KéraSelfiCône: Screening keratoconus Mobile app.

Problem Description:

Keratoconus is a progressive deformation of the cornea resulting in a decrease in visual acuity and can lead to blindness. Early screening of the disease can reduce these risks. The reported prevalence of keratoconus varies widely depending on the geographic location; in Canada it affects 1 per 1000 (usually young people between the age of 8 and 45 years).[1] In some cases, it can be linked to family history.[2] Early screening of the disease, removal of triggering risk factors, and early treatment can prevent the progression of this potentially blinding pathology and eliminate the need for more expensive corneal transplants. However, access to keratoconus screening tests is not easy and is expensive for the majority of the population. This explains why eye care professionals only receive patients with advanced stages of this disease.

Design Solution:

KéraSelfiCône is a preliminary detection smart phone app allowing early screening of keratoconus disease just by taking a Selfie or a picture with the camera in front of the smartphone whereby the application will use a scan program based on the reflection of rings onto the cornea (Figures1-3).

The first part of the platform will consist of a questionnaire with personal and family history, including change in prescription, decreased vision, and history of eye rubbing.

The second part of the platform will consist of the scanning process, where illuminated rings will be projected from the screen of the smartphone on the anterior surface of cornea and the reflexion of the rings on the cornea will be captured with the camera of the smart phone.

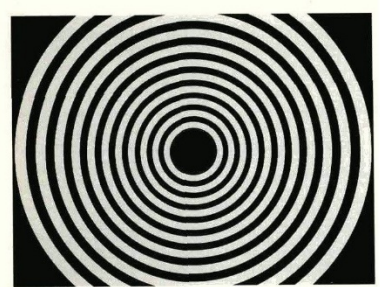

Figure 1 : Placido rings reflexion in the cornea.[3]

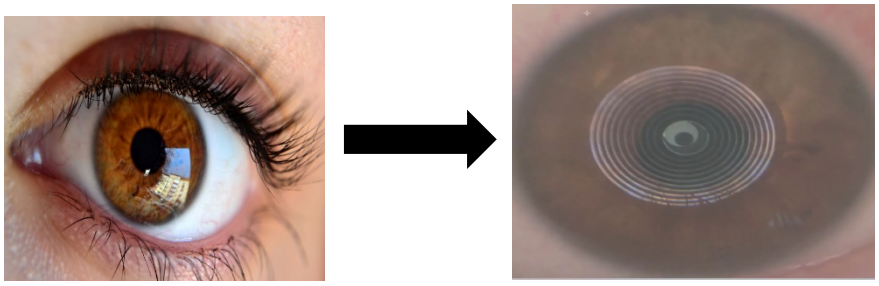

Figure 2 : Reflexion of placido rings in the cornea.

Application:

We have developed a basic prototype which contains an image of the placido rings (as shown in Figure 1) on the top half of the phone screen and a visual of the front-facing camera on the bottom half of the screen. The user will be prompted to hold their device with the app a specific distance away from their eye to achieve the best results.

Experiments will be performed on human eye biospecimens and later in patients to test the prototype after required institutional REB and biosafety approval.

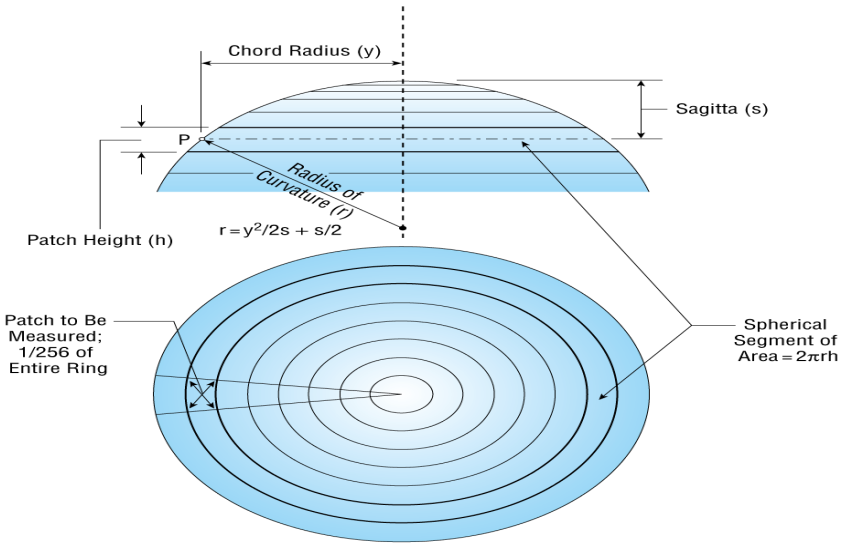

Figure 3 :Evaluation of corneal surface by spherical segments.[4]

Placido's disk; can provide a simple non-invasive visualization of the surface of the cornea by projecting a series of concentric rings of light onto the cornea, the measurement of the corneal curvature radius is the most important result (Figure3).

Implementation:

Currently, the app is being developed along with clinical trials and experimentation to prove our technique and to show our added value for the management of this disease.

In collaboration with the Keenan Research Centre for Biomedical Science and The Human Eye Biobank for Research (www.humaneyebank.ca); eye biospecimens will be imaged with optical coherence tomography (OCT) before and after imaging with the app to confirm that the projection of the rings will not influence the corneal and retinal tissues, with the use of a scientific protocol.

Finally, the app will be used alongside corneal topography as a gold standard on keratoconus patients to compare results and to improve the scanning algorithm.

References:

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2. Gokhale, N. Epidemiology of keratoconus. Indian J. Ophthalmol. 61, 382 (2013).

3. Douglas D Koch, MD and al, Journal of Refractive Surgery. 1989;5(6):424- 429.

4. Smolek MK, Klyce SD. Is Keratoconus a True Ectasia? An Evaluation of Corneal Surface Area. Arch Ophthalmol. 2000;118(9):1179–1186.