ended opinion question was asked of representatives, asking if they believed vision services should be included in the definition of primary care. Of the 32 representatives that were asked the question and answered, all expressed that vision services should be included in primary care.

The expansion of vision and eye care services in community health centers has become dependent on additional funding beyond standard federal funding for expansion of services. Often these vision problems do not have early warning signs, but can be detected by an eye care professional through comprehensive eye exams. In the 23 centers responding to the vision services question, the majority of centers (69%) had a significant diabetic population that was in need of eye care services. Of the 23 centers responding to the funding question, 78% felt vision services were available at health centers prior to receiving Expansion Services funding, 35 responses were obtained. Of these 33 centers surveyed, 22 centers did not have vision services prior to funding (67%) and 11 centers (33%) did have vision services. Of centers plans to utilize the funding, there were a variety of responses. The majority of responses included funding being used for new ophthalmic equipment (47%), hiring an optometrist (42%), purchasing an optical shop (38%), and mixed (24%).

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The objective of this project is to soak contact lenses in different colored food coloring as an alternative to prescription colored contact lenses. Vanessa Winans, a blogger of current styles, states that tinting contact lenses with food coloring “seems to be a great idea if the lenses, wear them to school and rake in the compliments.” While these compliments may be flattering, they are also short-term; the ocular consequences, on the other hand, are not. The American Optometric Association has issued an alert to its members after getting reports that many high school students, in the Midwest specifically, are dying their contact lenses with food coloring. The association officials warn that this practice can be dangerous and lethal to one’s ocular safety. Several allergic reactions, impaired vision, irritation and chronic eye infections are among the many repercussions of contact lenses tinted with food dye.

Simply searching for “food color tinted contact lenses” in Google presents with over 36,000 threads—a shockingly high result for such an unwanted and unsafe procedure. Optometrists concur that this trend can cause severe, long-term side effects, and research is being conducted on the interaction between these dyed contact lenses and the eye. Current research has shown that burning, grittiness, and irritation are common symptoms among those who wear these homemade tinted lenses. Opticians claim that this trend is equally prevalent among males and females, and stems from sci-fi movies and television. The desire behind it is the motivation behind it. Many sources say that teens are constantly exposed and influenced by the media. Vanessa Winans, a blogger of current styles, states that dyeing your contact lenses is as simple as “My friend (a) had it in his eyes so I decided to try it and see if it looked cool and if my friends liked it. I thought it was really cool.” In effect listing the color additive for such specific use. Contact lenses are approved before they can be used in food, drugs, cosmetics, or in medical devices that come in contact with the bodies of people for a significant period of time. The Food and Drug Cosmetic (FDC) Act states that devices containing a color additive are considered unsafe unless there is a regulation in effect listing the color additive for such specific use. Contact lenses are not cosmetics or over-the-counter merchandise, they are medical devices regulated by the FDA. They are meticulously researched and designed by large companies and carefully filled by an eye doctor. Contact lenses are medical devices and personal alterations can cause serious damage, including scratches on the cornea, corneal infections, conjunctivitis (pink eye), decreased vision or even blindness.

Of the various fashion statements that are popular today, tinting contact lenses with food dye is a growing trend among the teenage population. An increasing number of teenagers are dying their regular prescription contact lenses with food coloring as an alternative to prescription colored contact lenses. Vanessa Winans, a blogger of current styles, states that tinting contact lenses with food coloring “seems to be a great idea if the lenses, wear them to school and rake in the compliments.” While these compliments may be flattering, they are also short-term; the ocular consequences, on the other hand, are not.

The pH value of the tear film layer ranges from 7.0 to 8.5. Consequently, the color additive that contact in contact with conjunctiva or cornea should ideally be between 6.0 and 8.5 to ensure ocular comfort. On average, most saline solutions used to take care of contact lenses have a pH value of 7.18. McCormick food coloring contains propylene glycol as an active ingredient. According to a leadingrophic plastic manufactoring company, exposure to propylene glycol in one’s eye can cause irritation and may require medical attention. According to their protocol, contact with propylene glycol should be immediately flushed with the eyes with water. It can also aggravate pre-existing ocular diseases. Propylparaben is another ingredient found in McCormick food coloring and serves as a preservative as well as an eye irritant as it has a pH value of 4.5. If an individual experiences direct contact with either of the two active ingredients in food coloring in their eyes, immediate medical attention is necessary. The function of saline solution in contact lenses is to manage the structural integrity of the lenses while also serving as a tear environment for them. By replacing saline solution with food coloring, individuals compromise the sterility as well as the pH of these contact lenses. McCormick’s food coloring is relatively acidic in nature and this transposes the normal pH balance of the eye. By infusing these contact lenses in dye, structural changes were noted. The most notable changes were observed at the edges of the lenses. Over the span of 3 weeks, the food color tinted contact lenses became rigid at the edges; however, the dye was evenly distributed, which could result in a distorted vision because the contact lens would act as a color filter for the wearer.

3) Does the color fade throughout the day? Yes, often the color will fade throughout the day or the color of the contact will change slightly. Mostly this happens in the center part of the contact.

4) Do you wear the colored lenses for more than one day? I did not wear the colored lenses for more than a day. I felt like twelve hours was even a bit too long to wear them just because I didn’t want the dye to come out in my eye or even risk hurting my eyes.

5) Have you had an eye exam since trying this, and if so has your eye doctor noticed any change in your eye health? I did actually have an eye exam after wearing the contacts and the eye doctor presumably did not notice any change in my eye.

6) If you claim to not have any problems with your homemade colored contact lenses, reactions can differ on an individual basis. Her interviewee leaves room for speculation in regards to the severity of this practice on one’s ocular health.

Discussion – Continued

Reference:

References

DO OR DYE: The Effects of Food Coloring on Contact Lenses & Ocular Health


New England College of Optometry

Introduction

Methods

Results – Continued

Results

Discussion

References

Figure 1. Jixi Jones wearing her homemade colored contacts.

Figure 2. PH of McCormick Food Coloring: red, yellow, green and blue.

Figure 3. The figure above demonstrates contact lenses that have been soaking for 2 days and 3 weeks.

Figure 4. Corneal consequences of using contacts dyed food coloring; a) Corneal ulcer b) Corneal abrasion.

Figure 5. Comparison of using contacts dyed food coloring, a) Color additive b) Contact additive
Is Google Glass an Effective Teaching Tool for Indirect Ophthalmoscopy?

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Purpose
To evaluate the feasibility and efficacy of using the Google Glass Indirect Ophthalmoscope as a teaching tool.

Introduction
Binocular indirect ophthalmoscopy is currently taught in a clinical laboratory setting, while instructors visualize a student’s performance using a teaching mirror placed on the front surface of the indirect binocular ophthalmoscope. So far, instructors have not been able to provide students with real-time visual feedback regarding their focus of the retina or other ocular structures they are trying to examine. Presently, the only real-time feedback given by instructors is verbal. Motivations to use more visual and technological approaches in clinical training include:
1. Change in health care delivery.
2. Worldwide attention focused on the problem of medical errors and the need to improve patient safety.
3. Desire to shift to outcomes-based education with more stringent requirements for assessment and demonstration of clinical competence.

Specifications
The Google Glass Indirect Ophthalmoscope, recently described by Wang et al, is an alternative, lightweight, approach to the traditional binocular indirect ophthalmoscope. It was modified for use as an indirect ophthalmoscope by attaching a small keychain LED light to the Google Glass with velcro (Figure 1). The display of Google Glass also includes a small camera that is capable of providing a video feed, via Bluetooth, to a separate electronic device, such as an iPad. The instructor is then able to view the same fundus image as the student, in real-time, using the Google Glass Indirect Ophthalmoscope. Additionally, using video editing applications available on the iPad, the instructor can identify ocular structures that the student may have misinterpreted or overlooked.

Methods
This was a cross-sectional pilot study investigating the effect of using Google Glass as a teaching tool to refine students’ indirect ophthalmoscopy skills. Thirteen student participants were divided into two groups. Six subjects were dilated and sat as patients for the participants. Three clinical instructors also participated in order to evaluate the efficacy of Google Glass as a teaching tool.

1. The first group conducted indirect ophthalmoscopy with a traditional binocular indirect ophthalmoscope. Their performance was evaluated using a teaching mirror placed on the front of the ophthalmoscope, and they received verbal feedback from clinical instructors regarding their performance.
2. The second group conducted ophthalmoscopy with the Google Glass Indirect Ophthalmoscope, and received video-based feedback in addition to verbal feedback from clinical instructors.

Results
Participants' evaluation of Google Glass as an indirect ophthalmoscope teaching tool

Participant evaluation questions:
1. How would you rate the comfort level (weight on face, ease of use) of the Google Glass indirect ophthalmoscope?
2. How would you rate the ease of use of the Google Glass indirect ophthalmoscope as compared to other indirect ophthalmoscopy devices?
3. How beneficial would the ability to look back at previous exams be in learning how to perform indirect ophthalmoscopy?
4. How helpful would real-time verbal feedback from the instructor be in gaining a better understanding of indirect ophthalmoscopy techniques?
5. How useful overall would the Google Glass indirect ophthalmoscope be as a teaching tool to your learning experience?

Discussion
Google Glass as an indirect ophthalmoscope device shows a lot of promise, however some fine-tuning is required with regard to device specifications, software, along with training programs for use. Overall, both participants and instructors found strong utility in using the Google Glass device.

Conclusions
- Participants would have preferred that the Google Glass screen and camera be interchangeable between both sides of the device.
- Video software was adequate, but having a real-time two-way interface with a professor using a tablet would be ideal.
- Stable internet connection is required to maintain fluid video quality.
- Battery life could be improved, as it only holds charge for approximately one and a half hours of continuous use.
- Device tends to overheat when used continuously, creating a large lag time.
- A built-in light would be preferable to an attached light source, adding a degree of standardization.

The idea of Google Glass as an indirect ophthalmoscope was appealing to both participants and instructors, but both parties agreed that an adaptation period was necessary. Instructors found that students with better traditional BIO skills performed better when using the Google Glass, and adapted more quickly to the new technology.

References

Acknowledgements
A special thanks to:
Dr. Daniel Bastian, FAAO
Dr. Diane Russo, OD
Dr. Clifford Scott, OD, MPH
**The Prevalence and Health Consequences of “Beezing”**

Chuang, B., Deeley, M., Tran, S., Tu, B., Wong, K., Yu, W.
New England College of Optometry, Boston, MA

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**Introduction**

Beezing is a viral trend that started in 2019 which consists of applying Burt’s Bees lip balm on the upper and lower eyelids to get a brief heightened numb sensation. It was thought to be common among teenagers but has now been found to be known among various young people. The tingling sensation is created from the peppermint oil and menthol which are commonly used in Burt’s Bees as well as other brands of lip balm. Other uses of beezing include enjoying wine like a ninja.

The purpose of this project is to raise awareness and to prevent this trend as beeze are commonly used in Burt’s Bees as well as other brands of lip balm. Other uses of beeze are thought to be common among teenagers but have now been found to be known among various young people. The tingling sensation is created from the peppermint oil and menthol which are commonly used in Burt’s Bees as well as other brands of lip balm. Other uses of beeze include enjoying wine like a ninja.

---

**Potential Complications**

Peppermint oil and menthol have been found induce麻刺, but there are some mild side effects associated with direct contact of the balm with the eyelids. Some side effects are red eye, inflammation of the eyelids, and irritation.

Herpes Simplex Virus-1 can result in infection of the cornea superficially, resulting in epithelial keratitis. In severe cases, it can infect deeper layers of the cornea and cause stromal keratitis, which can eventually lead to corneal scarring and reduce vision.

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**Survey Methods**

Our group conducted a survey to look into the prevalence of beeze. While beeze is known to be more popular amongst those in high schools and college, the bulk of our responses came from gradate students and full time workers. It is the nature of those who responded to the survey. As such, it should be noted that this data may lead to an underestimation of the prevalence of beeze in the community. The survey garned 268 responses. Of the 268 responses, 75% of the responses came from graduate school students or people done with school. It should also be noted that many more responses stated that the survey is taken by men (65.3%) as compared to women, 34.7% of respondents were women, which may also have skewed the accuracy of our data as well. The survey was opened to anyone to respond to, although a push for more high school student responses was attempted unsuccessfully.

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**Survey Results**

Of the 268 people surveyed, 18% of people have heard of beeze prior to having taken the survey. While it is 18% of people who have heard of it, 27% of them have tried it themselves, while 38% of those with knowledge of beeze know someone who has tried it.

---

**Intervention**

Surveys

From the data collected in our surveys, it seems that the practice of beezing does occur. Since the data was gathered from a wide database, such as from online, targeting several schools in different parts of the U.S. could better determine the prevalence of this type of practice.

While it could provide valuable information, it would be difficult to distribute the surveys as the surveys must go through a strict administrative protocol.

School Nurse Pamphlets

Pamphlets can be provided to the school nurse discussing the risks and consequences of beeze. Pamphlets will educate nurses on the existence of such types of practices.

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**Discussion/Conclusions**

Based on the results from our survey, we have concluded that beezing is not as prevalent nor as much of a health concern as we previously hypothesized. Unfortunately, our survey garnered responses from the graduate and post graduate population, as opposed to the high school and undergraduate populations which seems common among teenagers. In the future, the prevalence of beeze within each individual population group can be surveyed to give a more accurate representation of the prevalence of beeze. Surveys could be targeted more towards middle schools and high schools, where it seems to be more a more popular trend. Many of the people who did answer our survey were those who have not heard of such practices.

Since this is a new trend, there has not been any research on the topic or documentation of acute infection from the sharing of lip balm. The infections presented in the complications section are references based on highly contagious bacteria and viruses that are common to the eye and mouth. After the survey was conducted, which correlated with reported symptoms online, eye irritation and redness is the most common complication of beeze. This is not a serious complication, and it can resolve on its own but does have the potential to make the person very uncomfortable. Overall, beeze is relatively safe if one is using their own lip balm, but there is always a risk of spreading infection when people share products.

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**References**


Mycopia, commonly known as nearsightedness, is a refractive condition in which constricted light fociates in front of the retina resulting in a blurred image. Since 1972, the prevalence of myopia has increased 66 percent in youth and adults aged between 12-54.10 The increasing prevalence myopia has shown to have social, educational, and economical impact.1 Therefore, determining the preventative risk factors for myopic shift is of great interest. There are many risk factors for myopia, including genetics and difference in axial length. An increase in the amount of near work has been shown to cause a myopic shift, and there are current studies looking at possible associations between prolonged near work and the use of electronics.2 With our society shifting from the use of print to electronics, younger generations rely more heavily on handheld devices such as smartphones and tablets that have a reading distance much closer than that of text printed on paper.1 Even schools are experiencing this shift as they transition from paper to electronic notes. Within this context, this project aims to identify the relationship between different types of media used for near work on the amount of myopic shift. We hypothesize a greater myopic shift with greater use of electronics compared to the use of paper.

Introduction

To determine whether reading on electronic media or print media has a greater correlation with the incidence of myopic shifts in optometry students from the U.S., Puerto Rico, and Canada.

Methods

A cross-sectional study was conducted on 190 optometry students (n=190) throughout the U.S., Puerto Rico, and Canada. The study consisted of a 13 question survey developed by six first-year optometry students at the New England College of Optometry (NECO) and submitted to and approved by the Institutional Review Board. It was then formatted using Google Forms and distributed through the means of social networks (i.e. Facebook) and optometry school email systems to be completed anonymously. The questions asked included general demographic information, visual acuity changes, refractive errors, and time spent reading in general, on electronic media, and on print. Of the responses received, 96 were from students at NECO and 94 were from other optometry schools. This data was analyzed with Microsoft Excel.

Discussion – con’t

Some studies have shown that as the population becomes increasingly more educated, there is a corresponding rise in the prevalence of myopia.9 From our survey of 190 optometry students, only 23 reported no refractive change and 17 reported hyperopia, whereas 152 optometry students, or 78.95% of the optometry students surveyed, reported myopia. Other research has provided strong evidence that attaining higher education is associated with the prevalence and progression of myopia.2 Some of our results were consistent with other studies as 46.67% of the subjects reported change in refractive error regardless of the amount of hours time spent reading on an electronic device. Although this is not what we predicted, this finding is consistent with other studies, which found no correlation between electronic screen use and the development of myopia.4 However, our findings that electronic devices have little correlation with myopia progression is supported by Kinge et al’s findings that the working distance when reading on computers is greater than the working distance of reading printed material.

Contrary to our hypothesis, but consistent with certain existing studies, no correlation was observed between electronic device use and increasing severity of myopia. Still, the issue warrants further studies. For instance, a school administration may provide tablets and laptops and distribute electronic notes. In light of our results, we suggest that students utilize more electronic than print media when reading or studying. In addition, we would remind the students on the importance of increasing the working distance, and suggest that students utilize their print and electronic media farther away while reading or studying.

Acknowledgments

We would like to thank Dr. Weissberg and Dr. Chu for their guidance in helping us refine our project.
Light Toxicity During Eye Exams

V. Huynh, G. Lin, A. Magbanua, A. Quach, B. Umaphathisivam, D. Veneziano
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Introduction

Exposure to light has long been understood to cause some form of retinal damage. While there exists mechanisms whereby the eye can protect itself, it is important to understand light can still penetrate and that the eye is not entirely resistant to its effect. Three mechanisms by which light damage can happen to the retina are as follows: thermal, mechanical, and photochemical.

Thermal Damage

Occurs from the denaturation of proteins when temperature increases and photons are absorbed in the retinal pigment epithelium (RPE). Light consisting of short wavelength yields greater kinetic energy and greater temperatures as it relates to a given exposure time. Thermal exposure duration is typically between 0.1 and 1.0 seconds. As temperature in the retina is raised by at least 10° C, irreversible retinal damage such as cell death may occur.

Mechanical Damage

Describes injuries sustained when there is a compression or force against the RPE. How severe the damage is depends on the rate of force delivery and the amount of energy absorbed. High irradiance (power delivered to the retina) between nanoseconds and picoseconds produce shock waves that cause physical disruption of tissue.

Photochemical Damage

Due to long exposure to bright illumination. This retinal injury is typically found for wavelengths below 600 nm exposed for more than 1 second where irradiance is too low to effect temperature.

ANSI

The American National Standard Institute (ANSI) established a user standard for Long-Term Exposure Limits known as ANSI Z 136.1. The maximum permissible exposure (MPE) limit is 2.92 J/cm². Other studies have found the safe maximum duration is typically found for wavelengths below 600 nm exposed for more than 1 second where irradiance is too low to effect temperature.

Purpose

To quantify total light exposure during a standard comprehensive eye exam in relation to ANSI Z 136.1 standard and to determine the potential of patients receiving light-induced retinal damage during the exam.

Methods

- Data was collected from 11 patient eye exams
- The 4 participating optometrists agreed not to make changes to their normal patient exam routine, so as to accurately time light exposure of a “typical” eye exam
- The amount of light exposure to each patient was measured in seconds during the following procedures:
  1. entrance tests: retinoscopy, ophthalmoscopy, pupils, extra ocular movements (EOMs)
  2. slit lamp biomicroscopy
  3. slit lamp with 90 D lens
  4. binocular indirect ophthalmoscopy (BIO)

Notes:

- Not all listed procedures were performed for every patient
- Contact lens exam patients were exposed to a longer duration of light exposure

Results

Table 1 and Figure 1 illustrate the average light exposure times of optometric procedures conducted by practicing optometrists compared to the MPE time standards set by ANSI Z 136.1. The MPEs were derived from previous studies comparing multiple slit lamps and BIO lamps. The average time exposure values measured for this study closely resemble what is used in real-time eye exams.

Discussions

A typical eye exam includes ophthalmic devices that bring light into the eye to image the retina and perform diagnostic tests. However, the retina can experience light damage through thermal, mechanical and photochemical forms if safe times are exceeded when performing such tests. This is calculated through the MPE time, which considers other factors influencing the total energy delivered to the retina such as intensity, wavelength, working distance, and retinal area exposed.

Based on our collected data, the majority of practicing eye care professionals that were observed follow techniques below MPE limits. Although a majority of experienced clinicians do not exceed the safe time when examining patients, there exists situations where safety duration times should continue to be recognized. MPE times should be made aware in a clinical teaching setting where light exposure is presented longer than necessary between inexperienced clinicians and students. Clinicians should especially be cautious for patients where there is possible intervention.

Based on our collected data, the majority of practicing eye care professionals that were observed follow techniques below MPE limits. Although a majority of experienced clinicians do not exceed the safe time when examining patients, there exists situations where safety duration times should continue to be recognized. MPE times should be made aware in a clinical teaching setting where light exposure is presented longer than necessary between inexperienced clinicians and students. Clinicians should especially be cautious for patients where there is possible intervention.

Conclusions

Possible Interventions

- Ultraviolet radiation filter in combination with a yellow filter, which prevents damaging blue light from reaching the retina, increases safe exposure time
- Lower light intensity will allow a longer MPE time
- Type of light, including the age and voltage of the bulb, will also affect the MPE time
- Supplements such as zeaxanthin, meso-zeaxanthin, and lutein to prevent against oxidative damage
- Awareness of the dangers of light exposure and the recommended standards to ensure an acceptable amount of retinal irradiance during a comprehensive eye exam

Acknowledgements

We would like to thank Dr. Gary Chu, Dr. Alan Lewis, Dr. Jameel Kanji, Dr. Bina Patel, Dr. Thomas Wong, Dr. Grace Wang, Dr. Nancy Coletta, and Dr. Thanasis Panorgias.

Table 1. Measured Exposure Times During Eye Exam Procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Measured Time (sec)</th>
<th>MPE Time (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slit Lamp</td>
<td>45.1 ± 9.3</td>
<td>18.53</td>
</tr>
<tr>
<td>BIO Lamp</td>
<td>42.6 ± 4.2</td>
<td>15.63</td>
</tr>
<tr>
<td>Direct Ophthalmoscope</td>
<td>100.7</td>
<td>42.6 ± 4.2</td>
</tr>
</tbody>
</table>

Figure 1. Comparison of Measured Light Exposure with MPE

Table 1 and Figure 1 illustrate the average light exposure times of optometric procedures conducted by practicing optometrists compared to the MPE time standards set by ANSI Z 136.1. The MPEs were derived from previous studies comparing multiple slit lamps and BIO lamps. The average time exposure values measured for this study closely resemble what is used in real-time eye exams.

Overall, the amount of light exposure during BIO with a 20D lens and slit lamp examination with 90D lens were close to MPE, while exposure from using the transilluminator and slit lamp were within the safe limits.

Discussions – continued

Possible Interventions

- Ultraviolet radiation filter in combination with a yellow filter, which prevents damaging blue light from reaching the retina, increases safe exposure time
- Lower light intensity will allow a longer MPE time
- Type of light, including the age and voltage of the bulb, will also affect the MPE time
- Supplements such as zeaxanthin, meso-zeaxanthin, and lutein to prevent against oxidative damage
- Awareness of the dangers of light exposure and the recommended standards to ensure an acceptable amount of retinal irradiance during a comprehensive eye exam

Conclusions

A typical eye exam includes ophthalmic devices that bring light into the eye to image the retina and perform diagnostic tests. However, the retina can experience light damage through thermal, mechanical and photochemical forms if safe times are exceeded when performing such tests. This is calculated through the MPE time, which considers other factors influencing the total energy delivered to the retina such as intensity, wavelength, working distance, and retinal area exposed.

Based on our collected data, the majority of practicing eye care professionals that were observed follow techniques below MPE limits. Although a majority of experienced clinicians do not exceed the safe time when examining patients, there exists situations where safety duration times should continue to be recognized. MPE times should be made aware in a clinical teaching setting where light exposure is presented longer than necessary between inexperienced clinicians and students. Clinicians should especially be cautious for patients where there is possible intervention.

Based on our collected data, the majority of practicing eye care professionals that were observed follow techniques below MPE limits. Although a majority of experienced clinicians do not exceed the safe time when examining patients, there exists situations where safety duration times should continue to be recognized. MPE times should be made aware in a clinical teaching setting where light exposure is presented longer than necessary between inexperienced clinicians and students. Clinicians should especially be cautious for patients where there is possible intervention.

Acknowledgements

We would like to thank Dr. Gary Chu, Dr. Alan Lewis, Dr. Jameel Kanji, Dr. Bina Patel, Dr. Thomas Wong, Dr. Grace Wang, Dr. Nancy Coletta, and Dr. Thanasis Panorgias.
Is Beauty Truly Timeless?

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Introduction

The Food and Drug Administration (FDA) does not legally obligate cosmetic companies to have warning labels or expiration dates on their products, however there are certain ingredients which are regulated as illegal imports. The FDA has recommendations and guidelines concerning usage of cosmetics. There are also set criteria for when a product may be held responsible for adulteration and misbranding, this is illustrated in the table below.

<table>
<thead>
<tr>
<th>Adulteration</th>
<th>Misbranding</th>
</tr>
</thead>
<tbody>
<tr>
<td>If any poisonous substance which</td>
<td>If labeling is false or misleading in particular</td>
</tr>
<tr>
<td>cause injuries to users under conditions of usage prescribed in the labeling</td>
<td></td>
</tr>
<tr>
<td>Cosmetic in whole or in part of any decomposed substance</td>
<td></td>
</tr>
<tr>
<td>In its container is composed in whole or in part of any poisonous substance which renders the content injurious to health</td>
<td></td>
</tr>
<tr>
<td>Its container is composed, in whole or in part, of any poisonous substance which the user is not able to destroy</td>
<td></td>
</tr>
<tr>
<td>Required information is not prominent and conspicuous</td>
<td></td>
</tr>
</tbody>
</table>

Results

• From past research projects the following statistics were derived. Kim et al. found that out of 140 subjects surveyed:
  - 64.91% have never checked the expiration date of makeup on packaging, even if present.
  - 41.2% of the participants were aware they were using expired eye cosmetics.

• Dhawan et al. reported:
  - 60% believed that their eyeliner should not be discarded before it runs out and
  - 43% have never checked the expiration date of their eye makeup.

• Bui et al. conveyed that of 103 participants:
  - 52% of the participants believed their eye cosmetics should be discarded even after they run out and
  - 47% of the participants believed that their eyeliner should not be discarded before it runs out.

• 25% of participants had no awareness of expiry dates.

• 20% of the participants purchased their mascaras in off-brand stores.

• 13% of the participants purchased their eye makeup online.

Results – cont’d

Eyeliner Expiration Date

- Liner
- Packaging
- Neither

Discussion

The FDA recommends that consumers should discard their eye cosmetics to avoid eye infections. It is suggested that after purchasing makeup the consumer should discard the product within two to four months. However, if the product is not stored correctly it is likely to expire before the two to four months and if the product is stored in the ideal conditions then it may not expire until after four months. For mascara in particular, the FDA advises that if it appears to become dry it should be disposed of. What is surprising is that the Federal Drug and Food Administration does not require manufacturers to include expiration dates of their cosmetic products on labels. This can significantly hurt the consumers purchasing the cosmetic products who do not know that prolonged usage of makeup has the potential to harbor bacteria which could lead to ocular disease formation or infection.

Based on previous research projects it is apparent that when purchasing eye cosmetics most consumers do not draw their attention to expiration information. When searching for new make-up products customers pay more attention to what the product has to offer rather than its shelf-life. The results show consumers do not replace their makeup frequently and will proceed to use the product until it is gone. It is probable that lack of awareness of harmful effects and the financial aspect both lead to the prolonged use of expired cosmetics.

The results of the researched cosmetics show that only one in four mascara brands have an expiration date on the product bottle, and one in five eyeliner brands print the expiration on the actual liner. The form of labeling these expiration dates was a small picture with months and years indicating after how many months of use the product expires. This is known as the period after opening (PAO). While 25% of mascara and eyeliner brands that were researched prior to the expiration date on the outer packaging and consumers typically discard this part in turn, they lose the expiration date, as it is not available on the product itself. Having a PAO or other visible expiration date on the mascara bottle or eyeliner would better inform and encourage consumers to abide by product expiration. One in five mascara brands included expiration information on both the outer packaging and the bottle itself. This allows two methods of communication to consumers; the expiration is visible during purchasing as well as when using the products.

Conclusions

From our research, we have found that there is a lack of consumer education about eye makeup in a prevalent issue. The duration of the make-up effects to the probability of developing an eye infection will increase or decrease. By replacing eye cosmetics based on their expiration date customers would decrease their risk of developing an eye infection caused by improper usage of eye makeup. It would be in the consumers’ best interest for the FDA and the cosmetic industry to work together in providing appropriate labeling and education to ensure minimal ocular problems.

References


Contact lenses are a revolutionary way to improve vision because they are medically approved and provide convenience with various daily activities. Although contact lenses provide many benefits, if proper care is not followed, complications such as infections and inflammation of the cornea can occur. If not treated quickly and efficiently by an eye care professional, these infections could lead to permanent vision loss. Non-compliance refers to disregarding steps in the regimen. Generally, young adults are more likely to be non compliant with contact lens care due to their impulsive lifestyle and the environment they live in. These individuals tend to be enrolled in postsecondary education where their busy schedules are obstacles in maintaining compliance.

Contact lens compliance involves patients following guidelines approved and provided by eye care professionals and organizations. The standard of care, as stated by the American Optometric Association (AOA), includes many recommendations for contact lens wearers. Patients are recommended to:

- Wash and dry hands before inserting or removing contact lenses each time
- Clean contact lenses using approved solution by their eye care professional
- Clean and dry their case thoroughly after each use
- Replace contact lens cases approximately every three months

The Centers for Disease Control and Prevention (CDC) also recommends that patients should not sleep in contact lenses, unless prescribed by an eye doctor.

Methods

We developed an anonymous survey to evaluate contact lens hygiene compliance and methods of patient education during eye exams. However, poor habits may develop because of factors such as infrequent (i.e. once a year) patient visits and discrepancies with patient education. To ensure compliance outside of the optometrist’s office, the CDC uses posters displayed in highly visible areas such as public spaces and schools. Despite the CDC’s efforts, there is still a high prevalence of complications due to poor patient compliance demonstrating the use of these practices to be somewhat ineffective. Therefore, the purpose of our research was to examine contact lens hygiene compliance and evaluate other methods of patient education that could improve compliance among young adults.

Results

The survey was marketed for approximately one week and produced 180 responses from both the United States and Canada. Of the 180 responses, 78.3% of them were female and 21.7% were male. Most of the individuals who responded were between the ages of 21 – 25 (67.8% between 17-20 and 24.5% between 26-29). Graduate students or students at an undergraduate institution represented 85.4% of responses, and 14.5% were not currently enrolled in a university or college level program. 120 of the responses were contact lens wearers.

Soft contact lens wearers represented 95.83% of the responses. Four types of soft contact lenses were worn by participants: monthly contact lenses, biweekly contact lenses, daily contact lenses, or overnight contact lenses. The majority of responses (79.17%) indicated that people wore dailies or monthlies. The remainder (20.83%) wore hard contact lenses.

The majority of individuals (69.3%) change the solution in their contact lens case every time they take them out. Of the individuals who wash their contact lens case (61.3%), 32% indicated that they wash their contact lens case every day.

The majority of respondents (69.3%) indicated that they change the solution in their contact lens case every time they take them out. Of the individuals who wash their contact lens case (61.3%), 32% indicated that they wash their contact lens case every day.

Table 1. Do you wash your hands before you PUT IN your contact lenses?

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.67%</td>
<td>83.33%</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Do you wash your hands before you TAKE OUT your contact lenses?

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.17%</td>
<td>80.83%</td>
<td></td>
</tr>
</tbody>
</table>

Discussion

Survey responses support our hypothesis that young adults have less than adequate contact lens hygiene practices. Although many may believe that their current contact lens hygiene habits do not support their claim which emphasizes the disconnect we predicted. Fortunately, one-third of participants feel as though they could learn and know more. The CDC, AOA, and FDA should seize this opportunity and consider other educational methods other than those in place. We agree that talking to an eye care professional is the best method of initial, and continuing patient education; however, a more hands-on learning approach, via a visual demonstration or experiment, would markedly improve contact lens hygiene compliance.

“Education alone is not a sufficient strategy to improve behavior; newer approaches aimed at improving compliance with lens care practices are urgently needed.” Young adults can be difficult to reach, and change will most likely occur in this age group once serious complications arise. We believe a visual learning approach may provide a new, engaging, beneficial way. If we can successfully target young adults to improve contact lens hygiene compliance, we could potentially improve it for many generations to come.

Conclusion

Overall, our study showed that many young adults have poor contact lens compliance, even though they believe they are well educated. Young adults obtain the majority of information for proper contact lens care from an ophthalmologist; however, it was found that an alternative method (hands-on) would be beneficial to patients. This method could increase patient compliance, but this can only be determined with future studies.

References


Evaluating Contact Lens Hygiene Compliance and Methods of Patient Education in Young Adults

A. Ferreira, A. Muia, F. De Rubeis, H. Tennant, P. Yassa

New England College of Optometry, Boston, MA

Introduction

Contact lens care education is initially provided by optometrists during eye exams. However, poor habits may develop because of factors such as infrequent (i.e. once a year) patient visits and discrepancies with patient education. To ensure compliance outside of the optometrist’s office, the CDC uses posters displayed in highly visible areas such as public spaces and schools. Despite the CDC’s efforts, there is still a high prevalence of complications due to poor patient compliance demonstrating the use of these practices to be somewhat ineffective. Therefore, the purpose of our research was to examine contact lens hygiene compliance and evaluate other methods of patient education that could improve compliance among young adults.

Purpose

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Methods

We developed an anonymous survey to evaluate contact lens hygiene compliance and the most effective form of patient education to improve compliance in young adults. The survey was created using Google Forms and distributed online via various social media platforms and E-mail. The survey was intended to target young adults between the ages of 17 and 29 despite being open to the public to control for bias. The survey questions were developed based on CDC, AOA, and FDA contact lens hygiene standards. Survey questions were customized based on responses according to type of contact lens worn and other variables. The survey consisted of 25 multiple choice questions regarding:

- Demographics
- Vision correction
- Contact lenses
- Patient education of contact lens hygiene
- Least and most effective methods of patient education

Prior to distribution, the survey was approved by Dr. Paul White, chair of NECO’s Institutional Review Board. The survey was available for responses for approximately one week.
Eyes Behind Bars: Analyzing the Current Eye Care Systems in Correctional Facilities

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New England College of Optometry

**Introduction**

According to the Folsom Prison Study, “90% of inmates cannot read due to vision skills deficits.” The inmate population in U.S. correctional facilities today shows greater incidences of ophthalmic diseases, including diabetic retinopathy, glaucoma, and ocular trauma than the general population. With undiagnosed poor vision in childhood being linked to misbehavior and even potentially criminal activity, it is important that this issue is recognized and acted upon to prevent post-sentence assimilation problems for inmates due to ophthalmic physiological barriers.

**Methods**

In order to investigate the current standard of care for inmates in the United States and the implications of undiagnosed visual impairments and ocular conditions due to violations of these standards, pre-existing studies on inmates were examined. The Ophthalmology Guidance set forth by the Federal Bureau of Prisons was analyzed in conjunction with state and federal court cases that resulted from convicted inmates who claimed that their visual impairment was a byproduct of the correctional facilities’ negligence and denial of prompt vision care. The data was collected primarily from inmate populations within the U.S. However, there was a marked dearth of data on the quality and quantity of vision care provided to inmates in the U.S. Therefore, the data from these studies were compared with studies from the U.K., which provided greater insight into the prevalence of uncorrected refractive errors and ocular conditions in the U.K. correctional facility system.

**Results**

The data available regarding the United States correctional facilities and visual problems is limited. Many sources state that vision care in correctional facilities is not acceptable. However, no large cross-sectional studies or evidence support these statements. In 1976, the Supreme Court passed a ruling that health care provided to inmates must meet certain standards. It states that only inmates who are 65 years of age and over should have visual acuity testing annually, and making it clear that patients should have two good eyes whenever medically possible.

**Discussion**

To help address the problems with current correctional facility eye care systems, we propose the following changes: annual exams for everyone (not just those over 65), performing retinoscopy (as opposed to VA) upon initial screening (and thereafter) to prevent mistrust and varying results due to accommodation, mandating a fundus exam for diabetic patients, surgical intervention whenever necessary, and making it clear that patients should have two good eyes whenever medically possible.

As indicated by the lack of statistics in the U.S. correctional facilities regarding eye care, there is a clear need for additional studies. In order to do so on a limited budget, we propose focusing these studies amongst the U.S. optometry schools to provide the manpower necessary to obtain such a mass amount of information. We suggest modeling the study into the current statistics on inmate eye care standards and criminal behavior linked to vision problems, as well as amending the current eye care available to inmates, we hope to prevent repeated criminal behavior that potentially stems from undiagnosed ocular problems and to assist in the successful assimilation of inmates back into society.

**References**


Gardiner, E. (2014). Vision in correctional facilities: an attempt of the inmate to deceptively present a worsened visual acuity.4

Images: Eyes Behind Bars: Analyzing the Current Eye Care Systems in Correctional Facilities.

**Results - con’t**

St. Clair Correctional Facility: www.splcenter.org4

Comparison of VA in the prisoners (scales 1 black and control scales 2 purple graphics)

Conclusions

By exposing the current statistics on inmate eye care standards and criminal behavior linked to vision problems, as well as amending the current eye care available to inmates, we hope to prevent repeated criminal behavior that potentially stems from undiagnosed ocular problems and to assist in the successful assimilation of inmates back into society.
An objective of Healthy People 2020 is to increase the use of personal protective eyewear in children during recreational activities, as eye injuries are one of the leading causes of blindness in children1. According to the American Academy of Ophthalmology, approximately 100,000 eye injuries result from sports-related and recreational activities in the United States with 86% of these injuries requiring emergency room visits and involving children2. It is estimated that 90% of sports-related injuries are preventable through the use of proper protective eyewear. Currently, 84.6% of children do not wear protective eye wear in recreational sports3.

Overview of Protective Eyewear

Discussion

Injuries age 0-14

Sports related eye injuries are the leading cause of preventable blindness in children, and costs society $100-200 million per year. Nurturant percent of these injuries are preventable with the proper use of protective eyewear. Currently, Massachusetts requires children to wear polycarbonate lenses, however frames for dress eyewear are not impact resistant. The protective eyewear meeting ASTM standards shifts the impact from the ocular region to the skull without causing intracranial injury8. Ammonity exists within the sports community as many players and coaches have cited aesthetics, impaired vision, and even speculate an increase in head injuries due to impaired peripheral vision when wearing protective eyewear. With recent mandates requiring the use of protective eyewear in high risk sports, sentiments are beginning to change.

New Jersey is the only state to pass legislation mandating the use of protective eyewear in children, and costs society $100-200 million per year. Ninety percent of these injuries are preventable through the use of proper protective eyewear. Currently, 84.6% of children do not wear protective eye wear in recreational sports3.

The International Floorball Federation mandated protective eyewear in children under-14 years of age. The amount of eye injuries documented in 2002 totaled 11 injuries. In 2011, after the mandate was instituted, the amount of ocular injuries was decreased to just one8.

The National Federation of State High School Associations mandated the use of protective eyewear for field hockey players in 2011, the incidence of head and facial injuries were found to be significantly lower than non-mandated states. This study found no correlation with a higher rate of concussions or contact injuries as many previously believed. This suggests that there are no adverse effects on peripheral vision and performance. These recent mandates demonstrate the effectiveness and need for such measures to be imposed for children participating in all sports.

References

6. Baserunner - ASTM F910
7. Goalie: Full Face Mask
8. Youth Batter and Fielder – F803
UV radiation initiates the formation of reactive oxygen species such as superoxide radicals, hydrogen peroxides, and hydroxyl radicals. These free radicals oxidize lipids, proteins, and nucleic acids, which results in disruptions to the cell membranes, protein synthesis, and DNA. Ultimately, this leads to inflammation and tumor formation.

UV radiation from the sun consists of high-energy light that is harmful to the eye. UV rays can damage different structures of the eye such as corneal endothelium that leads to pathologies such as photokeratitis (snow blindness) and actinic keratopathy. It can also cause conjunctival disruptions to the cell membrane, protein synthesis, and DNA. Ultimately, this leads to inflammation and tumor formation.

There are three forms of UV radiation; UVA, UVB, and UVC. UVA and UVB are the main concern for damage as the atmosphere filters UVC. The different types of radiation pose different ocular threats. For example, UVB has the ability to cause greater harm, especially to the cornea and conjunctiva, but the atmosphere contains ten times more UVA that perforates the cornea and initiates ocular pathologies such as cataracts and AMD.2

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The Prevalence of Ocular Health Myths Among Pharmacists

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Introduction
Myths and misconceptions about healthcare are prevalent in society. In 1997 in Sao Paulo, Brazil, a survey exploring ocular health myths was conducted among 122 healthcare professionals at the University of Campinas Clinical Hospital. The research showed that 62.5% of individuals working in the ophthalmology department believed myths such as glasses being a cure for refractive error and watching television close to the apparatus being harmful to vision. This suggested hospital staff may be passing along misinformation to patients. Vision based myths and misconceptions scientifically evaluated within the United States or even more recently were not found. However, several websites have articles regarding vision myths, including news articles.1

With healthcare becoming increasingly commercialized and integrative amongst disciplines, it is important to be sure information being conveyed to patients are facts rather than these commonly believed myths. The prevalence of possible myths and misconceptions was surveyed amongst pharmacists in the United States. Pharmacists were studied because they tend to have a large amount of possible face time with patients who have recently visited a clinic or who may be avoiding clinical care. It has also been found that pharmacists tend to improve upon direct patient care, making them an important link in the healthcare system. Thus, in addition to myths pharmacists were asked about their interactions with patients regarding vision care. It is vital that patients receive information from the most factually knowledgeable providers available, so as to help prevent the spread of misinformation.

Purpose
To determine the level of interest in continuing education (CE) seminars based around vision health care, how often patients ask pharmacists vision health related questions, and to investigate pharmacists’ basic knowledge of eye care myths and misconceptions.

Methods
A survey containing 25 questions was distributed as a Google Form so that it could be sent across the country. The survey was approved by NECO’s Institutional Review Board (IRB), and, using an email account made specifically for this project to help keep anonymity, the survey was distributed to the 50 state pharmacy associations and the National Alliance of State Pharmacy Associations (NASPA). Several, but not all, state associations passed the survey onto their members via email and/or newsletters. Participants were kept anonymous through the online survey and participation was voluntary. Participants were able to complete the survey up until March 25, 2015.

Participating pharmacists were surveyed on how long they have been in practice, as well as if they have ever attended a vision health continuing education (CE) seminar. Participants were asked about how often they have a customer ask about eye- or vision-based issues, how often they recommend their customer see an eye doctor, and how often they recommend a product for the eyes/vision. A sliding scale was used to rate each question from 1 (never) to 5 (extremely common/daily).

Participants were asked whether they have attended a vision health continuing education (CE) seminar, and if they are interested in attending a vision health based CE seminar. Participants were asked about how often they have a customer ask about eye- or vision-based issues, how often they recommend their customer see an eye doctor, and how often they recommend a product for the eyes/vision. The remaining 17 questions were true or false statements developed from common vision health myths. Examples include: “Reading with insufficient lighting can damage,” and “Vitamin supplements, such as lutein & zeaxanthin drops, are used to prevent macular degeneration.”

The survey analysis was performed with Statistical Package for the Social Sciences (SPSS) software.

Results
A total of 36 pharmacists (n=36), licensed to practice in 21 different states, responded to the survey. Of these 36 participants, 17 were female and 19 male.

To determine the level of interest in continuing education (CE) seminars based around vision health care, how often patients ask pharmacists vision health related questions, and to investigate pharmacists’ basic knowledge of eye care myths and misconceptions.

Graph 1. Representation of the number of participating pharmacists who have ever attended a vision health seminar.

Graph 2. The percentage of pharmacists who have attended a vision health based continuing education seminar. A significantly large percentage (89%, p≤0.05) have never attended a CE seminar about vision health.

Graph 3. A significant percentage (92%, p≤0.05) indicated their interest in attending a CE seminar about vision health versus those who were not interested.

Graph 4. An analysis of the rate of vision health based services provided by the participating pharmacists.

Discussion
Pharmacists are clearly an important part of the healthcare team. Patients trust them regularly and respect their advice. Pharmacists are approached regularly for vision health care advice so it is important that they are able to relay factual information to their patients. As this survey found, there is uncertainty about many aspects of vision health. Addressing this knowledge gap via a vision health based, pharmacist focused CE seminar may be this most efficient way of educating the profession as most states require, on average, 15 hours of continuing education per year of their pharmacist’s career.1 There appears to be a demand and need for pharmacist focused vision health CE seminars. A vision health focused CE seminar would benefit them best by focusing on topics like contact lenses and contact lens care, common eye diseases that are believed to be curable or preventable with supplements, causes and treatments for dry eye, when contact lenses should be recommended to patients and their role within the healthcare team, and vision health changes with age. Developing a CE seminar would bridge gaps in vision health care for patients.

The data from this exploratory survey suggests a follow-up analysis with a larger participant pool would help to develop a nationwide CE seminar for pharmacists, health care professionals, and the public.

References
Diabetes

Diabetes mellitus is a group of chronic metabolic diseases that affects many people worldwide. Diabetes is the result of the body’s incapability of maintaining homeostasis of blood glucose levels, consequently leading to hyperglycemia. This rise in blood sugar can have severe consequences for nerve, kidney, and heart health, and even be life-threatening. This rise in blood sugar can be managed by diet, exercise, and insulin administration. However, the body’s incapability of maintaining homeostasis of blood glucose levels can lead to complications such as diabetic retinopathy, nephropathy, and neuropathy.

Glaucoma

Glaucoma is a progressive degenerative disease that is often associated with elevated intraocular pressure (IOP) levels. Often, this elevated IOP is due to either increased production of aqueous humor in the posterior chamber of the eye, or due to an increased resistance in the outflow pathway for this aqueous humor. A company called Senomyx has developed a contact lens device that is able to monitor IOP throughout the day and night. The product, called Triggery, monitors patient’s IOP by detecting changes in the curvature of the cornea. It then transmits this data to a device to save this information.

This type of technology would be extremely valuable for glaucoma patients and healthcare providers alike. In the case that an acute spike in IOP occurred, a patient would be able to reference their data immediately and take necessary steps to prevent an acute glaucomatous episode. For practitioners, the constant monitoring of data would enable them to know the IOP at different times of the day, and potentially determine a better management plan for the glucoses.

Cancer

Cancer is a condition that affects everyone eventually in some form or another. There are many different types of cancer, each with its own unique set of symptoms and treatments. Some of the most common types of cancer include breast, lung, colorectal, and prostate cancer. These types of cancer can be treated with surgery, chemotherapy, radiation therapy, and/or immunotherapy.

Heart Failure

Heart failure is a condition that affects millions of people worldwide. It occurs when the heart is unable to pump enough blood to meet the body’s needs. This can lead to a variety of symptoms, including shortness of breath, edema, and fatigue. Heart failure can be caused by a variety of factors, including hypertension, diabetes, and obesity.

Refractive Aid and Accommodation

Refractive aid and accommodation are two common conditions that can affect vision. Refractive aid can be caused by a variety of factors, including astigmatism, farsightedness, and nearsightedness. Accommodation is the process by which the eyes are able to focus on objects that are close by. This can be affected by a variety of factors, including age and the natural aging process.

Drug Delivery

Drug delivery is the process of getting a drug from a patient’s hand to their body. This can be done in a variety of ways, including orally, topically, and intravenously. Drug delivery is an important aspect of healthcare, as it is necessary to ensure that patients receive the correct dose of the correct drug at the correct time.

References


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5 Mansouri K, et al "Continuous 24-hour monitoring of intraocular pressure patterns with a contact lens sensor: safety, tolerability, and reproducibility in patients with glaucoma"


3044x75007 et al. (2013). A contact lens with integrated telecommunication circuit and sensors for wireless and continuous tear glucose monitoring. J. Micromech. Microeng. 22, 075007


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**Introduction**

Since their introduction to the U.S. market in 2007, e-cigarettes have become a popular alternative to smoking conventional tobacco cigarettes. There has been an increase in the minds of the common consumer that e-cigarettes are a safe means of smoking and in some cases even a cessation method of cigarette smoking. In a 2013 survey conducted by the Center for Disease Control (CDC) the most frequently reported reasons for initiating e-cigarette use were “to try something new” (64%) and “to quit/reduce cigarette use” (56%). Furthermore, due to the lack of FDA regulations on this particular form of vaporized smoking, there has been a lack of awareness of the harmful effects of e-cigarettes. This has contributed to the significant increase in the amount of e-cigarette users since 2007. The marketing aspect of e-cigarettes highlights the different flavors available to the consumer while regrettably informing of the several equally harmful effects that e-cigarettes have compared to conventional cigarettes. This has attracted old and new cigarette smokers alike, with an increased participation of the adolescent demographics. In the 2013 CDC survey, just over half of the participants listed e-cigarettes as a healthy alternative to smoking conventional cigarettes.1

** Purpose and Methods **

The purpose of this study is to highlight the lack of awareness of the harmful effects of e-cigarettes. We will compare the chemicals found in both cigarettes and e-cigarettes in order to assess the correlation between these chemicals and those that cause or increase the risk of certain ocular diseases. We will then introduce potential tactics and reform recommendations to public health policies that will aid in increasing awareness and reducing health complications.

This report utilized an online survey that addressed public awareness on topics including: the relative safety of e-cigarettes, personal vaporizers (PV’s), and other electronic nicotine delivery systems in comparison to cigarettes, examples of chemicals found both in cigarettes and e-cigarettes, and the correlation between smoking and the increased risk of developing ocular diseases. The survey was posted online through social media and the anonymity of the submissions protected.

**Ocular Manifestations**

<table>
<thead>
<tr>
<th>Chemical Description</th>
<th>Ocular Manifestation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicotine</td>
<td>Ischemia, AMD, AION, Ophthalmoplegia, Amnionitis Fugax</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>Carcinogen, Inflammation</td>
</tr>
<tr>
<td>Acrolein</td>
<td>AIO, AION, Anemia, Fugax</td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td>AIO, AION, Anemia, Fugax</td>
</tr>
<tr>
<td>Polycyclic Aromatic Hydrocarbons</td>
<td>Carcinogen/Mutagen, Cataracts, Inflammation</td>
</tr>
<tr>
<td>Nitrosamines</td>
<td>Carcinogen, N/A</td>
</tr>
<tr>
<td>Metals</td>
<td>Cadmium, Aluminum, Lead, and Mercury, Cataracts</td>
</tr>
</tbody>
</table>

E-cigarettes are composed of an atomizer, battery unit, and a cartridge which produces vapor that users inhale and exhale. Though the cartridge in e-cigarettes contains less nicotine than regular cigarettes, the actual intake of nicotine is similar in both forms. Conventional cigarette smoking has been linked to many ocular health related issues, and through recent studies on e-cigarettes it has been found that some of the toxic chemicals found in cigarette smoke can also be found in e-cigarette vapor including: nicotine, nitrosamines, formaldehyde, polycyclic aromatic hydrocarbons, and toxic metals. Some of the ocular health diseases previously linked to cigarette smoking include age-related macular degeneration (AMD), cataracts, dry eyes, and ocular inflammation. Studies have also shown ocular issues in children exposed to passive smoke, with increased instances of strabismus and allergic conjunctivitis in these children.2

**Ocular Manifestations Cont’d**

Nicotine is a vasoactive substance that causes vasoconstriction through the stimulation of α-adrenergic vascular receptors. Excessive vasoconstriction may lead to vasospasms that reduce the flow of oxygen to the eye. This induced ischemia to the eye may result in oxidative damage and act as a cause factor for age-related macular degeneration (AMD), anterior ischemic optic neuropathy (AION), ophthalmoplegia, amnionitis fugax, and cataracts.3

Acrolein is a toxic aldehyde that has been shown to impact the effectivity of RPE cells.4 The consequence of this is a reduction of macular pigment and increased oxidative stress which is a risk factor for AMD.5

Polycyclic aromatic hydrocarbons (PAHs) are organic multi-ringed aromatic hydrocarbons comprised of fused benzene rings arranged in various configurations.6 PAHs are classified as carcinogenic and mutagenic in various animal models, the degree to which is dose and structure dependent.7,8 PAH induced cataract formation may be associated with the formation of insoluble precipitates in the lens during PAH metabolism by certain cytochrome P450 enzymes.9

Heavy metals (cadmium, aluminum, lead, and mercury) are present both in the exhaled smoke of cigarettes and the expired vapor of e-cigarettes.10 These metals may accumulate in the lens of the eye, distort the coloration, and upset the balance between oxidants and antioxidants. These factors may accelerate the development of cataracts.10

**Survey Results**

Were you aware that the nicotine, heavy metals, and other carcinogenic ingredients contained in traditional tobacco products are also contained in the vapor produced by e-cigarettes?

- Yes: 67 43.5%
- No: 87 56.5%

Were you aware that tobacco and e-cigarette use affects your eye health and can lead to eye-related diseases?

- Yes: 38 24.7%
- No: 116 75.3%

After reading the above information, do you believe that being previously informed of the risks of e-cigarettes and other electronic nicotine-related vapor products would influence your decision to start or stop using them?

- Yes: 126 81.8%
- No: 28 18.2%

**Discussion**

Out of 155 responses, 65.9% have used either a traditional tobacco or an e-cigarette product in the past. Most people (56.5%) were not aware that (similar to what has been revealed) the same harmful ingredients (nicotine, heavy metals, and other carcinogens) found in traditional tobacco products and an even higher number (75.3%) were not aware that tobacco and e-cigarettes had ocular health manifestations. Based on the information provided in the survey, 81.8% stated that having this knowledge beforehand would have influenced their decision to use e-cigarettes or other nicotine-related vapor products.

These results demonstrate that, while most people did see e-cigarettes as somewhat harmful, awareness of the ocular manifestations of e-cigarettes is low. If education on this is presented (such as the survey), people may be less likely to use e-cigarettes. It becomes the duty of health-care providers to educate the general public on the dangers of an increasingly common product.

**Intervention Plan**

The FDA has not yet conducted conclusive studies illustrating the potential benefits and harms of e-cigarettes.2 As a result, the lack of federal regulation and claims of e-cigarettes being a smoking cessation aid are unsubstantiated.4 The lack of current FDA regulations makes it easy for minors to legally acquire e-cigarettes in 41 states.2

Intervention tactics should therefore target children and adolescents with the goal of raising awareness of the harmful effects shared by e-cigarettes and tobacco cigarette products. According to the CDC, “The percentage of U.S. middle and high school students who use electronic, or e-cigarettes, more than doubled between 2011 and 2012.”14 While cigarette use has been falling among adolescents, the popularity of e-cigarettes is rising. Educational posters should be hung up in schools and including e-cigarettes in health-related courses should be required.

In order to bring e-cigarettes under federal regulation, there needs to be a way to standardize studies of various brands on the market to provide concrete evidence on adverse health effects of vapor products. Comprehensive regulation will limit who can buy these products and include Surgeon General warnings on packaging. Successful anti-tobacco campaigns, such as the CDC’s Tips From Former Smokers and “truth”, could include e-cigarettes into their advertisements so that there is an existing platform that reaches a large audience.

**References**


Telemedicine: Bridging the Gap

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Introduction

For many patients, access to care incurs a substantial burden, which impacts quality of life. This is compounded by the burden of travel to healthcare providers, insurance requirements, provider information, and an increase in ocular disease prevalence due to aging of the American population. The number of Americans with glaucoma would jump from 7 million to 7.6 million within ten years, making glaucoma the second leading cause of blindness worldwide (Djalilian & Bloomen, 2008). The prevalence of age-related macular degeneration is expected to increase from the current 6.7 million people afflicted in the United States by 2050 (NIH 2003). Diabetes mellitus is one of the primary health concerns for people living in rural areas, and currently affects 26.3 million people in the United States, with rates being seventeen percent higher in rural areas (Massey et al., 2010). Additionally, those living in rural areas are at a greater risk of dying from cancer or heart disease, failing to schedule regular follow-up visits for continued care, the number of Americans with ocular diseases and visual impairment will continue to rise. The increasing prevalence of ocular disease and visual impairment make it more necessary to Bridge the gap between providers and patients who struggle to access care. Telemedicine could play a role in bridging this gap, having a huge potential to improve care for rural patients who are too distant from a low vision provider, who live far from a low vision provider, or have an Amsler Grid. The 2013 American Academy of Ophthalmology recommends that patients over the age of sixty-five who are found to be at risk of glaucoma should be screened every one to two years. The number of Americans with AMD is expected to double from the current 6.7 million (Age-Related Macular Degeneration, 2013). For IOP measurements, digital output can be obtained with Goldmann applanation tonometry (Icare, Helsinki, Finland).

Age-Related Macular Degeneration

The American Academy of Ophthalmology recommends that patients over the age of sixty-five who are found to be at risk of glaucoma should be screened every one to two years. The number of Americans with AMD is expected to double by 2020 (Age-Related Macular Degeneration, 2013). For IOP measurements, digital output can be obtained with Goldmann applanation tonometry (Icare, Helsinki, Finland).

Telematics: The Help of the Future

There are several methods for the remote examination of patients with glaucoma have been described in recent literature. Automated perimetry, corneal topography, as well as imaging of specific fundus areas and anterior segment microscopy all require specialized equipment. When tele-transmitted electronically, these outputs may be viewed remotely and used to direct and manage glaucoma (reviewed by Stanghellini et al., 2014). For IOP measurements, several devices have been proposed to be used for home-monitoring by patients (currently undergoing FDA trials in the United States) (Figure 1) (Chen et al., 2011). Once Disc and serve fiber layer imaging can be achieved using adaptive micropupils (Michelson et al., 2004). These images may be then transferred via the internet and viewed using a LCD display or a personal computer equipped with an amsler跨越式 detail stereo display (Ramirez et al., 2009). Corneal topography and tomography are available for remote assessment via the internet. Surface curvature may also be sent via internet and analyzed from afar (Strebland et al., 2014). Optical coherence tomography can be assessed for assessment of the anterior segment, and could potentially be used as a proxy test for gonioscopy in telemedicine (Strebland et al., 2014). For functional testing, automated perimetry examinations may be the most widely telemedicine functional test for the evaluation of glaucoma, although frequency doubling technology may provide an even more alternative in terms of ease and time required for use (Peretz et al., 2014).

Glucoma

Statistics show that increased use of telemedicine devices for such as the ForseeHome AMD device, has greatly benefited from the availability of high-speed internet and a standard computer with a face-to-face visit for diagnosis.

Applications for the Visually Impaired

While telemedicine can be used to monitor and manage disease progression, it also could have important applications for patients who experience visual impairment. Many studies have documented the efficacy of low vision rehabilitation in improving patient outcomes. Despite the potential benefits, people who have visual impairment experience distinct barriers to low vision rehabilitation utilization. To address this barrier, a telemedicine intervention that combines ophthalmic telemedicine and low vision rehabilitation services in a single visit was developed. A study involving a systematic review and meta-analysis (Schiffman 2006) concluded that telemedicine has the potential to help bridge the gap between eye care providers and patients who struggle to access eye care. Telemedicine has great potential to make eye care more accessible, but progress is needed in many fronts to ensure that patients who suffer from visual impairment, diabetes, age-related macular degeneration and glaucoma.

In conclusion, there is currently no best way to implement telemedicine to help improve the standard of care, but telemedicine has proven to be a promising tool for diagnosing and managing chronic diseases. Telemedicine has the potential to help those who suffer from vision impairment, diabetes, age-related macular degeneration and glaucoma. Further research is needed to enhance the effectiveness of telemonitoring for patients with visual impairment. Developing methods to provide remote vision follow-up care could enable providers to better see some of whether devices are being used properly in non-clinical, non-clinical, non-clinical, non-clinical, non-clinical.

Diabetes

There are several telemedicine options available for diabetes management. Consumer applications available include remote home test strips, blood glucose meter help line, email correspondence and videoteleconsulting. Self-monitoring options include personal glucose devices and insulin pumps. There are also Community Health Advisors (CHAs) individuals who are trained to deliver health information and facilitate health care access. Telephonic help line support consists of the device group and sixty-two percent in the control group. The results were even better for participants who used the device two or more times in a regular schedule, increasing the benefit of developing CVD benefit from the use of home monitoring devices.

Insulin pens can be very effective with proper training and knowledge and are regularly improved upon with recent advances including single-use, prefilled, disposable pens as well as reflective meter or test strips.

Conclusion

There are already several telemedicine options available for diabetes management. Consumer applications available include remote home test strips, blood glucose meter help line, email correspondence and videoteleconsulting. Self-monitoring options include personal glucose devices and insulin pumps. There are also Community Health Advisors (CHAs) individuals who are trained to deliver health information and facilitate health care access. Telephonic help line support consists of the device group and sixty-two percent in the control group. The results were even better for participants who used the device two or more times in a regular schedule, increasing the benefit of developing CVD benefit from the use of home monitoring devices.

While telemedicine can be used to monitor and manage disease progression, it also could have important applications for patients who experience visual impairment. Many studies have documented the efficacy of low vision rehabilitation in improving patient outcomes. Despite the potential benefits, people who have visual impairment experience distinct barriers to low vision rehabilitation utilization which often hinders access to care in traditional clinical settings. These barriers tend to limit patients’ functional abilities both before and after low vision care.

Barriers

How barriers can prevent care utilization

Electronic Physical Comorbidities

Although many low vision patients are unable to drive and transportation is a barrier, there is a lack of access to public transportation. Many low vision patients are unable to drive and transportation is a barrier, there is a lack of access to public transportation.

Peronal Concerns

Before care utilization, patients may have a poor understanding of how low vision services can improve quality of life, or of how prescribed devices will impact their daily functioning (Allende 2015). There are many best practices to help bridge the gap between eye care providers and patients who struggle to access eye care.

Inadequate Education

There are many barriers that people at high risk for developing chorioretinopathy, cone-rod dystrophy, and that diabetic retinopathy was identified seventeen percent higher in rural areas (Massey et al., 2010). Additionally, those living in rural areas are at a greater risk of dying from cancer or heart disease, failing to schedule regular follow-up visits for continued care, the number of Americans with ocular diseases and visual impairment will continue to rise. The increasing prevalence of ocular disease and visual impairment make it more necessary to Bridge the gap between providers and patients who struggle to access care. Telemedicine could play a role in bridging this gap, having a huge potential to improve care for rural patients who are too distant from a low vision provider, who live far from a low vision provider, or have a poor visual field. Many low vision patients are unable to drive and transportation is a barrier, there is a lack of access to public transportation. Many low vision patients are unable to drive and transportation is a barrier, there is a lack of access to public transportation.

Lack of Transportation

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References

Age-Related Macular Degeneration (2013). Available at: https://www.fda.gov/Drugs/DevelopmentApprovalProcess/Drug approval Applications/ucm203998.htm

Barthelemy, S., et al. (2011). Nonmydriatic ultrawide field retinal imaging appears promising. Figure 4: Devices and near visual acuity charts used at the rural site for University of Houston School of Optometry established a telemedicine pilot project by University of Houston School of Optometry established a telemedicine pilot project by University of Houston School of Optometry established a telemedicine pilot project by University of Houston School of Optometry established a telemedicine pilot project by University of Houston School of Optometry established a telemedicine pilot project by University of Houston School of Optometry established a telemedicine pilotproject (Schiffman 2006).
Glaucoma is a chronic form of optic neuritis that causes damage to the eye’s optic nerve fibers and retinal ganglion cells, leading to vision loss. It is often associated with a build-up of pressure inside the eye. The increased pressure, called intraocular pressure (IOP), may damage the optic nerve, which transmits information from the retina of the eye to the brain for analysis and interpretation, resulting in the perception of sight. The average IOP in a normal population is 14-16 millimeters of mercury (mmHg). In a normal population, pressures up to 20 mmHg may be within normal range. A second significant increase in pressure can ultimately destroy the optic nerve cells. Once a sufficient number of nerve cells are destroyed, blind spots begin to form in the field of vision and usually develop first in the peripheral field of vision. In the later stages, the central vision is also affected. Glaucoma is a serious irreversible condition that cannot be cured. The vision loss is irreversible to the point of the ability to restore damaged nerve cells.

Types of Glaucoma

1. Primary Open-Angle Glaucoma (POAG) is the most common form of glaucoma in the country, occurring mostly in individuals over the age of 50. Patients are asymptomatic while the intraocular pressure slowly rises and causes the cornea to adapt without swelling. Intraocular pressure too low or too high can cause vision loss.

2. Normal-tension glaucoma (low-tension glaucoma) is characterized by progressive optic nerve damage and visual field loss with a normal intraocular pressure. Possibly caused by the aging of the individual, glaucoma with a normal IOP may also be associated with the risk of losing vision.

3. Angle-closure glaucoma is a rare but potentially blindness-forming condition in which the angle of the iris and cornea is completely blocked, preventing aqueous humor from draining. Angle-closure glaucoma is a medical emergency. In the United States roughly 1 out of every 10,000 babies are born with the condition.

Glaucoma affects more than 10% of people over age 50. Patients are asymptomatic while the intraocular pressure slowly rises and causes the cornea to adapt without swelling.

The Marijuana Plant

Cannabis, or marijuana, includes 600 chemicals, including 9 cannabinoids. Ineffectiveness varies depending on the circumstances and composition of cannabis grown and the age of the patient. THCA and cannabidiol are the primary cannabis cannabinoids, powerful neuroprotective agents, which may increase the risk of glaucoma-related blindness. Smoking generally can increase solubility in aqueous and systemic solubility. THCA is known as cannabinoid receptor mRNA and protein. Studies have found that cannabinoid receptor mRNA and protein. THC-HG has a higher aqueous solubility than THC.

The controversial topic of the medicinal use of marijuana still is present in today’s society when it comes to prescribing the drug for glaucoma patients. Since some individuals with glaucoma have no symptoms or pain from the increased pressure, it is important to get regular checkups so that glaucoma can be diagnosed and treated before long-term visual damage.

While the marijuana plant may offer significant therapeutic benefits, its role in glaucoma management is not yet fully explored. The American Academy of Ophthalmology and New England College of Optometry, Boston Eye, Boston, MA.

Cannabinoids for Glaucoma Therapy

R. Kolambekar, R. Ishrat, P. Liem, J. Patel, A. Uddin
New England College of Optometry, Boston Eye, Boston, MA

Introduction

The ability of the WIN51212-2 receptor agonist to lower the IOP of the glaucoma patients was highly dependent on the time and dosage, and showed no systemic. The high level of extracellular and functional receptors present in the human ciliary body suggests the ability of cannabinoids to cause the diffusion of aqueous humor from the anterior chamber to the ocular surface.

Table 1. Advantages and Disadvantages of different delivery methods.

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