

LIGHT FOR SIGHT
ACTIVITY REPORT
2019

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LIGHT
FOR SIGHT
Fighting preventable blindness

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LIGHT FOR SIGHT ACTIVITY REPORT

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LETTER FROM THE FOUNDERS

*NIKKI HAFEZI, MAS IP ETHZ,
FARHAD HAFEZI, MD, PHD*



February 1, 2020

Dear Friends and Colleagues,

This year has been an eventful and productive year for the foundation! With each year that passes, the foundation garners more and more support that directly helps us achieve the mission of eliminating preventable blindness in children and adolescents. In other words, the dedicated efforts made in the name of the foundation will have a ripple effect that will be seen in many years to come.

Keratoconus is a widely underestimated disease. Recent publications show that the prevalence of keratoconus can be as high as 4.79% (1:21) in Saudi Arabia, 3.30% (1:30) in Lebanon, 3.18% (1:31) in Israel, 2.50% (1:25) in Iran, and 2.30% (1:43) in central India. The Saudi prevalence study was published in 2018 in the British Journal of Ophthalmology, and it was conducted, supported and published thanks to the support of the Light for Sight Foundation.

The most cited publication about keratoconus prevalence is from 1986. The screening mechanism used at the time was subjective and cannot even be compared to today's sophisticated technology that uses objective measurements to assess corneal topographies. The foundation adapted the Saudi study protocol and created the KMAP global study to provide a better understanding of the true global prevalence of keratoconus using modern diagnostic technology. The goal of this study is to screen 30–50,000 eyes over five continents and regions by 2024.

Despite the sensitivity and accuracy in detection, these diagnostic devices are also expensive, bulky and immobile, which create an access barrier for vision healthcare professionals. Another focus of the foundation is to enable access to treatment for all. Therefore, the foundation has partnered with the Botnar Foundation to support the development of a smartphone-based keratograph ("SBK") to provide a simple screening tool. The SBK is expected to dramatically help with early detection especially among children and adolescents.

The foundation has been the platform to help disseminate and share information about keratoconus prevalence, high-risk patient groups, best practice models for pediatric and low-compliant patients, treatment modalities for keratoconus and refractive correction, and optimizing corneal cross-linking

(CXL) protocols. The largest event that the foundation supports is the CXL Experts' Meeting held every December in Zurich. This meeting provides one day of practical training and a two-day scientific program. It has grown to over 250 people representing 46 countries. After 15 years, the meeting has grown to a size where the meeting must now move to Milan to accommodate the demand.

More locally, optometrists in Zurich are often the first professionals to detect a suspicious cornea. However, education and training about how to manage these patients are quite limited. So, the foundation, in collaboration with the ophthalmic surgical clinic, ELZA Institute AG in Zurich, launched a pilot program to develop an "Associates" program that involved a mandatory three-day course about detecting irregular corneas and their treatment modalities. Although optometrists are not allowed to treat these patients, they can be recognized as professionals who are trained in detection. The program was conducted in the Swiss-French region, and the 15 graduates would be recognized on the foundation's website as Light for Sight Associates. Due to the feedback, this course will be repeated in the Swiss-German region and internationally.

Last, but certainly not least, is the support that the foundation provides for ongoing research projects. The Light for Sight Foundation understands that the only way to truly eradicate the disease is to find a cure. However, patients with keratoconus cannot wait until a cure is found, so the foundation supports endeavors that improve the efficacy and safety of the only proven treatment of keratoconus, CXL. For example, a better understanding of the parameters of oxygen saturation during the CXL procedure as a catalyst for biomechanical strengthening of the cornea could help improve the efficacy of current treatment protocols.

In summary, the leadership of the foundation continues year after year to support all four pillars of the mission. It is through productive collaborations with the members of the clinical network that many activities are made possible. So, we thank all of you for your unwavering support, confidence, trust, and encouragement!

With friendship and gratitude,

Nikki & Farhad Hafezi



NIKKI HAFEZI, MAS IP ETHZ

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LIGHT FOR SIGHT HISTORY

THE LIGHT FOR SIGHT STORY

The concept was simple: outreach to a population group at a high-risk of developing keratoconus (Down Syndrome) and provide access to annual eye screenings for early detection and intervention. In the beginning, this concept was called "Project Light for Sight," next it was the "Light for Sight 21," then finally, the "Light for Sight Foundation" in November 2015.

The concept started as a small local project in Geneva but due to the immediate demand of clinicians to participate and the great interest in performing collaborative research projects, it needed a more formal structure to allow for growth and have the means to accept support and donations. Also, having a foundation would create a body that has the potential to fund research initiatives dedicated to helping the foundation's mission. This body would be reliant on the achievements of the foundation as well as success in traditional fundraising in an already competitive market.

"Since keratoconus is currently classified as a rare disease, most eye care specialists know little to nothing about the disease in terms of its symptoms, diagnosis and treatment methods."

To increase the chance of success, the Light for Sight Foundation expanded its mission to eliminate preventable blindness among all children and adolescents with keratoconus. Keratoconus is one of the leading causes of severe visual impairment in children and adolescents. However, since keratoconus is currently classified as a "rare disease", most eye care specialists know little to nothing about the disease in terms of its symptoms, diagnosis and



treatment methods. Early detection and treatment are essential in reducing the severity of symptoms (and the impact these visual symptoms have on their ability to live their lives), so awareness is essential to combat this disease.

The scientific literature indicates that certain groups may show a higher keratoconus incidence rate than the general population. One of these groups is the Down Syndrome population. Given the fact that many of these individuals are deemed low to non-compliant, the eye care specialists who are conducting their vision screening tests may simply deem that the patient is "having a bad day" if the results are sub-optimal – or worse, give up trying to screen a profoundly non-compliant patient in order to serve the other patients in his or her clinic.

The Light for Sight leadership believes that there are three fundamental ways to increase the awareness about not only the disease, but also the services that the foundation offers to patients and healthcare professionals. These three ways include:

- Building a clinical network of qualified vision healthcare partners to properly diagnosis and treat keratoconus patients
- Establishing working partnerships with patient groups which consist of "high-risk" patients
- Develop/adopt/adapt patient handling methods for non-compliant patients to achieve better screening outcomes and proper diagnoses.



Mission Statement:

To eliminate preventable blindness among children and adolescents with keratoconus

THE LIGHT FOR SIGHT FOUNDATION'S FOUR GOALS:

Outreach

Outreaching to both high-risk patient groups and treating clinicians

Teach

Training/education and awareness of the disease and treatment

Access

Providing access to treatment for all children and adolescents with keratoconus

Research

Conducting research to better understand keratoconus

KERATOCONUS: IMPACT OF DISEASE

THE MOST COMMON CAUSE OF BLINDNESS IN CHILDREN AND ADOLESCENTS

Keratoconus is the global leading cause of blindness in childhood and adolescence.

In 1986, the results of a keratoconus prevalence study performed in Minnesota was published. It reported a prevalence of 0.05% (1 case per 2000), classifying keratoconus as a rare disease. Since then, the prevalence reported in subsequent studies has steadily increased. This increase is partly due to the development of more sensitive modern diagnostic equipment, but also to the fact that the prevalence varies geographically – and those variations are now being discovered.

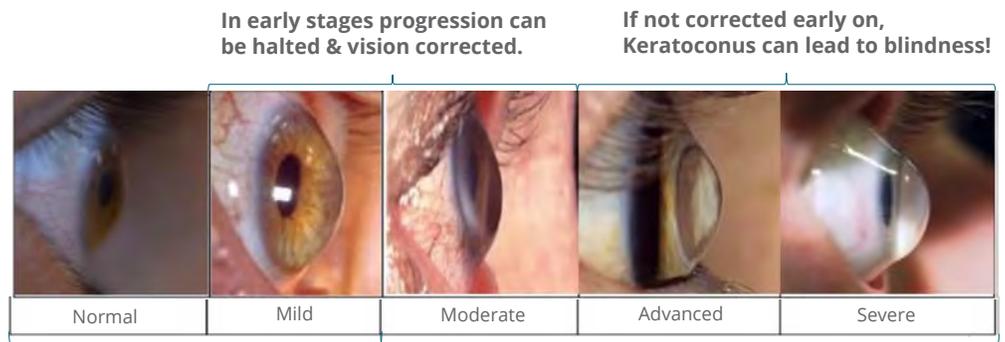
Keratoconus should no longer be considered as being a rare disease. Recent publications have shown that keratoconus in children and adolescents can be as highly prevalent as 4.79% (1:21) in Saudi Arabia, 3.30% (1:30) in Lebanon, 3.18% (1:31) in Israel, 2.50% (1:25) in Iran, and 2.30% (1:43) in central India.

A comprehensive literature search has been conducted to compile all prevalence studies into a meta-analysis. However, there were too many variables in the protocols used in these papers to let researchers to draw any robust conclusions, aside from the fact that the prevalence is massively higher than what has been reported since 1986.

KMAP is a global study that aims to map the prevalence of keratoconus in children and adolescents across the globe. Clinical sites from North America, Europe, Russia, Asia, the Middle East and Northern Africa are enrolling patients to provide a more accurate depiction of the global prevalence of keratoconus.

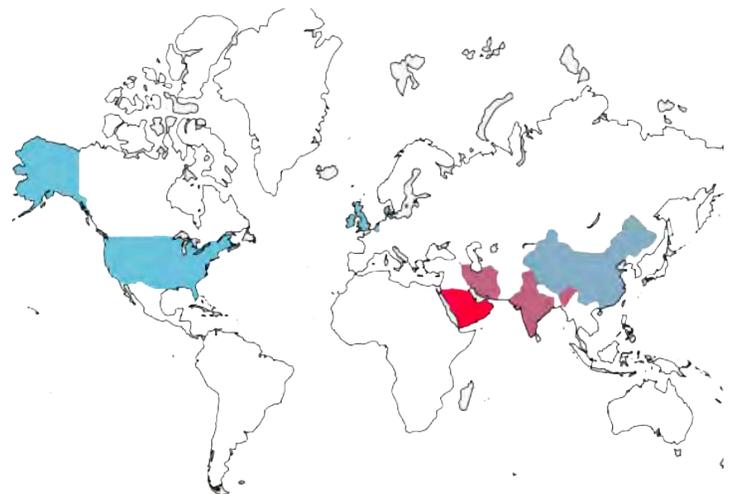


The Kennedy et al. (1986) paper that misidentified keratoconus as a "rare disease"



Keratoconus Onset: Age 10-16

Progressive corneal deformation throughout a lifetime



0.5% 1.0% 1.5% 2.0% 2.5% 3.0% 3.5% 4.0% ≥4.5%
Keratoconus prevalence, as reported in the literature to date

KMAP: GLOBAL PREVALENCE STUDY OF KERATOCONUS AMONG CHILDREN AND ADOLESCENTS

FAIR CARE FOR ALL

Geography, arid climates and genetic diversity play two important roles in prevalence of keratoconus.

The Light for Sight Foundation, through the expertise of Prof. Farhad Hafezi and his research team, designed the study protocol and managed a pilot study in Riyadh to obtain the prevalence of keratoconus among children and adolescents. This manuscript, published in the British Journal of Ophthalmology in 2018, reported the prevalence as 1:21.

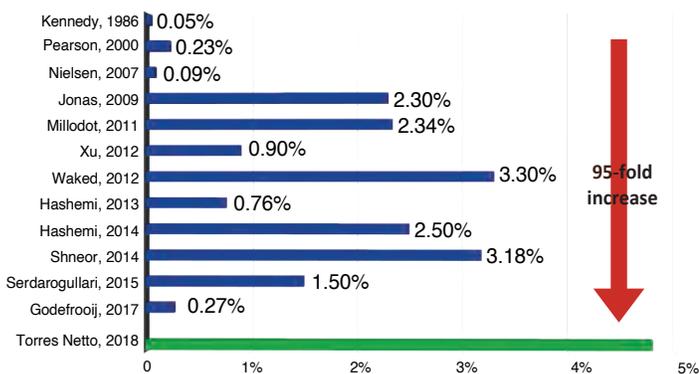
Based on this significant finding, Prof. Hafezi's team slightly modified the protocol and launched the global keratoconus prevalence study, KMAP, to determine whether, at least in certain regions of the world, keratoconus is or is not a rare disease. The study is currently running in many countries and has a goal of including 10,000 eyes.

The KMAP study is the largest international prevalence study about keratoconus ever performed. Prof. Farhad Hafezi is the principal investigator, and the investigator-initiated study is supported in part by the Light for Sight Foundation.

The KMAP team is working on a hypothesis that the overall global prevalence of keratoconus in children and adolescents is approximately 1:500 with a much higher rate in the Middle East and



Keratoconus is an underestimated disease, and this often silent disease is the leading cause of preventable blindness among children and adolescents.



95-fold increase in reported keratoconus prevalence since 1986

Northern Africa. With this hypothesis, roughly 42% percentage of world's population that is under the age of 25 years equating to 3.3 billion people. With a proposed prevalence of 1:500, the estimated number of children and adolescents with keratoconus would be 6.6 million.

Therefore, there is a public need for early intervention and screening initiatives, especially in the Middle East and Northern African regions.

So this KMAP study will not along provide us with a more accurate prevalence of keratoconus, it will also be a call to action for nations in these high-risk regions to implement national screening programs. The Light for Sight Foundation will be instrumental in this public policy endeavor in the future.

LIGHT FOR SIGHT ASSOCIATE CERTIFICATION PROGRAM

IN CLINICAL COLLABORATION WITH THE ELZA EDUCATION CURRICULUM (EEC)

Executive Summary

The goal of the inaugural Associate Certification Program (ACP) is to provide optometrists with practical training and medical guidance on how best to detect, inform, and later manage patients with keratoconus. After the completion of the didactic courses and conducting a mini-surgical observership with a Light for Sight Ambassador, the participation in the ACP will receive a certificate and named as an official "Light for Sight Associate Partner."

The Associate Partner should also plan on renewing his/her status every two years. The renewal is to attend at least one ACP or EEC course specifically about keratoconus in a period of two years of receiving the certificate.

Educational purpose of training and intended goals

- To enhance diagnostic skills, decision-making process and patient management planning of ACP participants specifically focused on keratoconus. A strong emphasis is placed on the understanding of the disease process from the basic science/cellular level.
- To provide exposure to live surgery of the cornea, specifically to observe a cross-linking procedure to better understand the whole spectrum of care for a keratoconus patient.
- To improve the medical management of diseases of the, cornea and anterior ocular segment, as well as recognition and treatment of posterior segment disease that may affect the anterior segment, including the principles of contact lens fitting and management of complications.
- To influence candidates to advocate for early screening and access to treatment, especially for high-risk patient groups like children and adolescents and in the Down Syndrome community

Switzerland ACP Faculty:

Prof. Farhad Hafezi, ELZA Institute AG (Dietikon/Zurich) – L4S Ambassador

The ELZA Institute (Zurich, Switzerland) is a team of 20 people, including seven ophthalmologists, plus two optometrists, one orthoptist, two opticians and one full-time corneal fellowship training post.

Course Curriculum 2019

French Language

Monday, March 4, 2019

Biel, Switzerland

"Diagnosing Irregular Corneas – Part I"

Monday, May 27, 2019

Fribourg, Switzerland (NH Hotel)

"Diagnosing Irregular Corneas – Part II"

September 2, 2019

Fribourg, Switzerland (NH Hotel)

"Treatment Options for Irregular Corneas"



Surgical Mini-Observership

After the completion of all three courses, each registered participant in the ACP was entitled to schedule a surgical observership with a Light for Sight Ambassador. The surgery mini-observership allowed the ACP participant to observe a live cross-linking procedure of a keratoconus patient.

Renewal Process

Every two years, the ACP requires that the optometrist attends at least one ACP course or an EEC with a topic that covers keratoconus. Then, upon the attendance of the course, the certification will be automatically renewed.

15TH ANNUAL CXL EXPERTS' MEETING

DECEMBER 3-5, 2019, MÖVENPICK HOTEL, ZURICH, SWITZERLAND



The first CXL meeting was held in Zurich, Switzerland in 2004 in response to a demand for more information and training about a novel treatment for a then, untreatable disease.

Since 2004, the meeting has traveled to neighboring countries in Europe, including Germany and Italy, and once to the United States in 2015. With over 250 participants from 46 countries, the 15th annual meeting was yet another success!

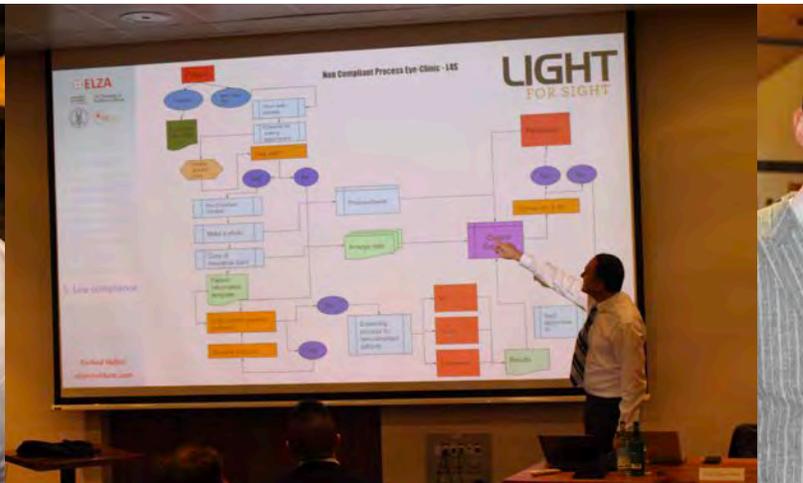
Since 2016, the Light for Sight Foundation has taken the responsibility of the organization and execution of the congress from the logistical management to the scientific program. The foundation strives to listen and implement the participants' suggestions and to identify clinically relevant presentation topics as well as good faculty members. This combination enables the foundation to have continual growth in attendance at each congress.

The most significant change that the foundation has implemented in 2014 was the prequel to the 2-day scientific program, historically held on Friday and Saturday. The prequel is a day

dedicated to didactic courses, wet labs and hands-on trainings, and sponsored company courses. The wet labs and training courses are practical sessions intended to educate new users on how to perform CXL in their clinical practices. The advanced courses are to introduce and train experienced CXL users about new clinical applications. The key to success is to keep the wet labs small in number to enable a relaxed environment that welcomes questions and answers from the faculty.

Another change that was implemented that increased the satisfaction of the participants was the combination of the poster session with the wine and cheese reception before the Friday banquet dinner. This poster session allowed time to socialize and speak with poster presenters in a relaxed environment. While most attendees participate in the Friday banquet dinner, this decision increased exposure to the posters. The posters remained on display on both Friday and Saturday.

While the goal for congress is to create an educational platform about CXL and keratoconus, the education can also include the knowledge exchange between experienced and inexperienced researchers about practical research applications like optimizing a study protocol. This exchange indirectly supports the mission of the foundation.





EYE CARE PROFESSIONAL TRAINING: 2019 CONGRESS CIRCUIT

PRESENTING OUR WORK TO OUR PEERS

The Light for Sight Foundation comprises of a large international clinical network. This network serves as a communication channel for congresses focused on educating ophthalmologists and opticians. A requirement for an ophthalmologist to be listed as a clinical partner is to provide educational presentations. Therefore, the clinical partners are asked to provide presentations at congresses they are either a part of or have access to. This way, there is a maximum benefit with no related costs to the foundation.

The Light for Sight Foundation was represented in at least 22 countries in 2019 alone. Here are some examples:

OTO, Zurich
January 10, 2019
Innovator's Lecture
"Corneal Cross-Linking (CXL) in 2019"

SIMASP, Sao Paolo
February 14-15, 2019
"Diagnosing, treating and managing low compliant pediatric keratoconus patients"
"Lessons learned from the last 10 years. How will CXL be in 5 years?"

European Symposium on Ambulatory Anesthesia and Analgesia, Zurich
March 9, 2019
"Addressing the needs of children and low-compliant patients during eye surgery"

Swiss Society of Optometrists, Bern
March 24, 2019
"Unterfunktion der Schilddrüse und Keratokonus"

Croatia Contact Lens Symposium, Zagreb
March 30, 2019
"The Light for Sight Session on Keratoconus"

SAMIR, Casablanca
April 13, 2019
"The Light for Sight Session on Keratoconus"

Finnish Society of Ophthalmology, Turku
May 17, 2019
"Using Light to Save Sight: keratoconus in pediatric and low-compliant patients"



channel to both international and national
ical partner is the agreement to provide
attending or are asked to be invited speakers.



- Keratoconus Theatre, Bangalore
May 19, 2019
"Navigating through the sea of protocols...what is right for your keratoconus patient"
- X International East West Meeting, Ufa, Russia
June 7, 2019
"CXL Technology and clinical applications"
- Vision China, Qingdao, China
July 26, 2019
"CXL treatment applications from keratoconus and infection"
- MEACO (Middle East & Africa Congress in Ophthalmology), Dead Sea, Jordan
September 5-6, 2019
8 presentations related to keratoconus and CXL applications
"The Light for Sight Course on keratoconus"
- ESCRS (European Society for Cataract and Refractive Surgery), Paris
September 13-16, 2019
16 presentations
- DOG – German Ophthalmic Association, Berlin
September 27, 2019
"Update on CXL in keratoconus and infectious keratitis"
- Egyptian Society of Keratoconus and Corneal Transplant, Cairo
October 3-4, 2019
"CXL: Basics and principles – 2019 Updates"
"Decision making in keratoconus"
"Prevalence, detection and treatment of pediatric keratoconus"
"Hormonal influences of keratoconus"
- American Academy of Ophthalmology, San Francisco
October 13, 2019
"Expanding CXL from KC to New Indications"
- Rabat Ophthalmologie, Rabat, Morocco
October 26, 2019
5 talks including: "Best practice model for treating pediatric patients"
- AOPA – Algerian Association of Private Ophthalmologists
November 1, 2019
6 talks including: "The Light for Sight Course on Keratoconus"
- GFOO – Fribourg Group of Optometrists and Opticians
November 7, 2019
"Corneal Cross-linking – Update 2019"

UNDERSTANDING THE LIMITATIONS OF OXYGEN

DETERMINING HOW MUCH IS ENOUGH TO MAKE CROSS-LINKING EFFECTIVE

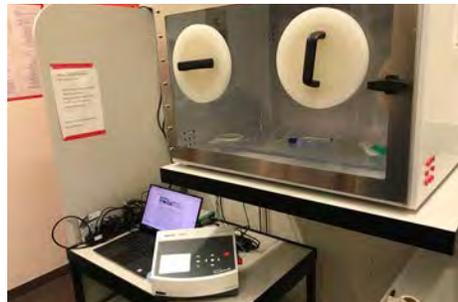
The Hafezi group was the first to discover that oxygen plays an essential role in corneal cross-linking.

They observed that without oxygen, cross-linking is impossible. Many groups – both academic and industry – have conducted their own research on the topic, and all have come to the same conclusion: oxygen is essential. Furthermore, the community agrees that limiting oxygen availability during cross-linking, for example by performing epithelium-on cross-linking, limits the efficacy of the treatment. However, the question still remains – how much oxygen is enough to create enough cross-links to arrest the disease?

Industry has already developed products to increase the oxygen flow and availability to patients during treatment with the hope of increasing the effectiveness of the procedure. Yet, the peer-reviewed publications needed to validate this method are still lacking. The question remains about whether or not this supplementary oxygen provides enough to combat the oxygen barrier caused by epithelial-on cross-linking.

The Light for Sight Foundation is dedicated to not only creating awareness and screening, but also to providing access to effective treatment for keratoconus patients.

In most cases, children have the most aggressive cases of keratoconus. Therefore, epithelium-off (“Dresden protocol”) treatment is used because it is the most effective treatment protocol to arrest the disease. In cases involving low-compliant patients, the post-operative risks need to be balanced with the efficacy of removing the epithelium. In these cases, maintaining the epithelium to reduce the risk of postoperative infection is the only way to treat these patients. So, optimizing the efficacy of epithelium-on cross-linking is necessary.

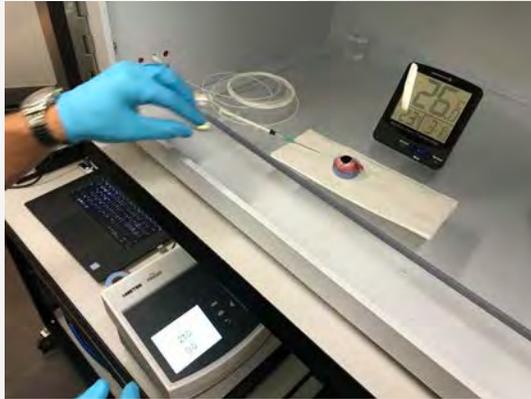
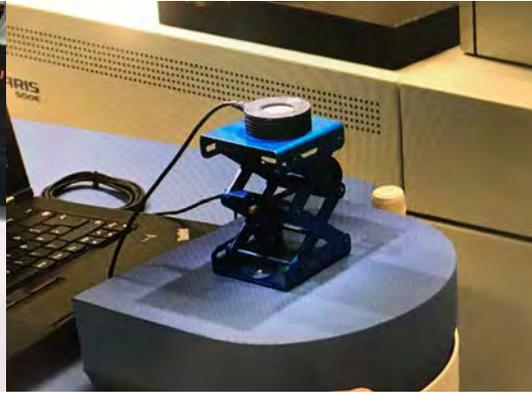


The question remains about whether or not this supplementary oxygen provides enough to combat the oxygen barrier caused by epithelial-on cross-linking.

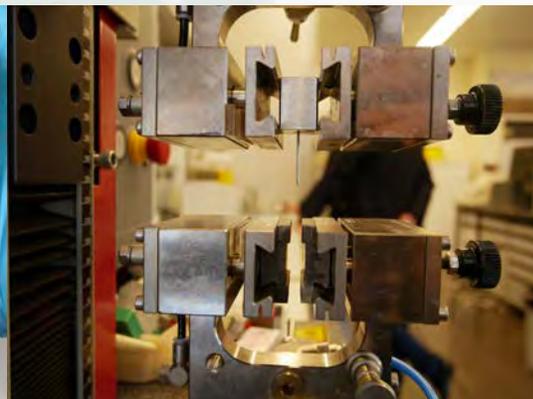
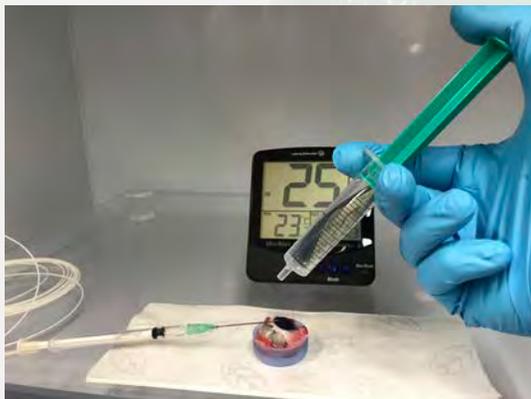
Currently, the community knows that no oxygen means no cross-links, and supplemental oxygen probably enhances the efficacy. However, the Light for Sight Foundation is supporting a PhD thesis from the University of Antwerp, Belgium, under the supervision of Prof. Carina Koppen, that is dedicated to answering the question, “Does corneal hypoxia influence the biomechanical effect of corneal cross-linking?” Specifically, at what oxygen saturation levels of the cornea does CXL no longer create cross-links or enough cross-links to have a biomechanical effect?

So far, the project has commenced the laboratory experiments at the Ocular Cell Biology Laboratory at the University of Zurich. The researchers have fine-tuned the experimental study design. Results from this study are expected in 2020.

Once these questions are answered, the next steps would be to investigate if there is an additional biomechanical strengthening in the cornea when exposed to supplemental oxygen and at what saturation levels.

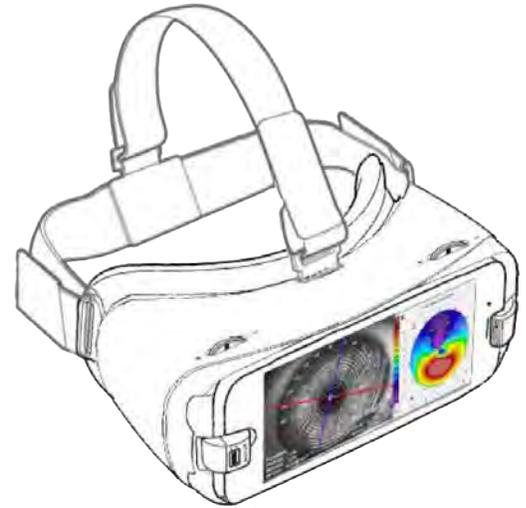


Workshop Ohio LLC 44140



ACCESS TO TREATMENT

2019 RESEARCH UPDATE



A mock-up of what the SBK might look like

“SBK – Smartphone-based Keratograph: solving today’s problems to improve tomorrow’s outcomes”

The most aggressive form of keratoconus occurs during puberty because sex hormones have been shown to influence the biomechanical properties of the cornea. Logically, screening during the pre- and early-onset of puberty would be optimal to detect any corneal shape irregularities. However, the SBK would not be used to diagnose the disease but rather provide a means to decide if clinical follow-up is necessary. This is important, as

pediatric keratoconus prevalence rates are as high as 1:21 in certain regions of the world. Keratoconus cannot be cured. However, keratoconus is treatable, and early detection can reduce the severity of this disease. Ninety percent of children with cones later progress; this, coupled with the fact that the disease prevalence

can be as high as 1:21 among children, keratoconus should no longer be considered rare. Individuals with progressive keratoconus who go untreated could ultimately result in legal blindness and in extreme cases have a perforation of the cornea.

Therefore, The Light for Sight Foundation and the Botnar Foundation have partnered to co-fund a project to help improve access to screening technology to support early detection for early treatment of keratoconus.

Preventative care is essential to reducing the severity of the symptoms that diseases like keratoconus can cause over a lifetime. Combining the use of advanced technology to simplify and improve diagnosis in an inexpensive, non-invasive and quick manner may be part of the solution to decreasing a leading cause of legal blindness in children globally.

The Smartphone-Based Keratoconus Screening project exemplifies the concept of efficient translational research to address an unmet medical need in developing and underdeveloped countries. The concept for the project comes from a young German engineer who was diagnosed with keratoconus. Being examined in Switzerland and having worked with

non-governmental organizations in the developing world, this engineer realized that there is a demand for low-cost and reliable technology because current devices are too expensive to be accessible by everyone. Three fundamental obstacles present with current corneal topographers: stationary design, relatively high cost (\$15k), as well as limited awareness about

A smartphone contains all expensive electronics to compute a corneal topography!



keratoconus and its symptoms. Since this screening/diagnostic tool can help prevent blindness, it should be available and affordable for all vision health care specialists. This project will address all three obstacles. The final project, scope of work and budget were finalized in mid-December 2019, and the team is set to kick-off in Q1 2020. This project is budgeted for a duration of 17 months, ending with a working prototype set for commercialization.

HOW CXL BECAME AN ALTERNATIVE TO ANTIBIOTICS

2019 RESEARCH UPDATE



The human cornea must maintain its shape throughout life as an essential prerequisite for good vision – and its shape is determined by its biomechanical properties.

The family of corneal ectatic diseases (e.g. keratoconus, post-surgical ectasia, pellucid marginal degeneration) is characterized by a reduction of corneal biomechanical strength, which leads to irregular changes in corneal shape. This leads to a progressive worsening of visual acuity, which, if left untreated, reaches a point where the visual defect cannot be corrected with glasses or even special contact lenses. Whereas post-surgical ectasia and pellucid marginal degeneration are rare diseases, keratoconus is not: it is the most common reason for severe visual impairment in childhood and adolescence.

Up to the late 1990s, no therapy was available to restore the biomechanical integrity of the cornea. Rather, penetrating keratoplasty (PK) was the only real surgical option, which involves exchanging the central part of the affected cornea for corneal tissue from a donor cadaver. However, PK can be associated with a number of complications, including impaired healing and tissue rejection – and there is still a high rate of ectasia recurrence, which starts in the peripheral cornea and migrates into the graft.

Corneal cross-linking (CXL) with riboflavin (vitamin B₂) and UV-A illumination represents a technique that increases the biomechanical resistance of the cornea and can restore strength to the weakened cornea. This process can halt keratoconus progression and preserve corneal shape, and thereby preserve the patient's visual acuity too.

In clinical use since 1999, CXL has become the standard of care

in treating corneal ectatic disease. Although a solid body of evidence exists for the clinical efficacy of the method, its working mechanisms and signaling pathways are poorly understood, which makes improving the technique difficult.

CXL is a photochemical process that requires a chromophore (riboflavin) to be applied to the cornea, and illumination with UV-A light to kick off the cross-linking process. Besides the immediate biomechanical effect, CXL also leads to long-term remodeling and structural changes in the cornea. This may be the result of the activation of as-yet-unknown signaling pathways that are initiated by the photochemical process during UV irradiation, but it could potentially also be due to a process known as mechanotransduction.

More recently, and in addition to its biomechanical effects, CXL has been used to successfully and efficiently kill harmful pathogens that can cause corneal infections. Corneal infections are the third leading cause of blindness globally, and with the rise of antibiotic resistance, alternative methods of treatments will be necessary in the near future to treat them and save people's vision. By exploring the different applications of CXL and understanding its true versatility, the findings will also provide a better understanding of its potential – and its limits.

Since early 2019, the Ocular Cell Biology Group at the CABMM (Center for Applied Biotechnology and Molecular Medicines) at the University of Zurich have been investigating this secondary application of cross-linking. Using established experimental set-ups to test biomechanics, the research team is dedicated to understanding the limitations of the antimicrobial effect as well as confirming the optimal conditions to use this method.

Results are expected to be published in 2020.

BIOMECHANICS

Biomechanical Impact of Localized Corneal Cross-linking Beyond the Irradiated Treatment Area

Joshua N. Vitell, MD, Owen Langille, Patrick Hoffman, MD, PhD, J. Bradley Randleman, MD, Giuliano Scarcelli, PhD

ABSTRACT

PURPOSE: To investigate the effect of localized cross-linking on corneal biomechanics, a finite element model was developed to simulate the effect of localized cross-linking on the biomechanical properties of the cornea. The model was used to evaluate the effect of localized cross-linking on the biomechanical properties of the cornea. The model was used to evaluate the effect of localized cross-linking on the biomechanical properties of the cornea. The model was used to evaluate the effect of localized cross-linking on the biomechanical properties of the cornea.

CONCLUSIONS

Localized cross-linking, the second leading cause of corneal cross-linking, is a technique for strengthening the cornea. The model was used to evaluate the effect of localized cross-linking on the biomechanical properties of the cornea. The model was used to evaluate the effect of localized cross-linking on the biomechanical properties of the cornea. The model was used to evaluate the effect of localized cross-linking on the biomechanical properties of the cornea.

INTRODUCTION

Corneal cross-linking is a technique for strengthening the cornea. The model was used to evaluate the effect of localized cross-linking on the biomechanical properties of the cornea. The model was used to evaluate the effect of localized cross-linking on the biomechanical properties of the cornea. The model was used to evaluate the effect of localized cross-linking on the biomechanical properties of the cornea.

CONCLUSIONS

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Webb JN, Langille E, Hafezi F, Randleman JB, Scarcelli G

Biomechanical Impact of Localized Corneal Cross-Linking Beyond the Irradiated Treatment Area.

J Refract Surg. 2019;35:253-260.

ARTICLE

Higher-order aberration measurements: Comparison between Scheimpflug and dual Scheimpflug-Placido technology in normal eyes

Andri J. Piccinni, MD, Owen Golan, MD, Farhad Hafezi, MD, PhD, J. Bradley Randleman, MD

PURPOSE: To compare higher-order aberration (HOA) measurements between Scheimpflug and dual Scheimpflug-Placido technology in normal eyes. The study was conducted to evaluate the accuracy and reliability of these technologies. The study was conducted to evaluate the accuracy and reliability of these technologies. The study was conducted to evaluate the accuracy and reliability of these technologies.

CONCLUSIONS: The study found that dual Scheimpflug-Placido technology provides more accurate and reliable HOA measurements compared to Scheimpflug technology. The study found that dual Scheimpflug-Placido technology provides more accurate and reliable HOA measurements compared to Scheimpflug technology. The study found that dual Scheimpflug-Placido technology provides more accurate and reliable HOA measurements compared to Scheimpflug technology.

Piccinni AL, Golan O, Hafezi F, Randleman JB

Higher-order aberration measurements: Comparison between Scheimpflug and dual Scheimpflug-Placido technology in corneal eyes.

J Refract Surg. 2019;45:490-494.

ARTICLE

Progression of keratoconus resulting from hormone replacement therapy

Torres-Netto EA, Randleman JB, Hafezi NL, Hafezi F

PURPOSE: To evaluate the progression of keratoconus in patients undergoing hormone replacement therapy. The study was conducted to evaluate the accuracy and reliability of these technologies. The study was conducted to evaluate the accuracy and reliability of these technologies. The study was conducted to evaluate the accuracy and reliability of these technologies.

CONCLUSIONS: The study found that hormone replacement therapy is associated with an increase in keratoconus progression. The study found that hormone replacement therapy is associated with an increase in keratoconus progression. The study found that hormone replacement therapy is associated with an increase in keratoconus progression.

Torres-Netto EA, Randleman JB, Hafezi NL, Hafezi F

Reply: Progression of keratoconus resulting from hormone replacement therapy.

J Refract Surg. 2019;45:490-494.

ARTICLE

Corneal crosslinking without epithelial removal

Seiler T, Randleman JB, Vinciguerra P, Hafezi F

PURPOSE: To evaluate the effect of corneal crosslinking without epithelial removal on corneal biomechanics. The study was conducted to evaluate the accuracy and reliability of these technologies. The study was conducted to evaluate the accuracy and reliability of these technologies. The study was conducted to evaluate the accuracy and reliability of these technologies.

CONCLUSIONS: The study found that corneal crosslinking without epithelial removal is effective in strengthening the cornea. The study found that corneal crosslinking without epithelial removal is effective in strengthening the cornea. The study found that corneal crosslinking without epithelial removal is effective in strengthening the cornea.

Seiler T, Randleman JB, Vinciguerra P, Hafezi F

Reply: Progression of keratoconus resulting from hormone replacement therapy.

J Refract Surg. 2019;45:490-494.



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