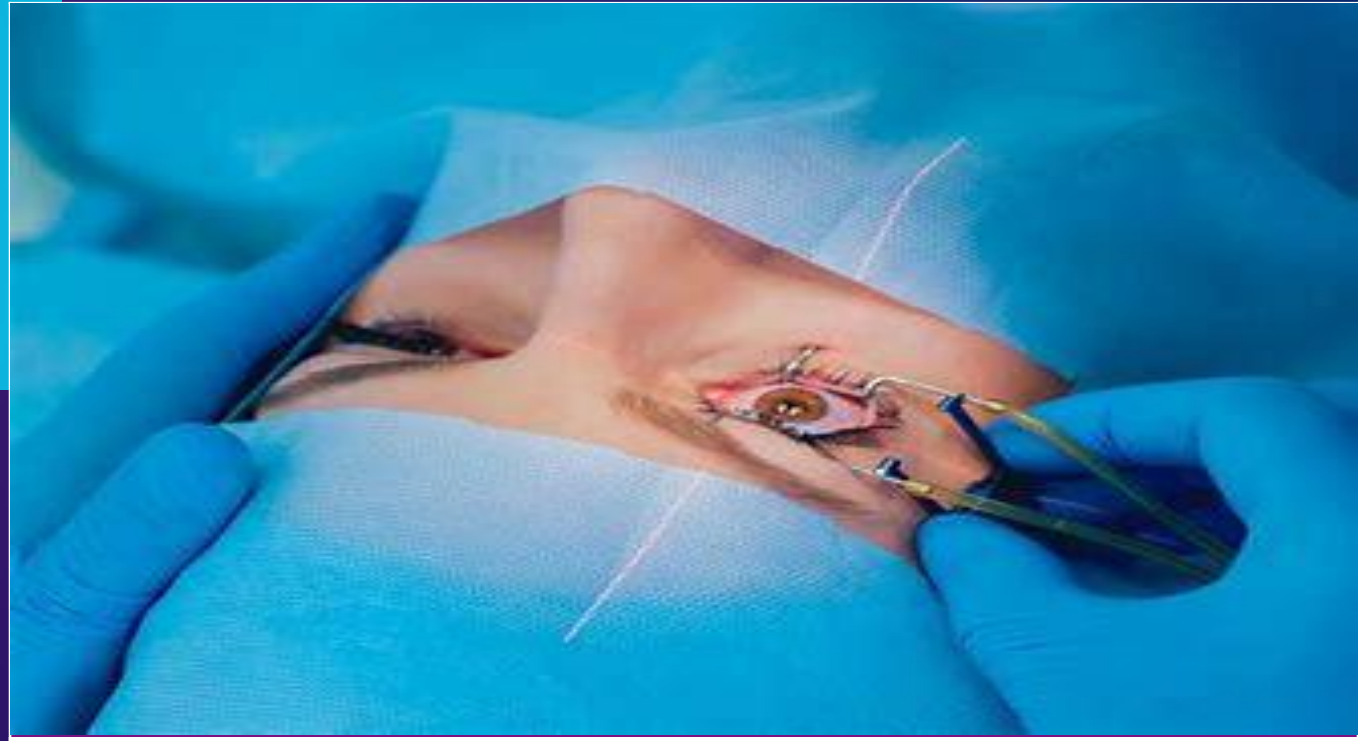




# KERATOCONUS DETECTION ALGORITHM USING CONVOLUTIONAL NEURAL NETWORKS

# WHAT ARE THE ADVANTAGES OF EYE SURGERY?

Eye Surgery has many benefits, including: It has been around for over 25 years and it works! It corrects vision. Around 96% of patients will have their desired vision after Eye Surgery. An enhancement can further increase this number. Surgery is associated with very little pain due to the numbing drops that are used.





# PROBLEM

## MOTIVATION

While overall patient satisfaction rates after primary KERATOCONUS surgery have been around 95%.

## COSTS

KERATOCONUS surgeries cost approximately ₹45000/-per surgery. An ability to predict post-operative UCVA can help patients make an informed decision about investing their money in undergoing a KERATOCONUS surgery or not. It can also help surgeons recommend the most promising type of laser surgery to the patients.

## PREDICTION

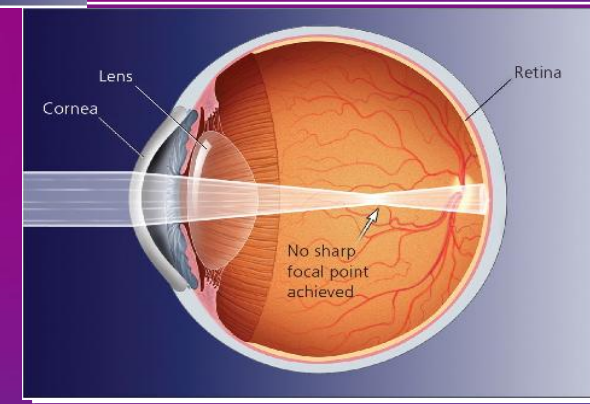
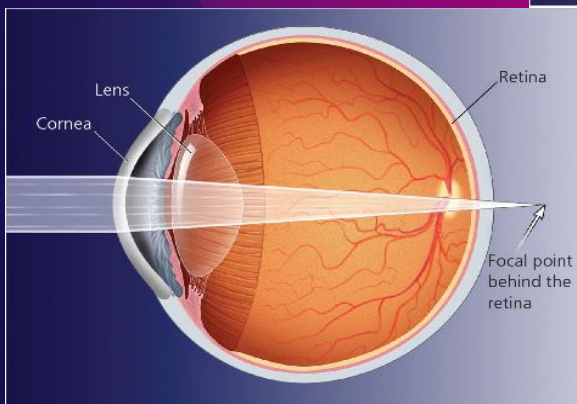
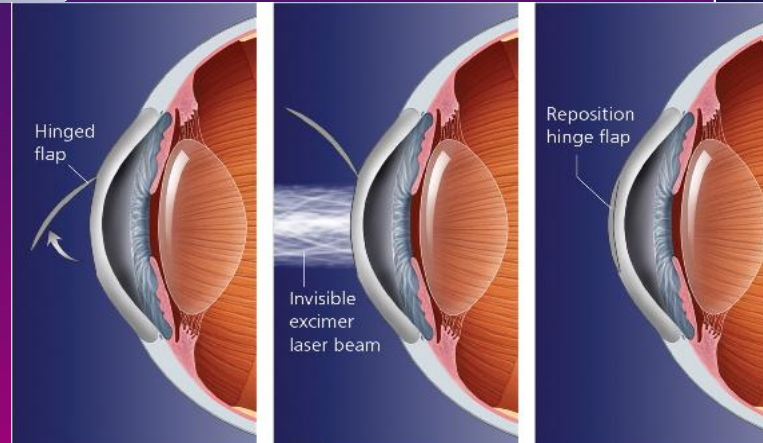
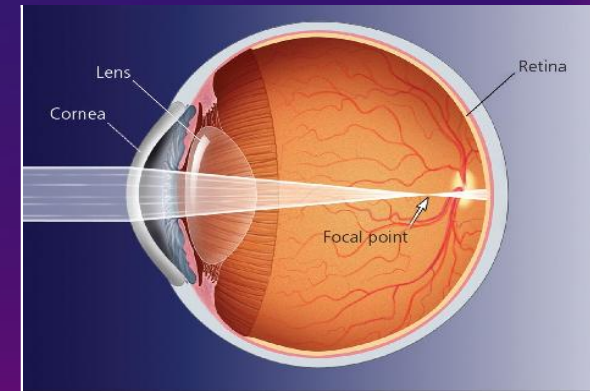
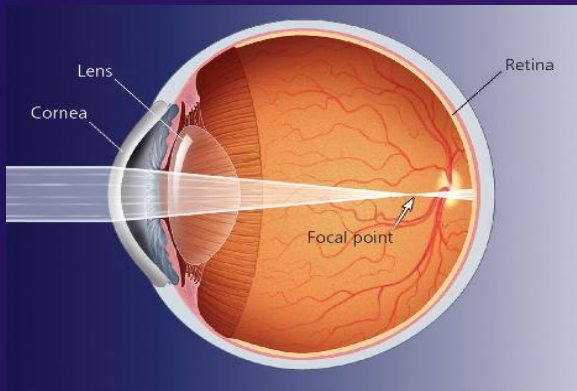
Further, while performing such surgeries, surgeons need to set multiple parameters like suction time, flap and hinge

## USABILITY

It may not be recommended for everybody for two reasons: (1) high cost with potentially no significant improvement for certain types of patients, and (2) possible eye complications after the surgery.



# SOLUTION



# KERATOCONUS OVERVIEW



## VISION PROBLEMS

KERATOCONUS eye surgery is the best known and most commonly performed laser refractive surgery to correct.



## RISKS

Certain side effects of eye surgery, particularly dry eyes and temporary visual problems such as glare, are fairly common.



## TESTED

To perform KERATOCONUS surgery you have to go through different tests for different types.



## ADVANTAGES

It corrects vision. Around 96% of patients will have their desired vision after KERATOCONUS. An enhancement can further increase this number.

# PREQUALIFICATION TESTS FOR KERATOCONUS SURGERY



## TESTS

Your eyecare provider will need to perform these tests to help determine whether you should proceed with KERATOCONUS surgery.

### Prescription Check

Before KERATOCONUS, an ophthalmologist may use cycloplegic eye drops. These drops temporarily paralyze the focusing muscle inside your eye. This allows the ophthalmologist to measure your total prescription without forcing you to focus too hard. Basically, it lets the ophthalmologist collect the raw data of your true vision.

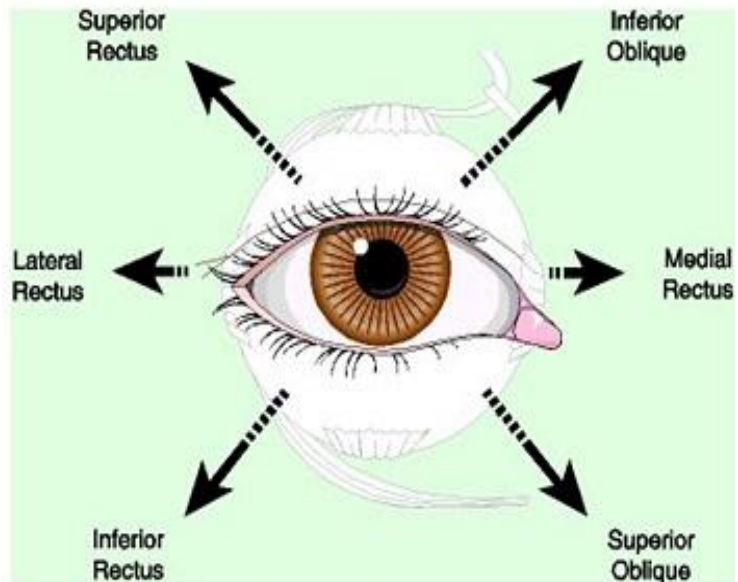


# PREQUALIFICATION TESTS FOR KERATOCONUS SURGERY



## TESTS

### MUSCLE TESTING: CARDINAL POSITIONS



### Eye Muscle Test

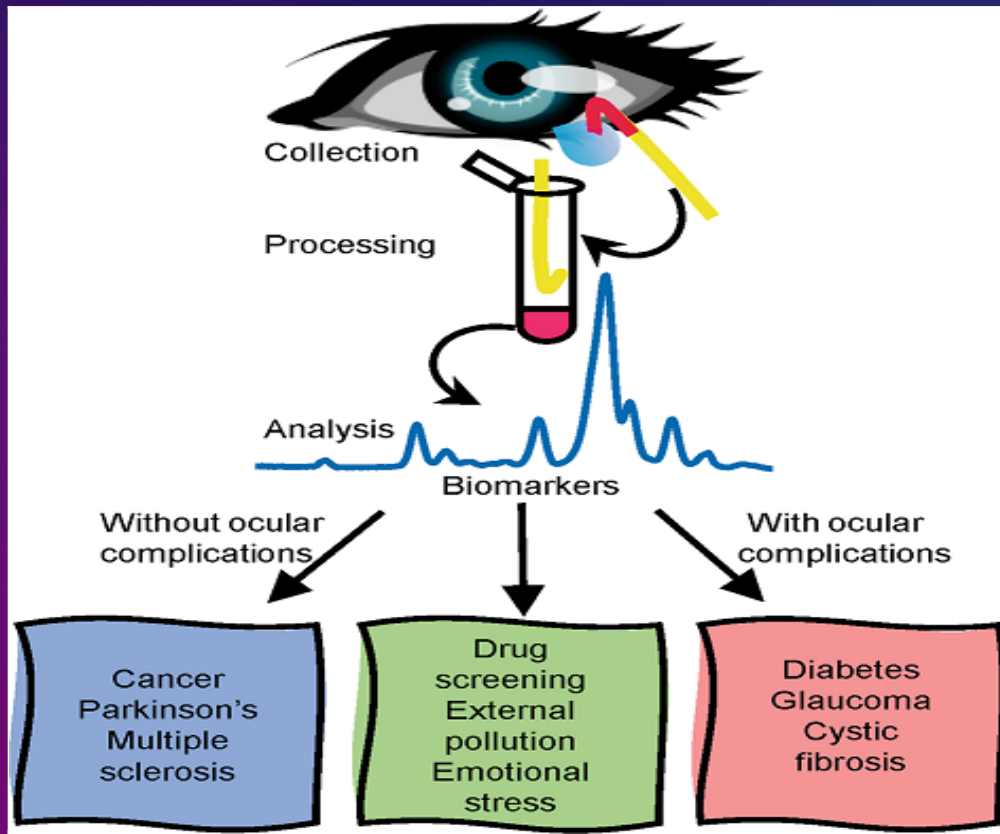
A binocular vision assessment is a vision test that checks how your eyes work together as a team. Your ophthalmologist will want to ensure that you do not have a binocular vision disorder, in which the eyes cannot merge the images into one in the brain.

The disorder can result in a wide array of vision problems, from dizziness and double vision to light sensitivity (photophobia) and poor depth perception. Such a disorder may interfere with positive KERATOCONUS results, so your ophthalmologist will want to eliminate it as a risk factor.

# PREQUALIFICATION TESTS FOR KERATOCONUS SURGERY



## TESTS



## Tear Analysis Test

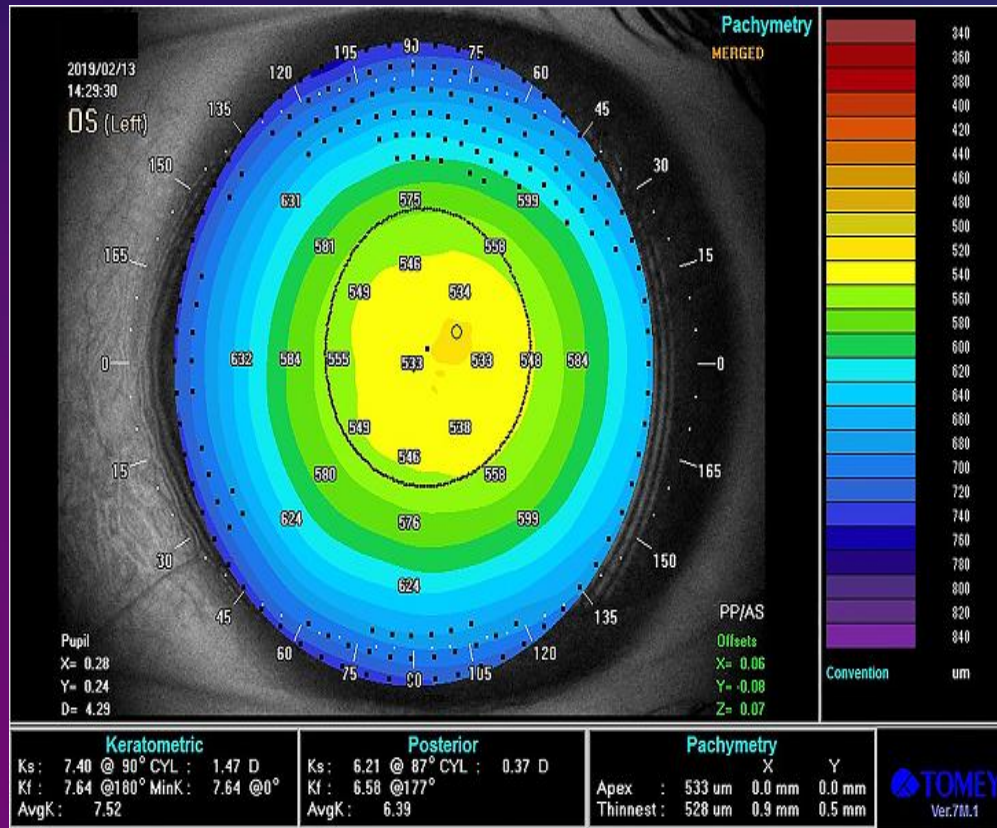
Qualitative and quantitative tear film tests examine your natural tears. If either one of these measures is not optimal, your ophthalmologist may choose to delay the KERATOCONUS procedure until the quality or quantity of your natural tears can be corrected.



# PREQUALIFICATION TESTS FOR KERATOCONUS SURGERY



## TESTS



## Cornea Measurements

Corneal topography is exactly what you would expect it to be:

A computerized method of determining the exact shape of the cornea. Measurements are computed and placed into color maps. Hotter colors, such as red, show steeper areas while cooler colors show areas that are flatter.

Some patients have a corneal shape that does not pose problems before KERATOCONUS but could put them at risk for developing a corneal disease, such as keratoconus, after having KERATOCONUS. This disease occurs when the cornea thins out and gradually bulges outward to form a cone shape.

# PREQUALIFICATION TESTS FOR KERATOCONUS SURGERY



## TESTS



## Wavefront Analysis

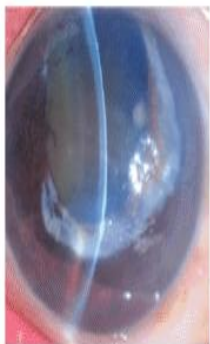


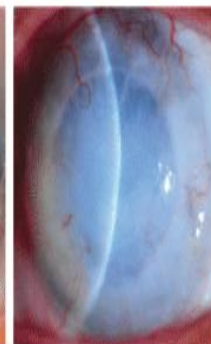
Wavefront analysis is a relatively new development in eye care and can be very important to measure vision deficits known as higher-order aberrations. These are similar to lower-order aberrations, such as near sightedness, farsightedness, and astigmatism. In all these aberrations, imperfections of the cornea can cause distorted vision.

Higher-order aberrations seem to be more apparent in some patients and often cause symptoms such as decreased night vision, glare, and halos around lights.

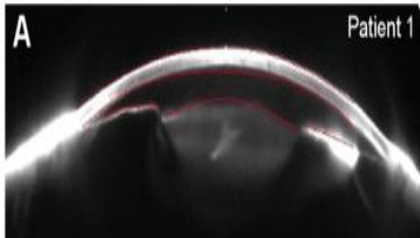
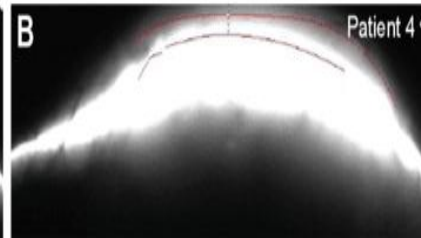
# PREQUALIFICATION TESTS FOR KERATOCONUS SURGERY



## TESTS

Patient		1	2	3	4
					
Mean	Pentacam	958	3,366	3,677	4,633
CCT	Visante	721	714	927	1,161
( $\mu\text{m}$ )	Cirrus	700	721	877	1,052
	Ultrasound	671	720	Error	Error

Pentacam		Patient 1
		Patient 4

## Corneal Thickness Measurement

A corneal thickness measurement (also known as pachymetry) discloses the thickness of the cornea and whether it's swollen. This quick and easy measurement is important for potential KERATOCONUS patients since the surgery depends on the health of the cornea. People with extremely thin corneas, for example, may not make good KERATOCONUS candidates.



## PREQUALIFICATION TESTS FOR KERATOCONUS SURGERY



### TESTS



#### **Pupil Size Measurement**

People with naturally large pupils or pupils that dilate heavily in dim light may experience more glare, halos, and contrast problems after having KERATOCONUS surgery. However, with today's laser techniques, this tends to be less of a problem.

Nonetheless, pupil size is measured with special devices, such as an infrared pupillometer, so that a better surgical plan can be devised.



## PHYSICAL EXAMINATION

# Complete Eye Examination

A complete eye examination is done, including tonometry and a posterior dilated exam.

Special attention is paid to the anterior segment of the exam.

Lid examination is important to look for signs of meibomian gland dysfunction.

If lid disease is present, pre-treatment is necessary for the patient.

Next, attention is focused on the conjunctiva and cornea, investigating for signs of dry eyes and punctate keratitis.

Staining with vital dyes, including fluorescein and Lissamine green are important to quantify dry eyes.

Next, it is important to look for any corneal irregularities/abnormalities, such as anterior basement membrane dystrophy, that may interfere with KERATOCONUS surgery.

Corneal scarring or vascularization may signal old infections, in which a herpetic infection could be a possibility. Anterior chamber and iris examination should be inspected for any signs of old iritis, or iris atrophy which again could signal the possibility of old herpetic disease, or other inflammatory diseases.

The posterior cornea should be inspected for signs of endothelial dysfunction such as guttae.

The crystalline lens should be carefully examined for any signs of cataract formation.

If cataracts are present, then KERATOCONUS surgery may not be indicated, and other alternatives may be discussed.

A complete dilated fundus examination is necessary. In highly myopic patients, it is especially important to perform a peripheral examination to look for tears and holes, which may need treatment by a retinal specialist before performing KERATOCONUS surgery.

However, no studies have found an increased risk of retinal problems such as retinal detachments after KERATOCONUS.

# TOOL OVERVIEW



# PROJECT MODEL

## RESEARCH

We based our research on whether the object is capable for surgery?

## ABSTRACT

We believe people need new Artificial Intelligence technology for the decision making strategy of eye surgery

## DESIGN

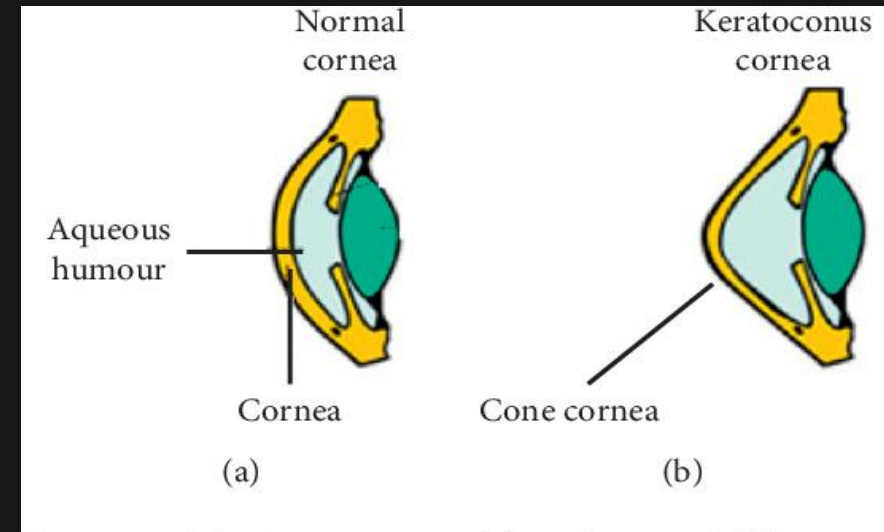
Minimalist design and easy to make the decisions for KERATOCONUS.



# OUR COMPETITION

## PLANS:

- Collecting data
- Model 1(csv data)
- Model 2(image data)
- Combination of models
- Project deployment

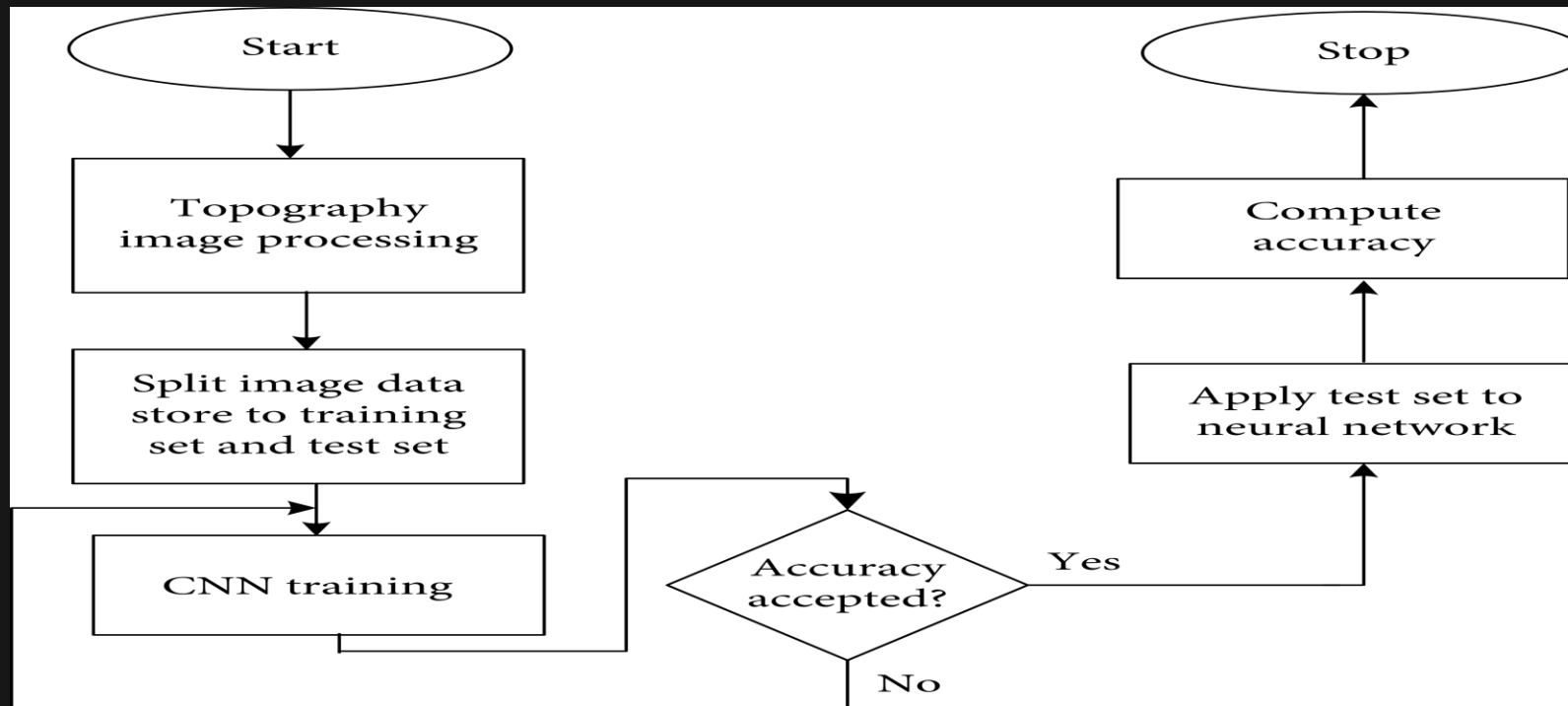




## CNN

The KeratoDetect algorithm analyzes the corneal topography of the eye using a convolutional neural network (CNN) that is able to extract and learn the features of a keratoconus eye. The results show that the KeratoDetect algorithm ensures a high level of performance, obtaining an accuracy of 99.33% on the data test set.

# CNN-PROPOSED ALGORITHM



Sr No	Title	Author	Abstract	Conclusion	Citation
1.	To investigate the association of laterality and severity of KC with allergic rhinitis, scratching, sleeping side, and manual dexterity.	•Author: Nofar Bar-Noy, Eyal Sheiner, Tamar Wainstock, Roy Kessous	Allergic rhinitis, sleeping side, ocular allergy, and itching.	Higher keratometry values and sleeping position have stronger association than that between keratometry and itching or manual dexterity.	Santos et al. (2021) <a href="https://link.springer.com/article/10.1007/s10995-021-03165-9">https://link.springer.com/article/10.1007/s10995-021-03165-9</a>
2.	To explore a wide range of risk factors associated with the severity of keratoconus (KC)	Srujana Sahebjada, Elsie Chan, Jing Xie, Grant R Snibson, Mark Daniell, Paul N Baird	Questionnaire addressing age, gender, educational background, ocular and medical history, smoking and alcohol	Our study has reported asthma as the only risk factor found to be significantly associated with the severity of KC. The results of this study	Sahebjada et al. (2020) <a href="https://link.springer.com/article/10.1007/s10792-020-01644-6">https://link.springer.com/article/10.1007/s10792-020-01644-6</a>
3.	To determine the prevalence of keratoconus (KC) among children with ocular allergy.	Amélie Harle, Alex Molassiotis, Oliver Buffin, Oliver Buffin, Jack Burnham, Jack Burnham, Jaclyn Smi...	The overall prevalence of KC was 34%. Risk factors for the development of KC in patients with ocular allergy were age, duration of symptoms specially eye rubbing,	systemic atopy, and VKC	Ahmed et al. (2020) <a href="https://bmc.cancer.biomedcentral.com/articl">https://bmc.cancer.biomedcentral.com/articl</a>



Thank you

## THANK YOU

Project Teacher

“Dr. Jayshree Prasad”

+91-98902-02229

[jayashree.prasad@mituniversity.edu.in](mailto:jayashree.prasad@mituniversity.edu.in)

Brijkishore Agarwal

+91-91469-17272

[brijkishorea27@gmail.com](mailto:brijkishorea27@gmail.com)

[www.mituniversity.edu.in](http://www.mituniversity.edu.in)