"EFFECT OF PTERYGIUM SURGERY ON PRECORNEAL TEAR FILM"

By

DR. CHAVA PREETHI, M.B.B.S

Dissertation submitted to

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH CENTRE, TAMAKA, KOLAR

In partial fulfilment of the requirements for the degree of

MASTER OF SURGERY
IN
OPHTHALMOLOGY

Under the guidance of

DR. USHA B.R

MBBS, DNB, PGDMLE, MBA.

DEPARTMENT OF OPHTHALMOLOGY

SRI DEVARAJ URS MEDICAL COLLEGE TAMAKA, KOLAR.

2024

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EFFECT OF PTERYGIUM SURGERY ON PRECORNEAL TEAR FILM

Abstract

Purpose

Objectives

Materials and methods

Results

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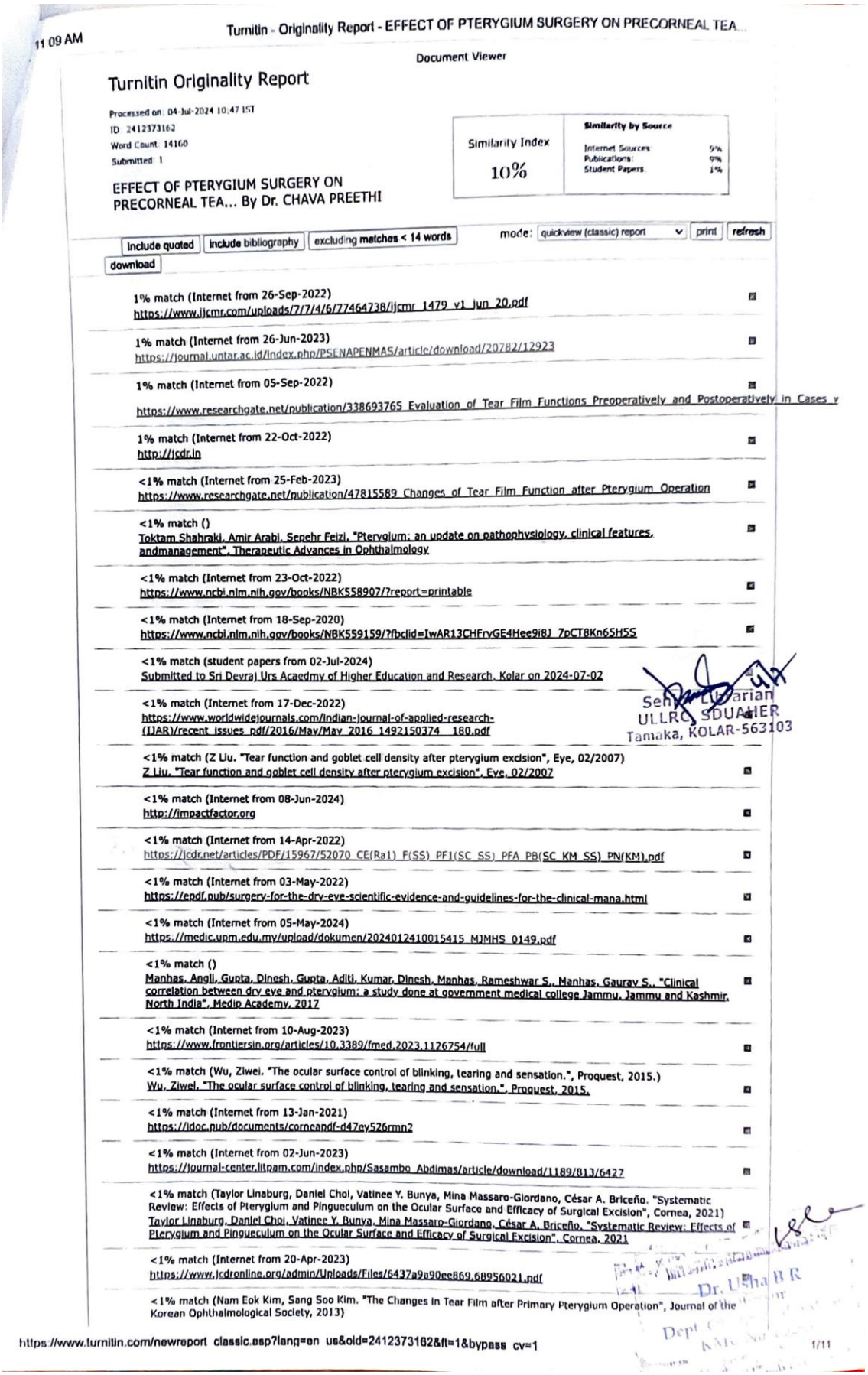

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LIST OF ABBREVATIONS

Abbreviation	Meaning
AP1	Activator Protein 1
DED	Dry Eye Disease
EOM	Extra Ocular Movement
HPV	Human Papilloma Virus
IgA	Immunoglobulin-A
IL	Interleukins
IOP	Intra Ocular Pressure
IQR	Interquartile Range
LSC	Limbal Stem Cells
MAP-K	Mitogen-Activated Protein Kinase
MGD	Meibomian Gland Dysfunction
MMP	Matrix Metalloproteinases
MMC	Mitomycin C
nF-kB	Nuclear Factor Kappa B
OCT	Optical Coherence Tomography
OSDI	Ocular Surface Disease Index
OSSN	Ocular Surface Squamous Neoplasia
ST	Schirmer's Test
ST-1	Schirmer's Test 1
ST-2	Schirmer's Test 2

TBUT	Tearfilm Break Up Time
TMH	Tear Meniscus Height
TMA	Area of the Tear Meniscus
TMR	Radius of the Tear Meniscus
TMH	Tear Meniscus Height
UV	Ultra Violet
VA	Visual Acuity
VI	Vascularity Index

ABSTRACT

Purpose

Pterygium is a common disease of the ocular surface characterized by the invasion of fibrovascular tissue from the bulbar conjunctiva onto the cornea. It can cause chronic ocular irritation, tear film disturbances, induced astigmatism, and decreased vision secondary to growth over the visual axis.[1]

- The first line of defence against environmental injury, including ultraviolet exposure is the precorneal tear film. Many authors suggest that disturbed tear film function in pterygium occurs because of pathological conjunctival, corneal, or eyelid changes while others suggest that abnormal tear function is a risk factor for dry eye.[2]
- Therefore we are investigating the tear film changes before and after pterygium surgery in tertiary care centre kolar .There are lot of patients coming with complaints of burning sensation, foreign body sensation with pterygium of different grades.
- The presence of pterygium and dry eye symptoms often co-exist. Pterygium disturbs the tear film. The extent to which the excision of pterygium will affect the tear film needs to be evaluated.[2]

Methods

This prospective observational study was done on all consecutive patients with pterygium came to ophthalmology OPD at R L Jalappa hospital in kolar from August 2022 to December 2023. A total of 39 eyes were included in each group of which 12 were males and 27 females. All the patients subjected for detail visual acuity (VA) assessment, slit lamp examination, intraocular pressure (IOP) estimation, tear film function tests and underwent Pterygium excision with conjunctival limbal autograft. They were followed post- operatively 1 week, 4 weeks and 6weeks.

Results:

Majority of the patients were females (69.2%), while 30.8% were males with average age (in years) as 51.33 years. Majority had Type 2 (51.3%), followed by Type 3 (26.6%) and Type 1 (23.1%).

Schimers test 1 was significantly decreased in the affected eye compared to control eye at pre-op and 1 week following post-op. There was no significant difference in the ST1 at 4 weeks and 6 weeks between the affected and control eyes.

Schimers test 2 was significantly decreased in the affected eye compared to control eye at pre-op, one week and four weeks following post-op. There was no significant difference in the ST-2 at 6 weeks between the affected and control eyes.

TBUT was significantly decreased in the affected eye compared to control eye at pre-op, and 4 weeks following post-op. There was no significant difference in the TBUT at 1 week and 6 weeks between the affected and control eyes TMH was significantly lower in the affected eye than the control eye at pre-op, and 1 week following post-op. No significant difference in the TMH at 4 weeks and 6 weeks between the affected and control eyes was noticed Comparision of schirmers test 1, schirmers 2, TBUT and TMH at 1week,4week & 6 weeks between preop and post op in type 1 pterygium**,** among the affected eye, the tear film function significantly improved.

Conclusion

Our research found that after the pterygium was removed, the measurements, such as Schirmers and Tear Break-up Time (TBUT), showed improvement over time. After a month after the operation in the affected eye, the Schirmers and Tear Break-up Time were almost as close to the control eye's values. This suggests that the dry eye symptoms related to the pterygium got better after the surgery. Nonetheless, our research did not include a long-term

check-up to explore if the pterygium would come back and how it might affect the tear film's function.

Keywords: Pterygium, Tear film, Dry eye disease, Tear film function tests, Ocular surface

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INTRODUCTION

INTRODUCTION

A key feature of pterygium, also known as surfer's eye, is the growth of limbal and conjunctival tissue on the edge of the cornea, creating a wing-like structure. The main elements of pterygium consists of the growth of limbal stem cells (LSCs), changes in the cornea's epithelial cells, the presence of active fibrovascular tissue, inflammation, and rupture of Bowman's layer at the edge of the pterygium. These changes occur due to alterations in the balance of the eye's surface environment.[1]

Pterygium development is hypothesized to be more susceptible to certain environmental conditions. The chance of acquiring these disorders is believed to be increased by over exposure to sunshine and ultraviolet (UV) radiation, with pterygium showing a higher correlation.[2] One theory is that UV radiation induces a mutation in the p53 tumor suppressor gene, which activates transcription factors that support the development of pterygium, including “activator protein 1 (AP-1)” and “nuclear factor kappa B (nF-kB)”. Additionally, pterygium has been linked to various eye conditions.[3] For instance, data suggests that individuals with dry eye disease (DED) have a higher prevalence of pterygium. According to a research, the likelihood of dry eye in a person with a pterygium was three times higher than in a patient without one.[4]

The effects of pterygium excision on epithelium of the eye surface and refraction were explored in great detail; however, little is known about the relationships between pterygium characteristics and excision prognosis. Pterygium has several symptoms with meibomian gland dysfunction (MGD) and dry eye, such as irritation and dryness.[5] As per the past studies, pterygium may directly cause localized rise of conjunctiva and unequal tear distribution, which may result in aberrant tear dynamics and dry eyes.[6]

Various studies have explored the relationship of pterygium with the stability of the tear film,

using tests like the “Schirmer's test (ST)” or “Tear Break-up Time (TBUT)”. These tests suggest that pterygium-related eyes tend to have lower ST and TBUT, pointing to a relationship of tear instability with issues of the eye's surface. The TBUT, which evaluates tear production qualitatively, indicates that a shorter TBUT is linked to tear film instability. This test is relatively easy and fast for assessing tear film health. The only therapy for pterygium is surgery. Options include the bare sclera method, conjunctival autografting, and additional treatments like MMC.[7]

Yet the studies assessing the impact of pterygium surgeries on the dry eye parameters are limited in Indian settings. Hence, the present study has been undertaken.

AIMS & OBJECTIVES

OBJECTVES OF STUDY

1. To assess precorneal Tear film before and after pterygium surgery.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

- **Pterygium**

One of the prevalent illnesses of the ocular surface is pterygium. The term "pterygium" is derived from two Greek words: pteryx, which means wing, and pterygion, which means fin. The earliest known ophthalmic surgeon, Sushruta, initially described it about 1000 BC.[8] Fibrovascular growth of the subconjunctival tissue that takes the form of a triangle shape and invades the cornea via the medial and lateral palpebral fissures is called as pterygium.[9]

❖ ***Epidemiology- Burden***

According to studies on population demographics, the occurrence of pterygium can vary from just 1 percent to more than 30 percent. An overview of twenty studies, all published in 2015, showed that the combined occurrence of pterygium was approximately 10 percent. A study focused on people living in rural areas of China discovered the greatest frequency of pterygium, reaching a rate of 33 percent.[10]

A few documented risk factors for pterygium include age, male sex, prior outdoor work experience, poor education, living in a rural area, having a darker skin tone, and smoking. According to a research conducted in North America, Black people were 2.5–3 times more likely than White people to have pterygium. Pterygium is most prevalent around geographic latitude 40° near the equator, despite its global presence. It is stated that the prevalence rate of pterygium in this location is almost ten times greater than that of the surrounding area. This finding provides compelling proof for the UV irradiation involvement in the pathogenesis of pterygium.[10]

❖ ***Etiology***

The immune system, inherited traits, and ongoing exposure to environmental factors—this encompasses UV (ultraviolet) rays, warmth, arid climates, breezes, dusty surroundings, and the length of time spent in these conditions—are among the various known risk elements. The leading cause, nonetheless, is extended exposure to UV rays from the sun, with subsequent continuous eye discomfort from dry, dusty settings.[11]

Many studies on epidemiology have discovered a link between exposure to UV rays and the growth of pterygium.[12] The area lying between the 40 degree north and south latitudes of the equator, where there is a elevated level of UV radiation impacts the inhabitants, is known as the "pterygium zone".[13] Subsequent research revealed that pterygium was highly common among specific families over several generations, suggesting that genetic elements might contribute to making the conjunctiva more susceptible to intense responses to external factors.[14]

Besides UV rays and genetic traits passed down through generations, it's believed that viruses also played a part in the development of pterygium, contributing to a complex series of steps in its progression. These factors play a part in the "second hit" hypothesis, which postulates that oncogenic viral infections cause pterygium to arise in genetically predisposed people.[15]

Over the nasal side in the interpalpebral zone, the following processes are thought to be responsible for the prevalence of pterygia:[9]

- The light focus travels from nasal limbus through medial part of cornea hence receives more light than temporal limbus, where the light rays travelling towards it are blocked by the nose.
- The area around the eye and the cornea are protected from light by longer eyelashes on the upper part of the eye that curve outward, covering two-thirds of their length.
- Dust that gets into the space around the eye can cause more irritation to the area near the

nose compared to the area near the temples. Normally, tears flow from the area around the temples to the area near the nose, close to the tear duct.

- Irritants can lead to increased redness in the area near the nose because this area has two blood vessels that supply the ciliary muscles, while the area near the temples only has one.

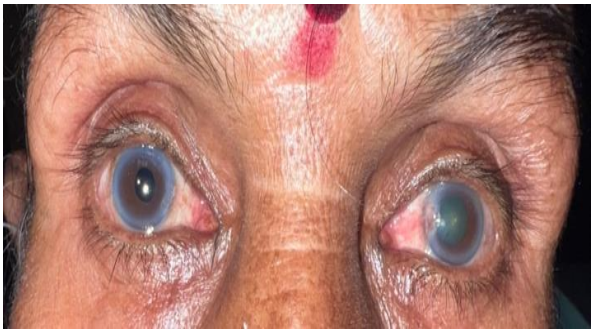
Pathophysiology

Pterygium is characterized by fibrovascular growth and elastotic degradation of the collagen, with an intact epithelium covering it. The aberrant collagen of the elastotic degeneration exhibits basophilia on the H&E stain. Additionally, it colors like elastic tissue, but because elastase does not break it down, it is not real elastic tissue. Cellular proliferation, tissue remodelling, and neovascularization are the hallmarks of these lesions. Following the removal of these growths, the cornea remains scarred because the pterygium causes the bowman's membrane to rupture. The development of pterygium is initiated by ultravoilet radiation, even if the pathophysiology of the condition is unknown.[16] Researchers have found that the elastotic alterations in the pterygium are similar to the actinic degenerative alterations in skin that has been exposed to UV light on a regular basis. 23 Several investigations have shown that the expanding margins of the lesions express metalloproteinases (MMPs) and their inhibitors.[17] MMPs could be important in tissue remodelling, invasion, and bowman's layer degradation related to pterygia.

Pterygium is an epithelial hyperplasia and fibrovascular development that starts at the limbus. These altered limbic cells actively travel in the direction of the cornea by processes including angiogenesis, tissue remodelling, cell proliferation, and inflammation. The first trigger appears to be UV light, which stimulates epithelial cells in the vicinity of the limbus to release growth factors and cytokines (IL-6 and IL-8) that lead to tissue remodelling, fibrovascular proliferation, angiogenesis, anti-apoptosis, and inflammation. One such marker of pterygium invasion is the destruction of Bowman's membrane. the following elements that

contribute to pterygium pathogenesis.[16]

Figure 1 : Pterygium



Clinical Characteristics

Patients often show up with symptoms of eye discomfort, lacrimation, feeling of a foreign body, cosmetic imperfection, and a variety of functional issues, such as blurred vision and trouble getting contact lenses to fit properly.[9]

A thorough medical history should be obtained, including information on age, gender, employment, and exposure to dust, smoke, and sunlight. Asking about prior treatments and pterygium in the family is important. The patient should have a general physical examination as well as a systemic examination to exclude the presence of mucocutaneous problems. To categorize the pterygium into (a) main pterygium and (b) recurrent pterygium, history should be considered. Malignant pterygium is described in older textbooks as a recurring pterygium that causes symblepharon development and limits the motions of the eyes. Conversely, a pterygium is a benign condition that needs to be identified apart from cancerous conditions like ocular surface squamous neoplasia (OSSN) through the examination of tissue samples, impression cytology, and/or the patient's symptoms.[9]

❖ ***Diagnosis***[9]

A detailed check-up of the eyes is necessary, which involves evaluating visual acuity, extraocular movements (EOM), and anterior segment assessment. A comprehensive eye test should be conducted to assess the astigmatism type as well as severity.

To assess the health of the tear film, the ST (schirmers test), TBUT (tear film break up time) and TMH (tear meniscal height) is done. The position, size, blood supply, spread, and coverage of the cornea affected by the pterygium (the area from the edge of the eye to the cornea and how much the cornea is touching the edge) should all be considered when examining the pterygium. This examination can be performed with a torchlight from an angle and confirmed with a closer look under a microscope. It is noted if there is a Stocker's line present.

Complications/Outcomes

Corneal astigmatism

The patient's visual function may be compromised much earlier in the illness, leading the ophthalmologist to operate before the disease reaches its final state, even if the main reason for the operation is the physical obstruction of the eye's line of sight by a pterygium. A pterygium can lead to astigmatism and unevenness on the eye's surface, which can greatly impact the regularity of the cornea's surface.[18] Pterygium often leads to a type of astigmatism that is aligned with the eye's axis, owing to flattening of the eye's horizontal meridian at its leading edge.[19] It is suggested that the basic mechanism behind the flattening of the cornea horizontally involves the formation of a tear-like space between the middle of the cornea and the edge of the pterygium.[20] This alteration in the corneal shape, caused by the pterygium, happens uniformly across the cornea's nasal paracentral area, making it difficult to measure

using standard refraction or traditional keratometry. Therefore, it appears that computerized video keratography is the best technique for evaluating changes in the cornea's shape in individuals with pterygium.[19]

Astigmatism caused by pterygium = 0.080× RL (percent) + 0.039× VI – 0.823,

where VI is the vascularity index, which is calculated using computer algorithms on an anterior segment, and RL represents the size of the pterygium divided by the width of the cornea in horizontal extent.[10] The development of the pterygium and an increase in corneal irregularity have been linked, according to a research conducted over 456 patients.[10] Multiple data sets evaluated using Fourier harmonic analysis in this study revealed that topographical irregularity caused by pterygium progression preceded other irregularities.[18]

The term "ocular surface squamous neoplasia" (OSSN) describes a range of surface abnormalities, from aggressive SCC to moderate dysplasia.[21] Pterygium and OSSN may coexist or even be connected since they share similar risk factors. Among these frequent risk factors include UV rays, persistent inflammation, extended contact to dust and other ocular surface irritants, as well as oncogenic viruses like HPV.[22] Two characteristics have been linked to a greater incidence of OSSN in pterygium samples: older age and inferiorly situated pterygia. Conversely, Kao et al. found no substantial variation in the mean age among the casses with pterygium linked to OSSN and those without OSSN.[23] They reached the conclusion that, in cases involving pterygium, age was not a determinant for the OSSN onset.[24]

- ❖ ***Management***
- ✓ ***Medical***

In modern healthcare, the use of synthetic tears or nasal decongestants is common to slightly

improve appearance and offer short-term relief. Loteprednol eye drops, applied directly to the eye, offer additional comfort. Medications that constrict blood vessels help to decrease redness, enhance appearance, and mix with decongestant eye drops to reduce swelling and discomfort caused by histamine.[25]

- ✓ ***Surgical***

Removing a growing pterygium before it touches the central cornea stops the eye's main line of sight from being blocked by a lasting corneal scar, because the pterygium that's taken out will create a scar on the cornea. The progress a patient says they've made might not be the same as what the doctor sees; this can be checked by looking at the pterygium's dimensions during later check-ups.[26] In a similar manner, restricted eye movement brought on by a big pterygium seems to call for surgery. Atypical characteristics suggestive of dysplasia should also prompt early action, as delaying the removal of a suspected neoplastic tumor puts the patient at risk for intraocular or systemic involvement. Ophthalmologists may disagree on a few more disorders in addition to these clear indicators. Before reaching the corneal center, pterygium may be the cause of a vision-impairing astigmatism, which may motivate the surgeon to do an early procedure to correct the patient's refractive defect. The available research, however, indicates that it is challenging to forecast the degree of astigmatism reversal after surgery. It is important to consider the potential decrease in corneal astigmatism in comparison to the surgical risks and sequelae, particularly the recurrence rate of pterygium. It is still debatable whether pterygium removal is necessary to control chronic signs and symptoms like redness and irritation; the surgeon should always rule out blepharitis and dry eye as the cause of any presenting symptoms in favor of other coincidental ocular surface conditions. The circumstances around pterygium excision are similar to those surrounding a cosmetic procedure. In these cases, it's critical to discuss the operation, the post-operative

recovery time, and the likelihood of pterygium recurrence with the patient.[26]

Grades of pterygium[27]

"Type 1 extends less than 2 mm onto the comea. A deposit of iron (Stocker line) may be seen in the comeal epithelium anterior to the advancing head of the pterygium.

Type 2 involves up to 4 mm of the come and may be primary or recurrent following surgery

Type 3 encroaches onto more than 4 mm of the cornea and involves the visual axis."[27]

Tear Film

The tear film, which covers the ocular surface, is vital for keeping the conjunctiva and the avascular cornea healthy as well as shielding the eye from the elements and lubricating the surface. It also helps to maintain a smooth surface for light refraction. The secretion of the tear film occurs at a rate of 1 to 2 microliters per minute, with a volume ranging from 3 to 10 microliters and a thickness of 3 micrometers.[28] The mucin layer on the inside, the aqueous layer in the center, and the lipid layer on the outside are the three primary components that make up this structure. When the eyelids are closed for extended periods, like during sleep, there's an increase in carbon dioxide levels, which lowers the pH. The conjunctiva and accessory lacrimal glands in the eye produce only a small amount of aqueous tear layer, which is mainly made by the larger primary lacrimal glands. Evaporation or excretion of the tears via the lacrimal puncta are the two possible outcomes.[29]

Layers

The inner mucin, middle aqueous, and outside lipid layers make up the three separate and heterogeneous layers that make up the tear film. However, there is mixing and overlap between strata in a more practical sense. Delicate lipid layer, ranging from 50 to 100 nanometers in thickness, along with an aqueous phase that contains different amounts of

mucin depending on the content of the layer, constitutes the majority among the tear film.[28]

The goblet cells that are found in the epithelium of conjunctiva, the acinar cells that are found in the lacrimal gland, and the corneal epithelium and conjunctiva are the cells that secrete mucins, which are responsible for the foundation of the inner layer. According to Hodges, it serves to stabilize the aqueous layer. The concentration of them decreases in the more superficial layers and is highest in the innermost tear layer. Proteins, urea, salts, glucose, immunoglobulins, and glucose are also present in the mucin layer. Mucins play a crucial role in making sure the eye's surface is evenly moisturized by securing the watery layer to the water-repellent corneal layer through the glycocalyx. They also improve the stability and decrease surface tension at tear film.[28]

The aqueous layer is necessary for the ocular surface to remain lubricated and protected. It is made up of substances that all of which are necessary for both cleaning the ocular surface and removing pollutants and detritus.[28,30]

The lipid layer is present at the interface between the environment and the tear and is crucial in slowing down the pace of tear evaporation. Fatty acids, phospholipids, wax esters, and cholesterol are all present in this outermost lipid layer. Tears include more than 600 distinct lipids from 17 different lipid groups. They are mostly generated by the meibomian glands, which are present at edge of the eyelid. More specifically, polar and nonpolar lipids are present in meibum. The main ingredients of the polar component, which acts as a surfactant, include phospholipids, phosphatidylcholine, and sphingomyelin. The main ingredients of this layer are wax esters and cholesterols.[30]

Figure: 2 - Position of tear film[31]

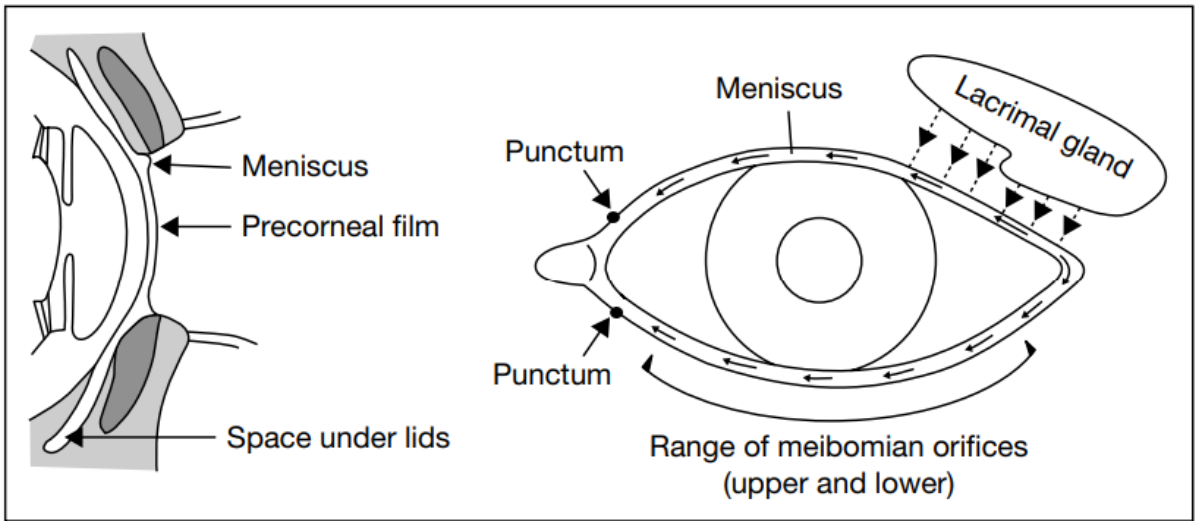


Figure:3 - Ionic composition of normal human tears[31]

Ion	Concentration mmol · l^{-1}
Na^+	128.7
K^+	17
Ca^{2+}	0.32
Mg^+	0.35
HCO_3^-	12.4
Cl^-	141.3

❖ ***Functions***

The cornea doesn't have blood vessels because transparency is essential. Oxygen and nutrients are provided directly through the tear film because the slow diffusion from blood vessels at the corneal edge wouldn't be enough to meet their needs; the tear film functions as bridge for O_2 from the air, as demonstrated by the effectiveness of contact lenses with varying transparency levels. Similarly, the aqueous humor in the anterior chamber of the eye

fulfills a similar role for the corneal endothelium. Given that the tears are exposed to air when the eye is open, it's believed they are full of oxygen. But after closing the eye, O_2 should come from the blood in the blood vessels of the conjunctiva (55 mm Hg), leading to a significant change in the corneal cells' oxygen levels between these two conditions.[32] It's important to note that when the eye is closed, the tear fluid that spreads under the eyelids likely acts as a coupling agent for the cornea. The exact thickness of this layer is unknown, but it's also thought that a mucous layer which is of moderate thickness, created by the overlapping mucous layers on the cornea and the tarsal conjunctiva, covers most of this area.[31]

Physical Protection: The tear film' outermost layer can sometimes reflect lighter substances like dust, hair, or bacteria, particularly those that are attracted to water and tend to bounce off the oil layer. Shying away, or rapidly blinking one's eyes or lowering the eyebrows, can stop many harmful or intimidating substances from reaching the eye. A large number of particles and microorganisms are trapped, soaked up, and held in place by the mucous layer that lines the eye's surfaces. After that, these particles and bacteria are expelled from the eye as a component of the mucous thread. This mucous thread is then transported to the lower fornix, where it is finally expelled onto the skin surrounding the inner corner of the eye. The lubricating property of the mucous layer also protects the delicate skin at the eye's surface from friction damage, which can occur at speeds as fast as 20 centimetre per second during a single blink.[31]

Tears contain various components that possess properties against bacteria. The capacity of lipocalin and lactoferrin to bind with iron limits the growth of bacteria that rely on iron, while lysozyme is most known for its role in breaking down the cell wall of Gram+ve bacteria through its muramidase function.[31] Following plasma cell priming against certain microbes

and viruses—priming may occur through mucosa-associated lymphoid tissue in the conjunctiva—secretory IgA provides immune protection.[33] Recently, immunochemical techniques have been used to identify a set of tiny defensive peptides called defensins in the tears. They are said to hasten the healing process of the epithelium and possess a wide range of antibacterial action against bacteria, fungi, and viruses.[34]

❖ ***Evaluation***

The film's thickness must be known in order to estimate the tear volume. Not with standing the fact that several methods were used throughout the years, measuring this is difficult. Basic methods involve placing a piece of absorbent paper around the eye to soak up liquid within a specific region, determining the brightness of fluorescence following the addition of a predetermined quantity of fluorescein to the paper, or separating a part of the tear film by pressing the tip of a broad-necked syringe against the eye and noting the amount of liquid removed.[31,35] Lately, three approaches have been employed to examine the variation in the intensity of light reflected: altering the angle, frequency, or wavelength. "Optical coherence tomography (OCT)" can evaluate the thickness of the film by contrasting the thickness of the cornea when a contact lens is present versus when it is not. The thickness of the film on the front of a contact lens is usually shallower and more variable compared to the film before the cornea, although this difference can vary based on the kind of contact lens and other elements such as how much the surface of the lens is affected by components in the tears.[36]

TBUT is a duration assessed using a slit-lamp microscope to examine the consistency of the tear layer following the injection of fluorescein. A TBUT of less than 10 secs is considered unusual and frequently indicates evaporative "dry eye disease (DED)".[37]

The tear film' stability may be determined by measuring the tear osmolarity. In healthy eyes, osmolarity is between 300 and 310 mOsm/kg, but in patients of DED, it may exceed 360

mOsm/kg.[38] Insufficient tear production or too much tear evaporation and replacement result in tear hyperosmolarity. Prolonged tear hyperosmolarity is associated with pro-inflammatory pathways activated by mitogen-activated protein kinase (MAP-K), which could damage the corneal layer and goblet cells, as well as produce inflammatory substances and cytokines.[39,40] Inflammatory cytokines and matrix metalloproteinases are produced more when MAP-K pathways are activated.

Fluorescein, lissamine green, and rose bengal staining of the ocular surface might be utilized to see surface flaws in the cornea as well as dead and degenerated cells. Schirmer's test is a useful tool for assessing tear production since it tracks the quantity of tears produced over time. The ST measures the amount of wetness from tears by inserting a strip into the lower eyelid. Another way to determine the tear volume is to examine the tear meniscus. Biomarkers that cause inflammation, such as lactoferrin, lysozyme, and matrix metalloproteinases, can be assessed to gauge the extent of eye inflammation and irregularities in the tear layer.[37]

TBUT

The time interval from last blink to the earliest development of a black spot in the fluorescein-stained tear is known as the TBUT. Apart from the slit light, most of the other tests need specific equipment, which makes them impractical to employ in private practice. It's possible that the TBUT test is the easiest, quickest, and most practical of the minimal number of tests available for determining stability of tears, which explains why it's been reluctantly abandoned in clinical practice. The contradictory results that many researchers employing the TBUT test have produced may point to the test's flaws. Despite being widely used, the TBUT test's methodology varies from investigator to investigator. For instance, there are differences in the way fluorescein is injected, the frequency blinks permitted prior to

TBUT measurement, the frequency of fluorescein is applied at the time of the test, and the number of TBUT measurements taken for each subject on every occasion.[41]

✓ ***Principle/Procedure***

A wide beam of cobalt blue light is used to study the patient's tear film while fluorescein is injected into it. The patient is instructed not to blink throughout this process in order to quantify TBUT. As may be observed in this evolution of these slit lamp photographs over time, TBUT is measured as the total seconds that pass between the final blink and the emergence of the first dry patch in the tear film. A TBUT of less than ten seconds is deemed abnormal. Another indicator of dryness on the ocular surface, punctate epithelial erosions (PEE) in this patient stain positively with fluorescein. [42]

❖ **Schirmer's test**

Schirmer test (ST), also referred to as the Schirmer tear test (STT), is employed to assess the amount of tears produced, especially in individuals experiencing dry eyes, excessive tear production, or indications of keratoconjunctivitis sicca.[43] The Schirmer test comes in two varieties: Schirmer test 1 (ST-1) gauges basal and reflex total tear production. Schirmer test 2 (ST-2) is a reflex secretion measure that solely uses nasal stimulation once the strip is inserted.

Schirmers test types

ST-1

Applying a topical anesthetic before inserting the strip is one Schirmer I variant that would enable basal secretion measurement. Anesthetic administration during the ST-1 might give a more realistic picture of basal secretion, however there is debate on the usefulness and overall

efficacy of this combination.[44]

ST-2

The primary purpose of the ST-II test is to measure the reflex tear secretion of the major lacrimal gland by utilizing a cotton-tipped swab so that the nasal mucosa can be irritated before assessing tear production. Although Prause et al. reported that this commonly used test is reliable and reproducible in practice,[45] several other studies have shown that it lacks precision and reproducibility in detecting dry eye, and there can be significant variation in test results taken from the same subject at the same time every day for several days.[46]

- ✓ ***Procedure***

The principle of capillary action, that permits the moisture in tears to pass through a paper test strip in a manner similar to that of a vertical capillary tube, is the mechanism behind the test. The speed at which tears are generated is in a direct relationship with how quickly they travel along the test strip.[47]

Tear test strips marked "L" for the left eye and "R" for the right eye are utilized for the examination. After this, each strip is bent back and forth at an angle of ninety degrees. The patient's lower eyelid is gently pulled down, and they are directed to look up. In order to ensure that the strip is positioned between the bulbar and palpebral conjunctivas of the lower eyelid for optimal results, the bent end of the strip is inserted into the eye. The aforementioned process is then carried out once again for the second eye. Following the placement of both strips, the patient is instructed to shut their eyes in a gentle manner for a period of five minutes without engaging in any kind of pressure. Following the completion of this time period, the patient will be instructed to open their eyes and gaze upward once again in order to remove the test strips. The wet strip area length, as indicated by the scale provided

with the strips, along with the time it took to measure this, is used to determine the Schirmer test result. Stevens considers a score of over 10 mm in five minutes to be normal. A tear deficiency is noted if the score falls below 5 mm in five minutes.[48]

To identify issues such as DED, which may show a range of signs including a burning or stinging feeling, a burning or tearing sensation, sensitivity to light, and/or occasional sharp pains in the eyes, the Schirmer test is employed during eye check-ups to assess tear production. Keratoconjunctivitis sicca refers to the inflammation of the cornea and conjunctiva, along with the broader condition of dry eye. There are two varieties of dry eye: reduced tear production and increased tear evaporation. Both subtypes cause the precorneal tear film, which typically protects the eye, to be insufficiently fluid. Approximately ranging from 5 percent to 34 percent, it stands as the most prevalent eye condition among the elderly and is among the top issues faced in the field of ophthalmology. Factors such as age over 50, being female, and undergoing refractive surgery increase the likelihood of developing dry eye. A new, more comprehensive definition of dry eye was introduced in 2007, characterizing it as a complex disease that impacts the tear quality and the eye's surface, leading to discomfort, reduced vision, and potential damage to the eye's surface. Furthermore, it involves a discomfort of the eye's surface and an increase in the tear film's osmolarity concentration.[49,50]

TMH

The tear volume and tear film condition may be evaluated using the "tear meniscus height (TMH)". 75–90 percent of the entire tear volume is contained in the tear meniscus, which is situated in outside border of the upper as well as the lower eyelids.[51] The lower tear meniscus is more stable, and the lower tear meniscus index—which is likewise targeted at the lower tear meniscus—is the primary tool used in the DED study.[52]

- ***Principle/Procedure***

TMH is either partially or fully manual. For instance, doctors must participate in the evaluation process to determine and delineate the top and bottom boundaries of the tear meniscus in the picture, and they also choose the TMH measurement locations based on actual data. Frequently employed techniques for evaluating the amount of tear film, especially in diagnosing and managing dry eye conditions, involve assessing Tear Meniscal Height (TMH), the radius of the tear meniscus (TMR), or the area of the tear meniscus (TMA). The location of the measurement on the eyelids, the occurence of conjunctival folds, the temperature, the lighting used, and the duration since the last blink can all influence the properties of the tear meniscus. A shortage of aqueous tears is suggested by a tear meniscus height of 0.20 mm or less.[53]

Numerous techniques for measuring TMH have been reported, including the use of an "optical coherence tomography (OCT)", reflective meniscometry, interferometry, and reticule at the slit-lamp. TMH measured in healthy eyes using those techniques ranged from 0.12 to 0.46 mm.[54] When it comes to identifying dry eye disease, using 15 TMH assessed with OCT has shown consistent results (ICC ranges from 0.900 to 0.981), high accuracy in detecting the condition (ranging from 67.0 percent to 80.5 percent), and specificity (ranging from 81 percent to 89.3 percent).16–18 Interferometry allows for the measurement of TMH with a similar degree of dependability as OCT (ICC ranges from 0.870 to 0.920). The methods for capturing images also demonstrate consistency similar to OCT yet better reliable than those involving a reticule under a slit lamp.[55] It is challenging to define the top margin of the meniscus due to lower magnification and lower picture quality.[55] The use of a Tearscope has been advised in order to improve meniscus visibility at the slit-lamp and, therefore, the reproducibility of TMH readings.[56] As an alternative, it is not necessary to identify the upper

limit of the meniscus when measuring the TMR using reflected meniscometry.[57] It was proposed that reflective meniscometry may serve as a helpful stand-in for OCT measurements of TMR.

- ***Clinical significance of tears***

A persistent metabolic disorder or illness conditions in both ocular surface and systemic disease might be indicated by abnormalities in tear film biomarkers. On the other hand, contact lens use, illness, and ocular surgery may also cause dysregulation of tear components. When it comes to conditions like glaucoma, diabetic retinopathy, issues with the meibomian glands, and even widespread malignancy, elevated levels of proteins and inflammatory substances have been discovered in the tear film.[28] The tear film may be utilized to track the evolution of an illness or to better understand how it is progressing since it is a good indicator of the ocular environment and is easily accessible for non-invasive collection and analysis. After undergoing a stem cell transplant from a donor, patients often experience abnormal tear film production in graft-versus-host disease. This condition is marked by intense dry eye and problems with the surface of the eye. The tears of these patients, along with those of many others with dry eye, show raised amounts of inflammatory markers such as IL-6.[58]

- ***Tear films and Pterygium***

Several authors propose that an aberrant tear function is a predisposing factor for illnesses caused by UV radiation, such as pterygium. This is because the tear film in front of the eye acts as the primary protection against environmental damage, including UV exposure. (which is thought to be the key factor in the development of pterygium). On the other hand, other writers propose that pathological alterations in the conjunctiva, cornea, or eyelids resulting from pterygia cause disruptions in the function of the tear film. Artificial tear treatment was

adopted to prevent the development of pterygium, given the potential for co-occurrence of pterygia and dry eye.[59]

In people with pterygia, Kadayifcilar and Ishioka found that the tear film's ability to stay stable was lacking. They believed that irregular function of tear could be another causal factor for the growth of pterygium. Yet, several more literature have revealed that tear function is actually normal in pterygia.[60,61] Therefore, the question of whether the aberrant tear function is directly related to pterygium remains unanswered.[62] For this condition, surgical pterygium removal is the recognized course of therapy.

- ***Previous studies assessing the impact of surgery on tear film***

Kampitak et al. assessed the ST results and the duration of tear breakup before and following the pterygium surgery. Schirmer's test findings and tear breakup time did not alter statistically significantly between before and one month after surgery. The Schirmer's test findings showed mean of 9.2 and 10.0 millimeters before and one month after pterygium surgery, respectively; the TBUT results showed 7.5 and 7.9 seconds, respectively. One month after surgery, the findings of the Schirmer test and the tear breakup time may not change if the pterygium is removed.[63]

When patients had pterygium excision using either the bare sclera approach or conjunctival autograft technique, along with intraoperative MMC treatment, Sharma et al. examined the changes in parameters of tear films. Regardless of the procedure, the mean preoperative ST-1 was 9.333 mm, and it increased to 12.203 mm after pterygium removal. Regardless of the method used, the mean preoperative TBUT was 7.212 seconds; however, after pterygium excision, it increased to 13.059 seconds. This improvement was statistically significant. In the autograft group, the preoperative mean values of TBUT and ST-1 mean values improved. In the autograft approach, the mean postoperative Schirmer's I was 12.678 mm, whereas in the

bare sclera procedure, it was 11.692 mm. Both groups' postoperative improvements were statistically comparable. In the autograft procedure, the average postoperative TBUT was 14 seconds, whereas in the bare sclera technique, it was 12.046 seconds. The autograft group's postoperative outcomes were found superior to those of the group with bare sclera.[7]

Li et al (2007) assessed the impact of pterygium removal on tear function in the short term. In comparison with the preoperation TBUT, the tear break-up time at one month after the surgery (11.49±3.76 s) was much longer. In the tear-ferning test, only 17 percent of the patients exhibited normal crystallization prior to surgery. One month after surgery, this percentage climbed dramatically to 90 percent ($P<0.001$). The Schirmer test result does not significantly change between pre- and post-surgery ($P>0.05$). Pterygium removal improves tear function in individuals with primary pterygium, suggesting a tight link between pterygium and DED.[64]

Türkyılmaz et al. looked at how patients who had pterygium surgery changed on dry eye tests. Patient records were split into two groups: Group 1 included patients whose pterygium did not return, and Group 2 included patients whose pterygium returned following the operative procedure. They came to the conclusion that pterygium is linked to abnormal tear film function. Tear osmolarity and tear film function were enhanced by pterygium removal. However, with the return of pterygium, tear osmolarity declined once again.[65]

The impact of pterygium as well as the pterygium excision surgery using conjunctival autograft method on tear film was investigated by Patkar et al. Prior to surgery, the average TBUT in the case eye was 9.71 divisions, whereas the control eye had a mean of 10.64±1.32 divisions. Postoperative TBUT rose considerably. Prior to surgery, the average Schirmer's I in the case eye was 13 mm, whereas it was 14.54 mm in the control eye. Following surgery, there was a significant rise. Prior to surgery, the case eye's Schirmer's II test value was 9.85

mm, whereas the control eye's value was 10.44 mm. There was no postoperative alteration seen. This demonstrated that the case eye eventually had greater tear film stability after pterygium removal, which was equivalent to the control eye.[66]

After a main pterygium procedure, Kim et al. (2013) assessed the alterations in the tear film in pterygium patients. In eyes undergoing pterygium surgery, the preoperative values for tear film thickness, TBUT, and ST-1 were 21.53 microm, 4.84 seconds, and 11.67 mm, respectively. The corresponding values were 13.02, 5.81 seconds, and 24.23 microm three months after the procedure. Following pterygium surgery, there was a considerable rise in BUT score and tear film thickness. Before and three months after the pterygium procedure, there was no statistically significant change in the findings of the St-1. Three months after the pterygium procedure, the subjective parameter (OSDI) improved. Pterygium surgery may improve tear film thickness and tear BUT following pterygium surgery, which helps to partly restore the tear film function to normal.[67]

Singh and colleagues assess the alterations in the ocular tear film pre- and post-pterygium surgery (conjunctival autograft). Nine (12 percent) of the 75 patients who had conjunctical autografting and pterygium excision had recurrence within three to six months. After pterygium surgery with conjunctival autograft, among patients who did not exhibit any recurrence, the TBUT rose from 8.26 seconds to 10.06 secondss one month after surgery. The TBUT values rose from 8.33 seconds preoperatively to 10.44 secondss one month postoperatively among the patients who subsequently showed recurrence. There was statistical significance in each of these changes. After pterygium surgery, all patients' levels of schirmer-1 and schirmer-2 exhibited modest improvement, although such improvements were not statistically significant. This research showed that the development of pterygium is linked to defective tear film function. The ablation of pterygium greatly enhanced TBUT and

tear film function.[68]

Kilic et al. examined the impact of pterygium excision on the tear function tests in fourteen eyes belonging to thirteen cases utilizing the limbal conjunctival autografting procedure. The findings of the tear function test during the short-term follow-up are unaffected by pterygium excision since there was no discernible change in the ST and TBUT at 1 and 6 months following surgery compared to preoperative.[69]

In order to cure primary pterygium, Yang et al. examined the long-term effectiveness of pterygium excision and corneal limbal conjunctival autograft. There were no statistically significant variations seen in the postoperative TBUT between the two groups. Patients in group A had fewer surgical complications and milder symptoms of ocular surface irritation.[70]

Li et al.'s (2019) goal was to compare the pre- and post-operative outcomes of excision for patients with pterygium in terms of dry eye and "meibomian gland dysfunction (MGD)". Significant improvements were seen in the postoperative OSDI, "Noninvasive keratography average tear film breakup time (NIBUTav)", lid margin abnormalities, and lipid layer grading values ($p < 0.05$ for all scores). No difference ($p>0.05$) in the ST-1, TMH, and meiboscore outcomes between the pre- and postoperative values was found. Schirmer 1 and TMH, two of the traditional and automated indices, showed a strong association with the parameters of pterygium one month following the operative procedure; however, no correlation was seen three or six months later. Pterygium metrics showed a strong correlation with the OSDI, NIBUTav, at one, three and six months postoperatively. Following pterygium removal, the people with primary pterygium saw an improvement in tear film and "meibomian gland (MG)" activity, which was associated with the alleviation of unpleasant ocular symptoms.[5]

MATERIALS

&

METHODS

MATERIALS AND METHODS:

SOURCE OF DATA:

During the study period September 2022 to December 2023, 39 patients with pterygium who had fulfilled inclusion and exclusion criteria, were admitted for pterygium surgery in Department of ophthalmology at R.L Jalappa hospital, Kolar , and had post-operative follow up as outpatient at the same hospital.

STUDY DESIGN: Observational study.

INCLUSION CRITERA:

1. All patients of either sex above 18 years of age
2. Patients with unilateral pterygium

EXCLUSION CRITERIA:

1. Allergic conjunctivitis
2. Corneal ulcer
3. Type 2 diabetes mellitus
4. Bronchial asthma
5. Previous history of eye surgeries
6. Sjojren ‘s syndrome
7. Medications (anti histamines, beta blockers, antispasmodics, diuretics)
8. Contact lens users

9. Vitamin A deficiency

Ethical clearance

Prior to the commencement, the study was approved by the Ethics and Research Committee, Sri Devraj Urs medical college, Kolar.

Informed Consent

All patients fulfilling selection criteria were explained about nature of the study. A written informed consent was obtained from all the participants before enrolment (Annexure II and III).

METHOD OF COLLECTION OF DATA

A total of 39 eyes fulfilling the inclusion criteria were included in each group.

TECHNIQUE

All the consecutive patients underwent detail visual acuity assessment, slit lamp examination, intraocular pressure estimation and tear film function tests.

Tear film function test includes (TBUT), Schirmer's test (1&2), Tear meniscus height(TMH)

1.TBUT – After instilling fluorescein into the lower fornix, patient is asked to blink several times and Tear film present over cornea is examined with a broad beam under cobalt blue filter on the slit lamp. The time interval in seconds between the last blink and first dry spot is noted.[3,4]

2. Schirmer's test - Schirmer's strip of Whatman no. 41 filter paper strips measuring 35x5 mm folded at the notch is placed gently over the lower palpebral conjunctiva at the junction of lateral 1/3rd & medial 2/3rd. Ask the patient to look straight, keep his eyes open & blink

normally. The amount of wetting in millimeters is recorded after 5 minutes after removing the strips.[3,4]

- If the length of the wetting is less than 10mm at the end of 5 minutes, the Schirmer's test-1 (without anaesthesia) is considered positive.

- The Schirmer's test 2 after anaesthesia (Basal secretion) is performed in similar way as Schirmer's but after instillation of 0.5% proparacaine.[3,4]

3. TMH : Patient is asked to look straight ahead and TMH is measured over the central lower eyelid using slit lamp reticule.

Pterygium surgery - Pterygium excision with conjunctival limbal autograft

OPERATIVE PROCEDURE:

- Surgery is initiated under aseptic precautions and local anaesthesia.

- The body of the pterygium is separated from the bare sclera 3 mm from the limbus. The extent of bare sclera is measured using a Castroviejo Calliper.[4]

- The source of the allograft is the superior bulbar conjunctiva of the same eye. Juxta-limbal orientation is maintained by marking the limbal side with a surgical marker. The graft is then placed on the bare sclera.[4]

- At the end of surgery antibiotic-steroid ointment is inserted into the conjunctival sac.[4]

- All patients were followed post- operatively at 1 week, 4 weeks and 6weeks. TBUT, schirmer's test and TMH performed 6 weeks post- operatively.

SAMPLE SIZE ESTIMATION

Sample size has been estimated by using the difference in Mean Schirmer's -1 between Diseased eye and normal eye from the study Angli Manhas et. al. as 13.2 ± 4.6 and 16.1 ± 3.[2] Using these values at 95% Confidence limit and 90% power sample size of 35 was obtained in each group by using the below mentioned formula and Med calc sample size software. With 10% nonresponse sample size of 35 + 3.5 ≈ **39 eyes** were included in each group.

Sample Size Estimation Formula:

$$N = \frac{2\,SD^2(Z_{\alpha/2} + Z_{\beta})^2}{d^2}$$

- Where $Z_{\alpha/2}$ is the critical value of the Normal distribution at $_{\alpha/2}$ (e.g. for a confidence level of 95%, **α** is 0.05 and the critical value is 1.96).
- Z_{β} is the critical value of the Normal distribution at β (e.g. for a power of 80%, ß is 0.2 and the critical value is 0.84),
- SD is the standard deviation from previous study population variance, and
- d is the difference between two mean

STATISTICAL METHODS USED FOR THIS STUDY

Data has been entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as test of significance. Continuous data was represented as mean and standard deviation. Independent t test was used as test of significance to identify the mean difference between two groups. P value <0.05 was considered as statistically significant.

RESULTS

RESULTS

Data Analysis

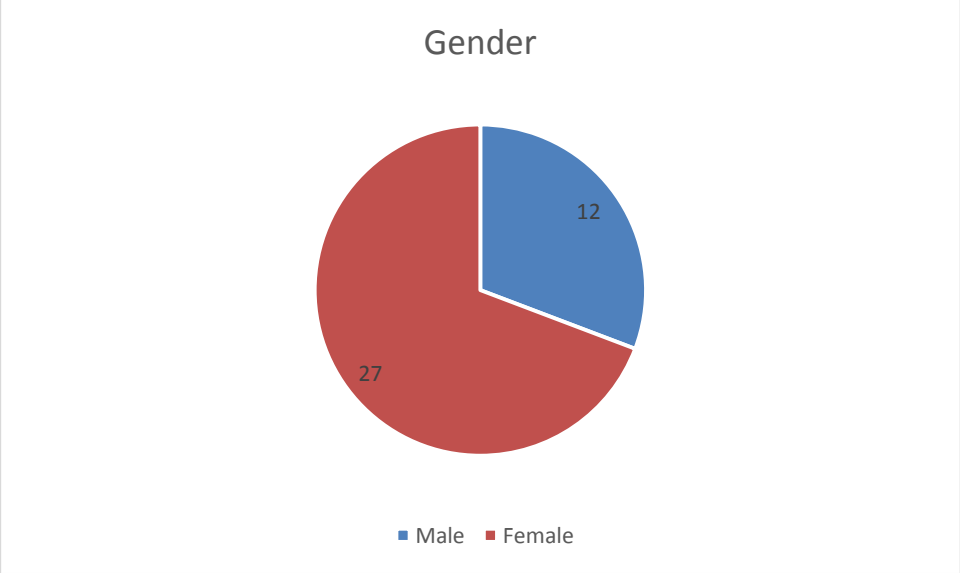
Data of the study was analysed by SPSS v26.0. Numbers and percentages were estimated for qualitative data. Mean (SD) and Median (IQR) were calculated for quantitative data. Quantitative data were found to have skewed distribution. Hence, Mann-Whitney test was applied to test significance in difference of quantitative data between the affected (pterygium eyes) and control eyes (eyes with no pterygium). Wilcoxon signed rank test was applied to test the significance in change of the continuous variables at follow-up from baseline. P value of below 0.05 was considered significant. Appropriate figures in the form of pie charts, bar charts and box plots were made.

Majority of the patients were females (69.2%), and 30.8% were males.

Table:1 – Distribution of subjects according to gender

Gender			
		Frequency	Percent)%)
	Males	12	31 %
	Females	27	69 %
	Total	39	100%

Graph:1 – Distribution of subjects according to gender



The patients had an average of 51.33 years.

Table: 2 – Patient Characteristics

Mean	51.33
Median	52
SD	13.36
IQR	40,60

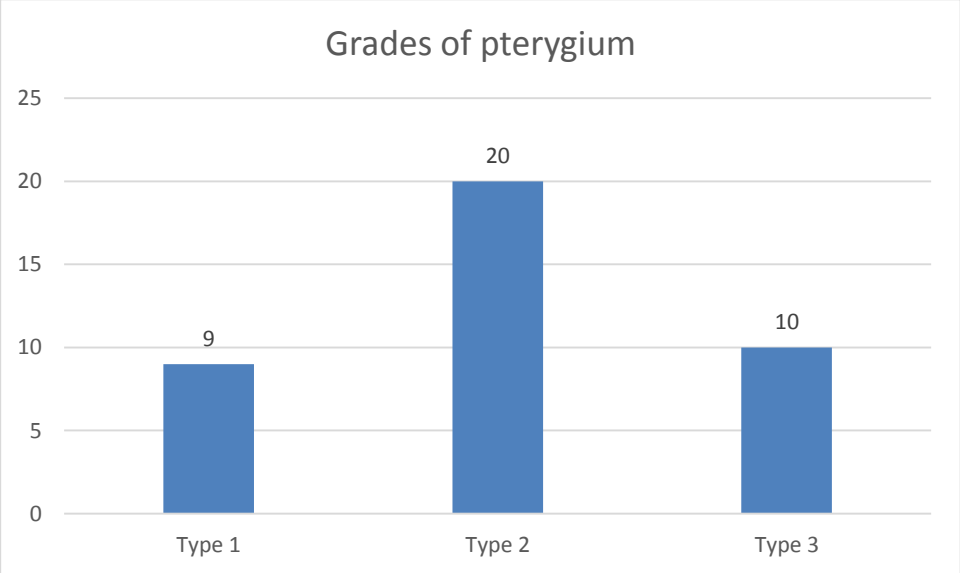
Majority of the patients had Type 1 (51.3%), followed by Type 3 (26.6%) and Type 1 (23.1%).

Table: 3 - Distribution of grades of pterygium

DIAGNOSIS

Grades of pterygium	Frequency	Percent (%)
Type 1	9	23.1%
Type 2	20	51.3%
Type 3	10	26.6%
Total	39	100.0%

Graph:2 - Distribution of grades of pterygium



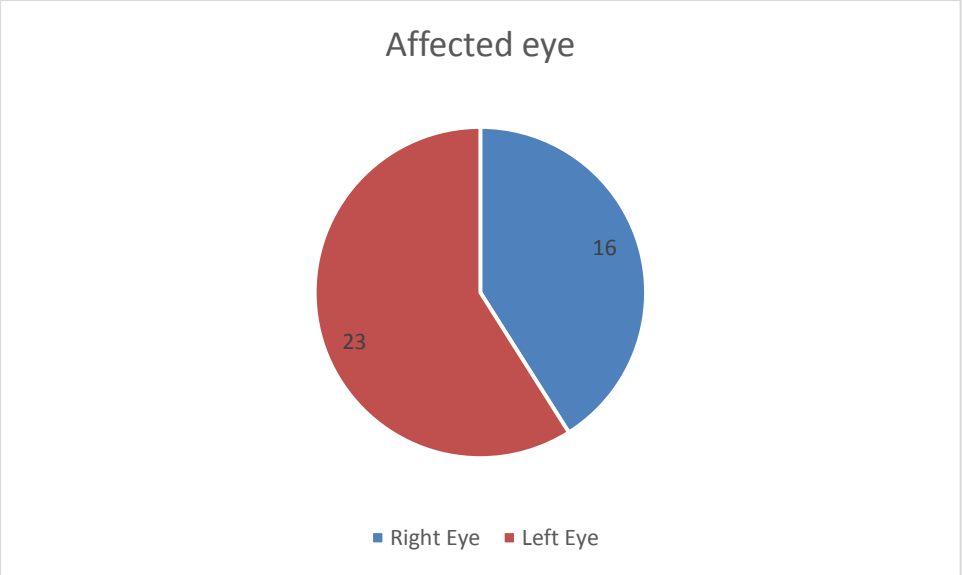
Most of the patients had their left eye affected (59%)

Table:4 – Laterality of pterygium

Laterality of pterygium

Laterality of pterygium	Frequency	Percent(%)
Right Eye	16	41.0%
Left Eye	23	59.0%
Total	39	100.0%

Graph:3 - Laterality of pterygium



The mean Schirmers test 1 pre-op values of affected and control eyes were 8.38 and 22.62, respectively.

The mean Schirmers test 1 one week post-op values of affected and control eyes were 19.79 and 22.92, respectively.

The mean Schirmers test 1 four weeks post-op values of affected and control eyes were 22.05 and 22.67, respectively.

The mean Schirmers test 1 six weeks post-op values of affected and control eyes were 24.21 and 24.21, respectively.

The mean Schirmers test 2 pre-op values of affected and control eyes were 10.54 and 26.15, respectively.

The mean Schirmers test 2 one week post-op values of affected and control eyes were 22.31 and 25.18, respectively.

The mean Schirmers test 2 four weeks post-op values of affected and control eyes were 25.03 and 25.74, respectively.

The mean Schirmers test 2 six weeks post-op values of affected and control eyes were 25.69 and 25.79, respectively.

The mean TBUT pre-op values of affected and control eyes were 8.44 and 15.9, respectively.

The mean TBUT one week post-op values of affected and control eyes were 15.82 and 16.69, respectively.

The mean TBUT four weeks post-op values of affected and control eyes were 16.46 and 18, respectively.

The mean TBUT six weeks post-op values of affected and control eyes were 17.1 and 17.46, respectively.

The mean TMH pre-op values of affected and control eyes were 0.22 and 0.29, respectively.

The mean TMH one week post-op values of affected and control eyes were 0.28 and 0.29, respectively.

The mean TMH four weeks post-op values of affected and control eyes were 0.29 and 0.29, respectively.

The mean TMH six weeks post-op values of affected and control eyes were 0.29 and 0.29, respectively.

Table-:5 - Comparison of Tear Film Parameters Between Affected and Control Eyes

	Eye with pterygium (affected eye)				Eye without pterygium (control eye)			
	Mean	Median	Std. Deviation	IQR	Mean	Median	Std. Deviation	IQR
Schirmers test 1 pre-op	8.38	5.00	6.44	5,6	22.62	24.00	1.73	22,24
Schirmers test 1 1 week post-op	19.79	20.00	2.71	20,22	22.92	22.00	1.44	22,24
Schirmers test 1 4 weeks post-op	22.05	22.00	1.69	22,22	22.67	22.00	1.85	22,24
Schirmers test 1 6 weeks post-op	24.21	24.00	1.44	24,26	24.21	24.00	1.44	24,26
Schirmers test 2 pre-op	10.54	7.00	7.03	6,8	26.15	26.00	1.41	26,28
Schirmers test 2 1 week post-op	22.31	22.00	1.42	22,24	25.18	26.00	1.27	24,26
Schirmers test 2 4 weeks post-op	25.03	24.00	1.29	24,26	25.74	26.00	1.31	24,26
Schirmers test 2 6 weeks post-op	25.69	26.00	1.69	24,28	25.79	26.00	1.76	24,28
TBUT pre op	8.44	7.00	4.00	5,9	15.90	16.00	1.50	15,18
TBUT 1 week post-op	15.82	16.00	2.17	14,16	16.69	16.00	2.40	15,18
TBUT 4 weeks post-op	16.46	16.00	2.22	14,18	18.00	18.00	2.05	16,20
TBUT 6 weeks post-op	17.10	17.00	1.79	16,18	17.46	18.00	1.83	16,18
TMH pre op	0.22	0.19	0.06	0.16,0.28	0.29	0.28	0.02	0.28,0.3
TMH 1 week post-op	0.28	0.28	0.02	0.26,0.29	0.29	0.30	0.01	0.29,0.3
TMH 4 weeks post-op	0.29	0.29	0.01	0.28,0.3	0.29	0.29	0.01	0.28,0.3
TMH 6 weeks post-op	0.29	0.29	0.01	0.28,0.3	0.29	0.29	0.02	0.28,0.3

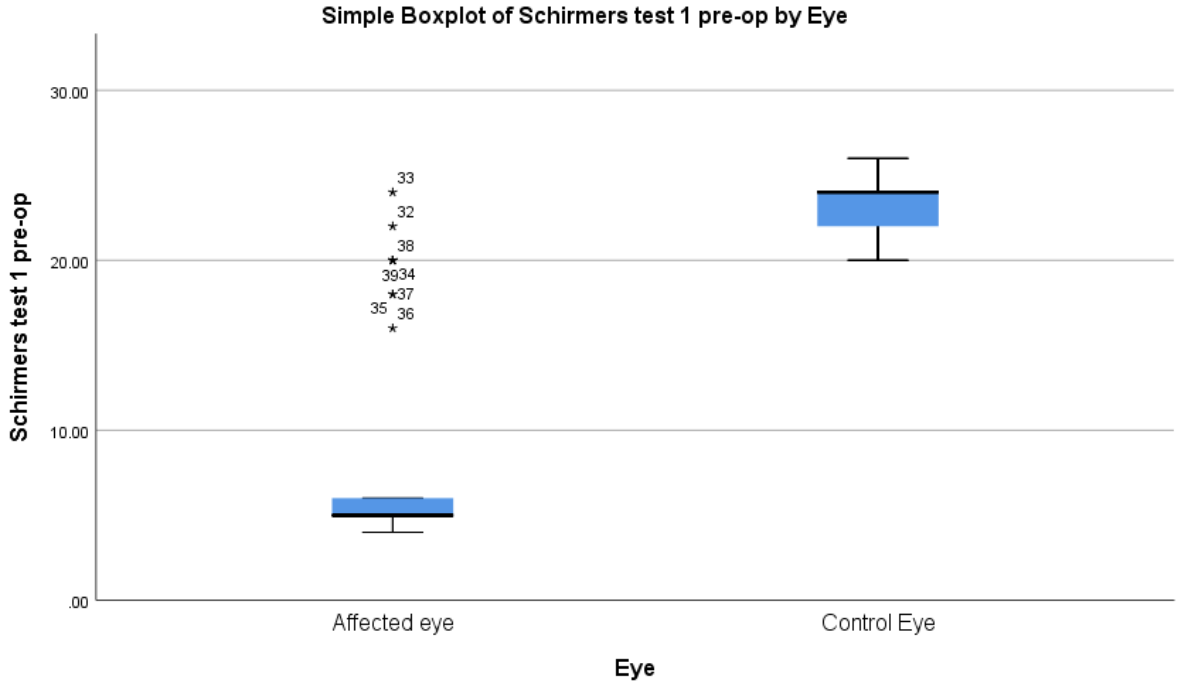
Tear Function between the affected and control eyes at various time points

Schimers test 1 was significantly lower in the affected eye than the normal eye at pre-op and 1 week following post-op. There was no significant difference in the ST1 at 4 weeks and 6 weeks between the affected and control eyes.

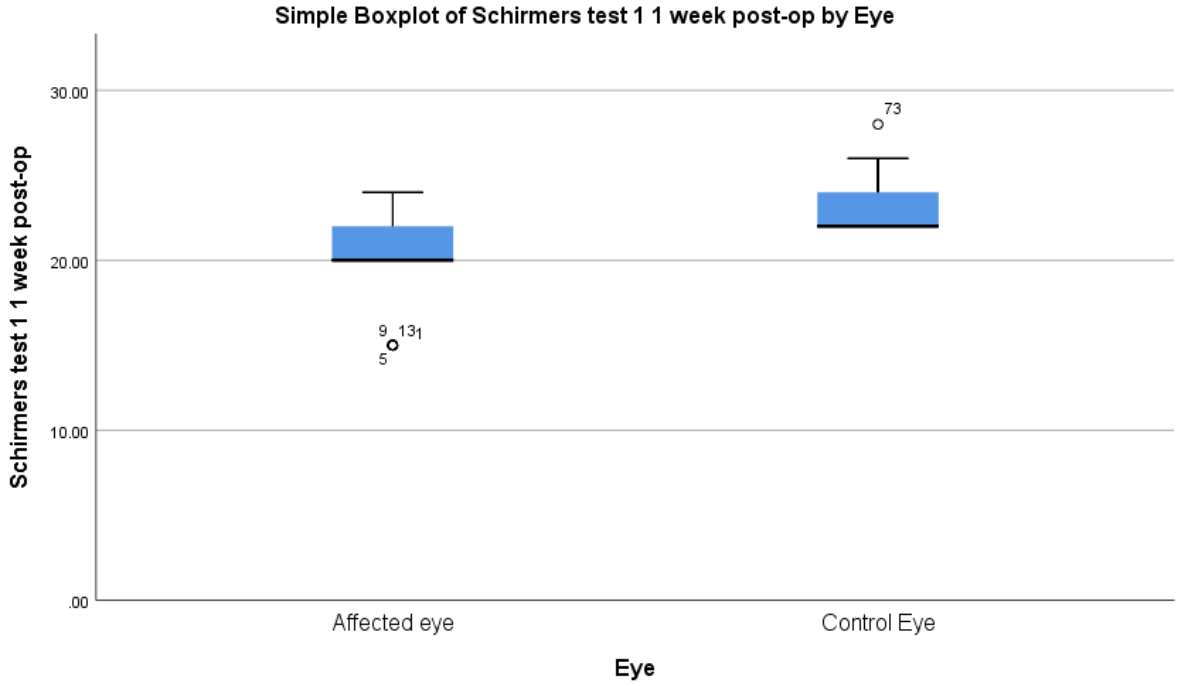
Table:6 - Comparison of Ranks for Schirmer's Test 1 Between Affected and Control Eyes

Ranks					
	Eye	N	Mean Rank	Sum of Ranks	p value
Schirmers test 1 pre-op	Affected	39	21.55	840.50	**<0.001**
	Control	39	57.45	2240.50	
	Total	78			
ST 1 post1w	Affected	39	25.41	991.00	**<0.001**
	Control	39	53.59	2090.00	
	Total	78			
ST 1 post4w	Affected	39	35.18	1372.00	0.068
	Control	39	43.82	1709.00	
	Total	78			
ST 1 post6w	Affected	39	39.50	1540.50	1.000
	Control	39	39.50	1540.50	
	Total	78			

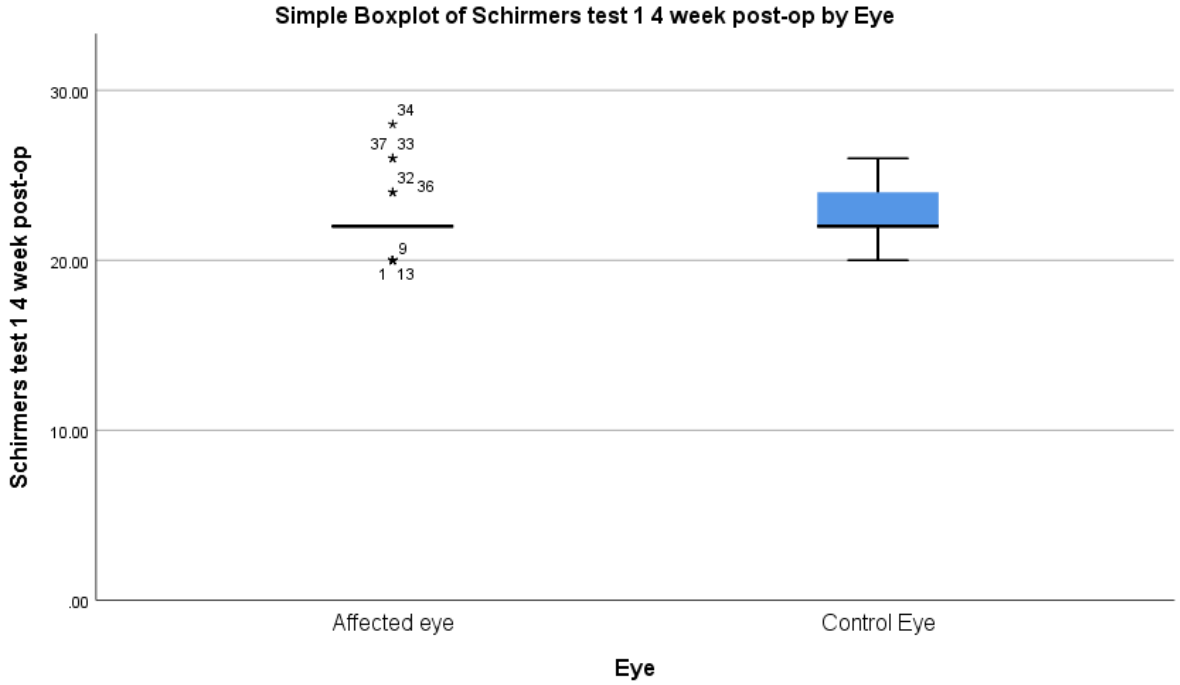
Graph:4 - simple box plot of schirmers test1



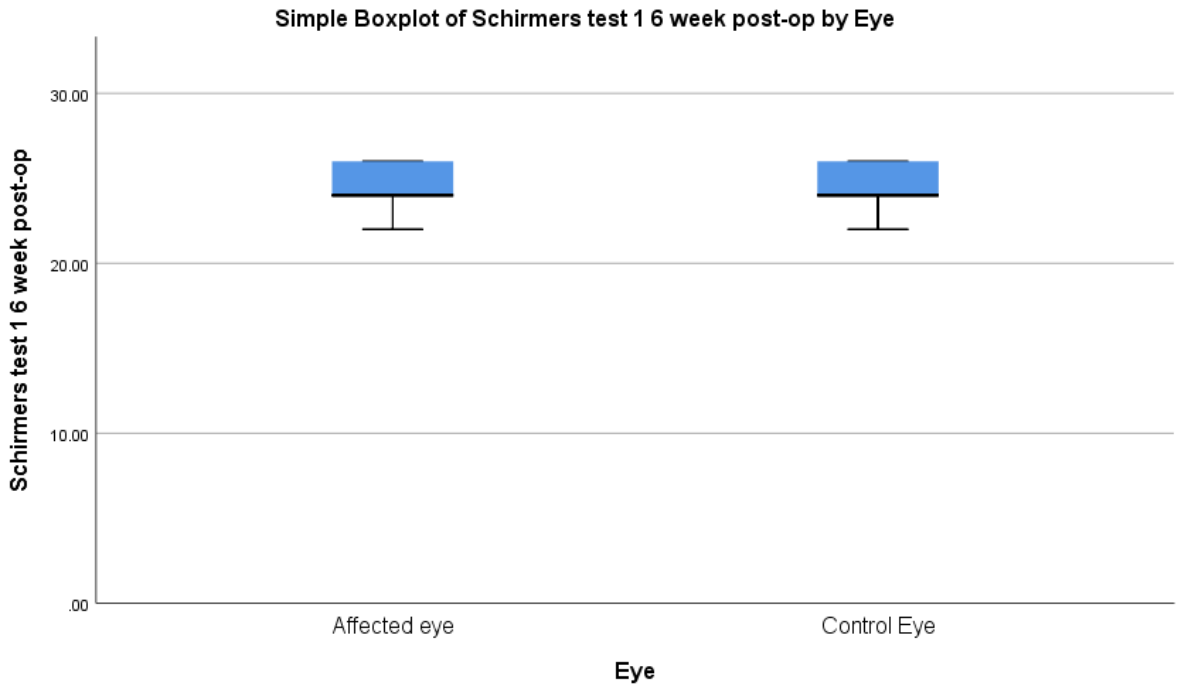
Graph:5- Simple Boxplot of schirmers test 1, 1 week post op



Graph:6 - Simple Boxplot of schirmers test 1, 4 weeks post op



Graph:7 - Simple Boxplot of schirmers test 1, 6 weeks post op

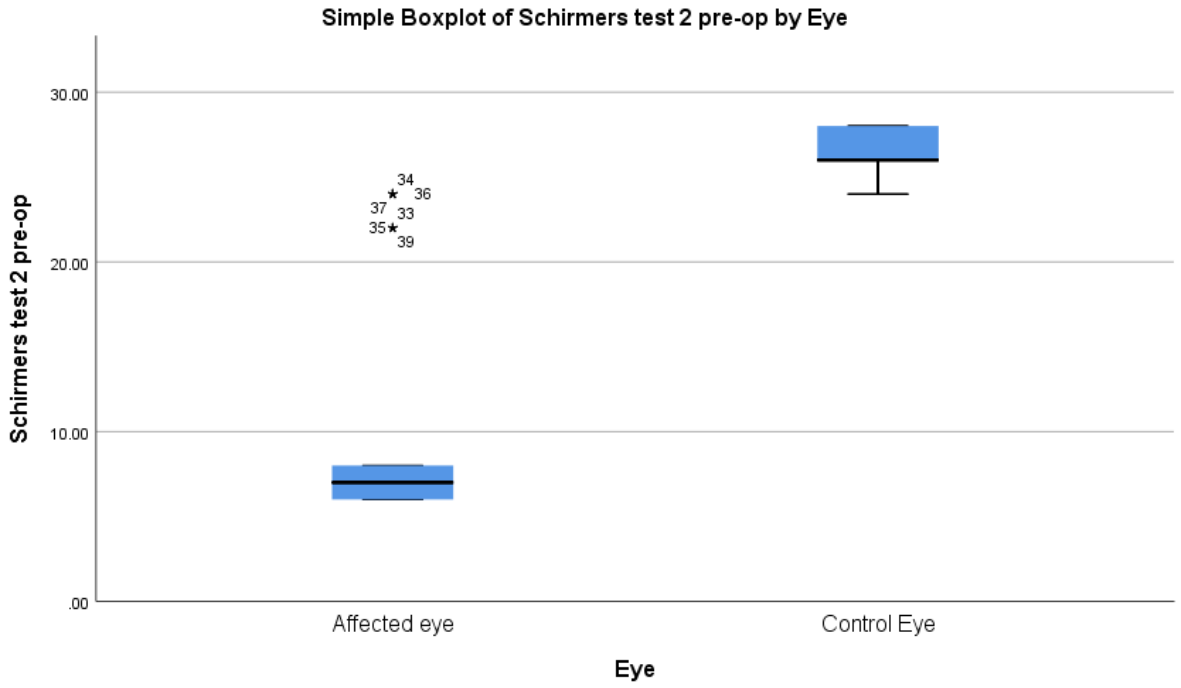


Schimers test 2 was significantly lower in the affected eye than the normal eye at pre-op, 1 week and 4 weeks following post-op. However, at 6 weeks no variation was measured between the affected and control eyes, as per ST2

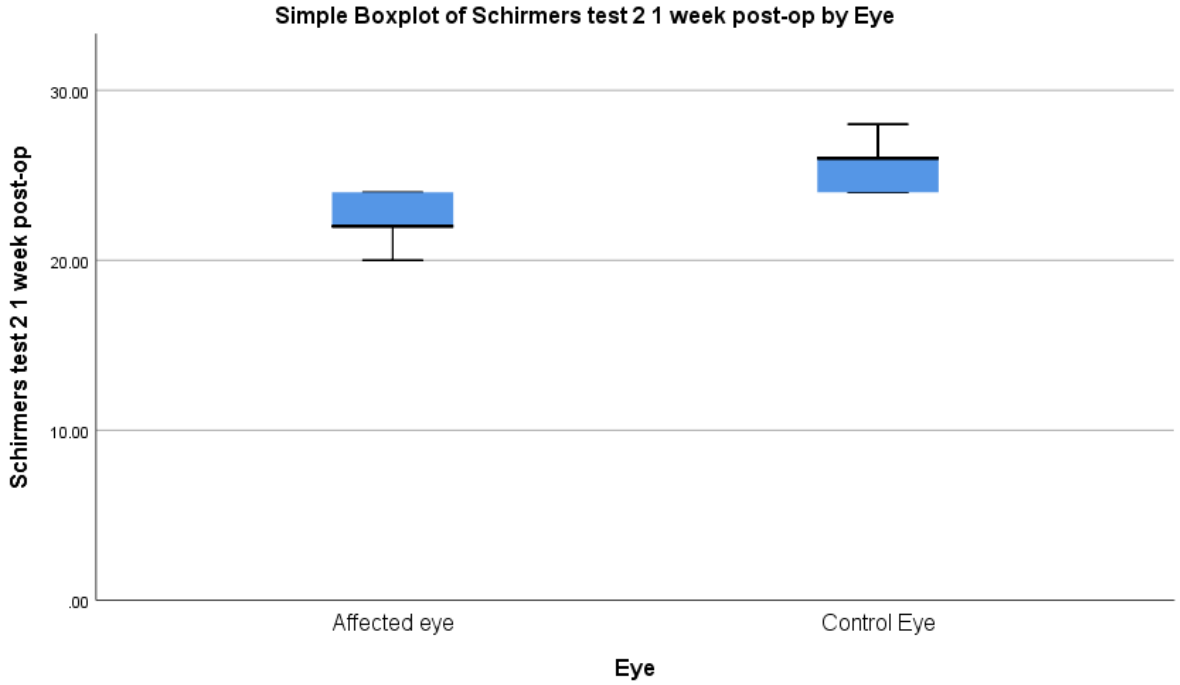
Table:7 - Comparison of Ranks for Schirmer's Test 2 Between Affected and Control Eyes

Ranks					
	Eye	N	Mean Rank	Sum of Ranks	p value
Schirmers test 2 pre-op	Affected	39	20.51	800.00	**<0.001**
	Control	39	58.49	2281.00	
	Total	78			
ST 2 post1w	Affected	39	23.17	903.50	**<0.001**
	Control	39	55.83	2177.50	
	Total	78			
ST 2 post4w	Affected	39	34.12	1330.50	**0.018**
	Control	39	44.88	1750.50	
	Total	78			
ST 2 post6w	Affected	39	38.94	1518.50	0.814
	Control	39	40.06	1562.50	
	Total	78			

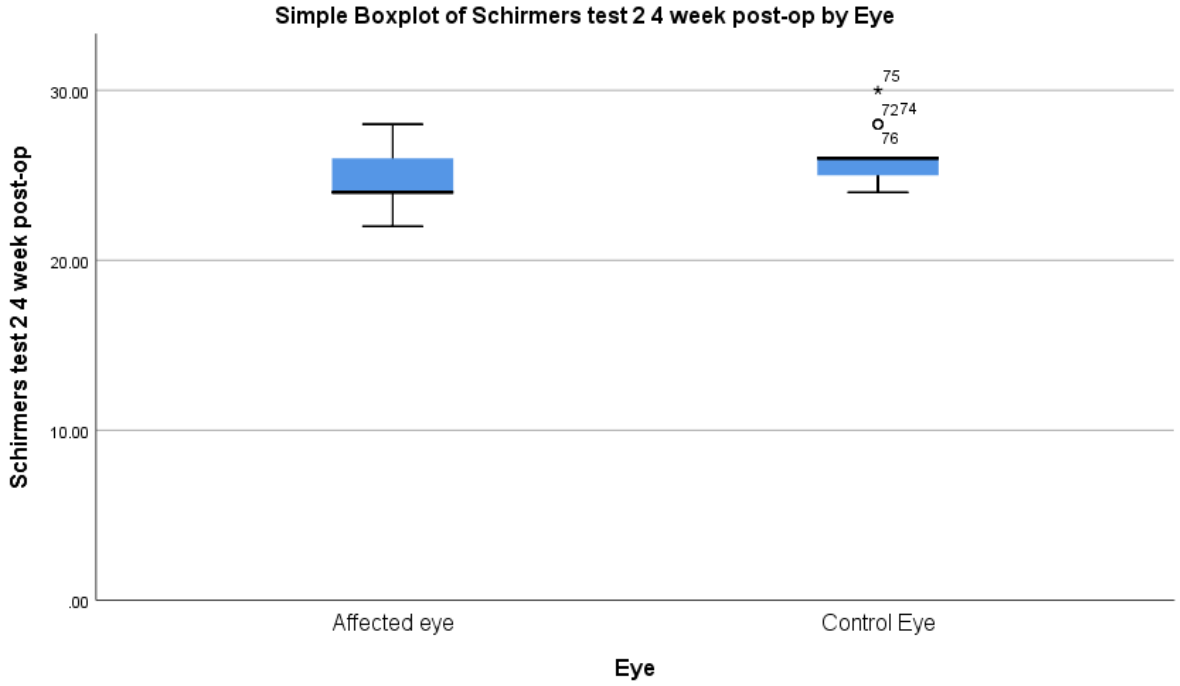
Graph- 8 - Simple Boxplot of schirmers test 2, preop



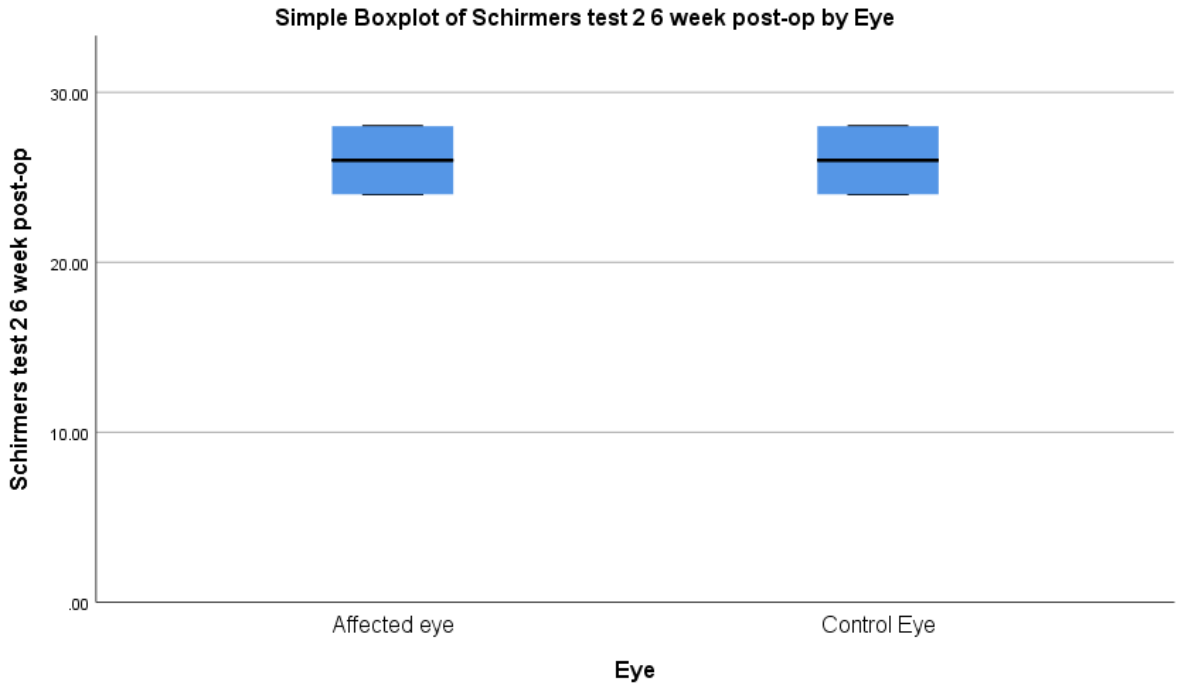
Graph:9 - Simple Boxplot of schirmers test 2, 1 week post op



Graph:10- Simple Boxplot of schirmers test 2, 4 weeks post op



Graph:11 - Simple Boxplot of schirmers test 2, 6 weeks post op

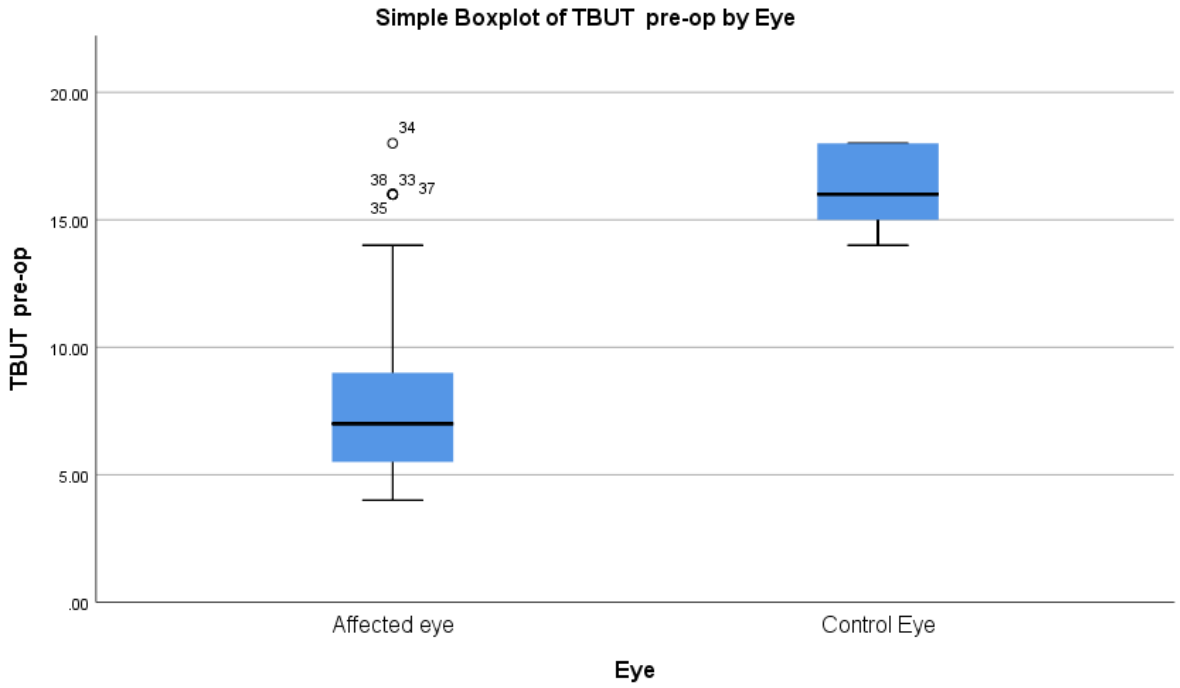


TBUT was lower in the affected eye than the control eye at pre-op, and 4 weeks following post-op, which was significant. There was no significant difference in the TBUT at 1 week and 6 weeks between the affected and control eyes

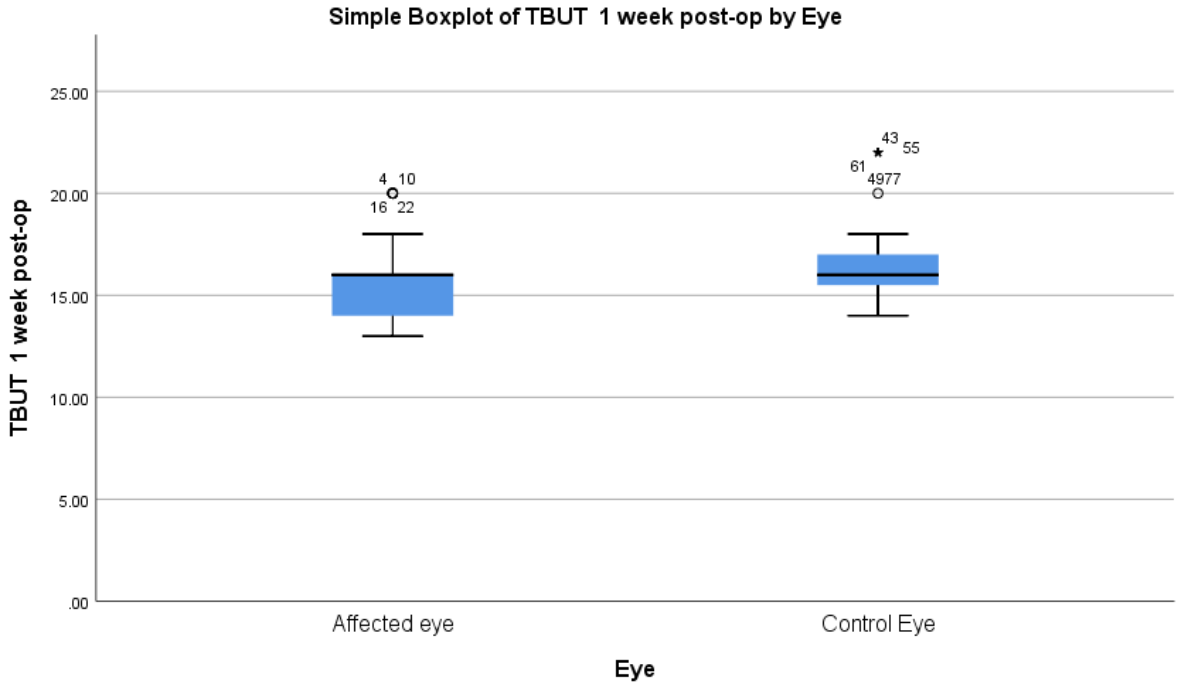
Table:8 - Comparison of Ranks for Tear Break-up Time (TBUT) Between Affected and Control Eyes

Ranks					
	Eye	N	Mean Rank	Sum of Ranks	p value
TBUT pre	Affected	39	23.42	913.50	**<0.001**
	Control	39	55.58	2167.50	
	Total	78			
TBUT post1w	Affected	39	35.62	1389.00	0.112
	Control	39	43.38	1692.00	
	Total	78			
TBUT post4w	Affected	39	32.90	1283.00	**0.008**
	Control	39	46.10	1798.00	
	Total	78			
TBUT post6w	Affected	39	37.10	1447.00	0.337
	Control	39	41.90	1634.00	
	Total	78			

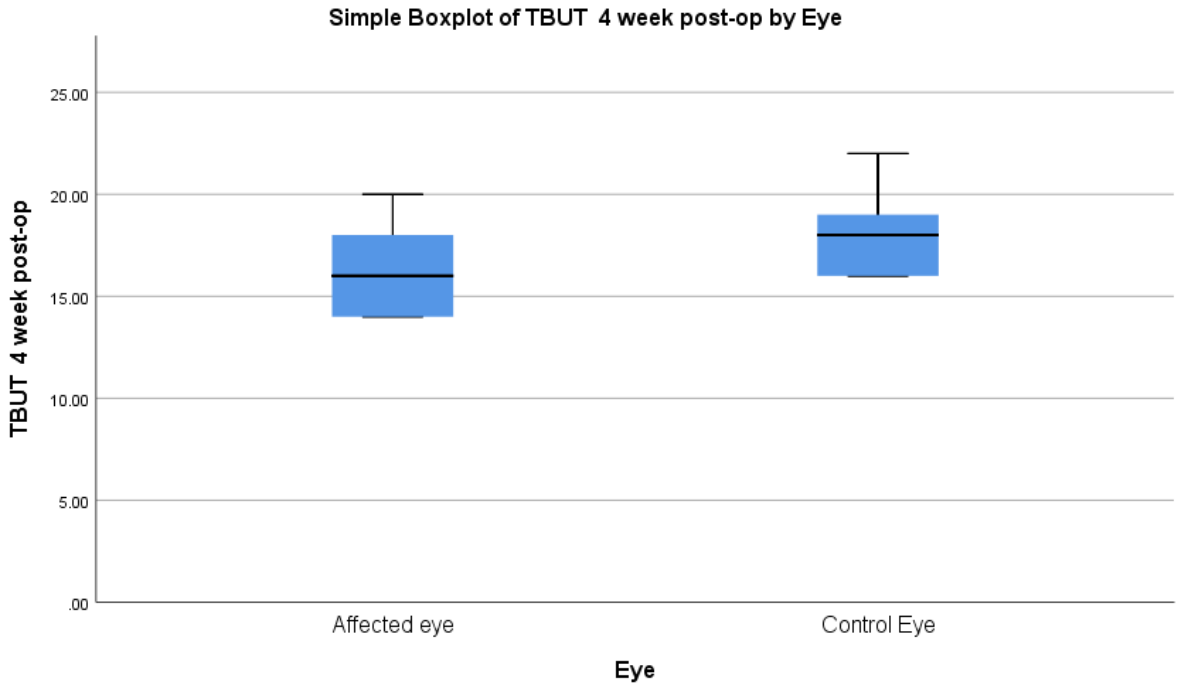
Graph: 12 - Simple Boxplot of TBUT, preop



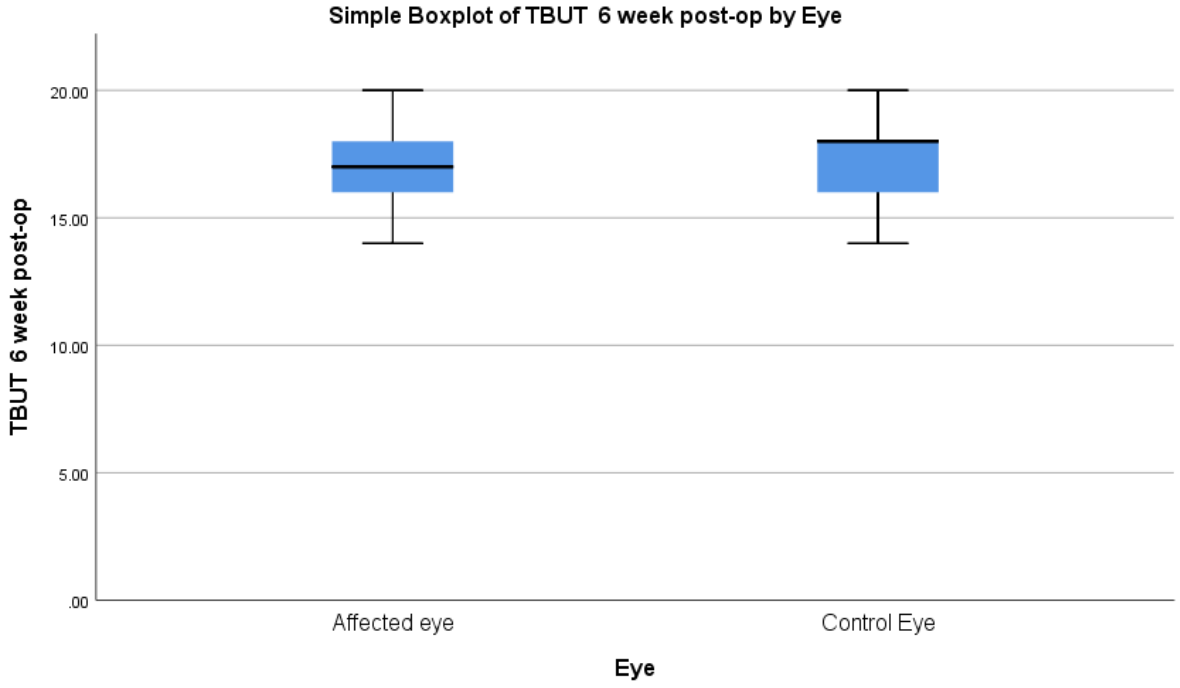
Graph:13- Simple Boxplot of TBUT, 1 week postop



Graph: 14 - Simple Boxplot of TBUT, 4weeks post op



Graph:15 - Simple Boxplot of TBUT, 6 weeks post op

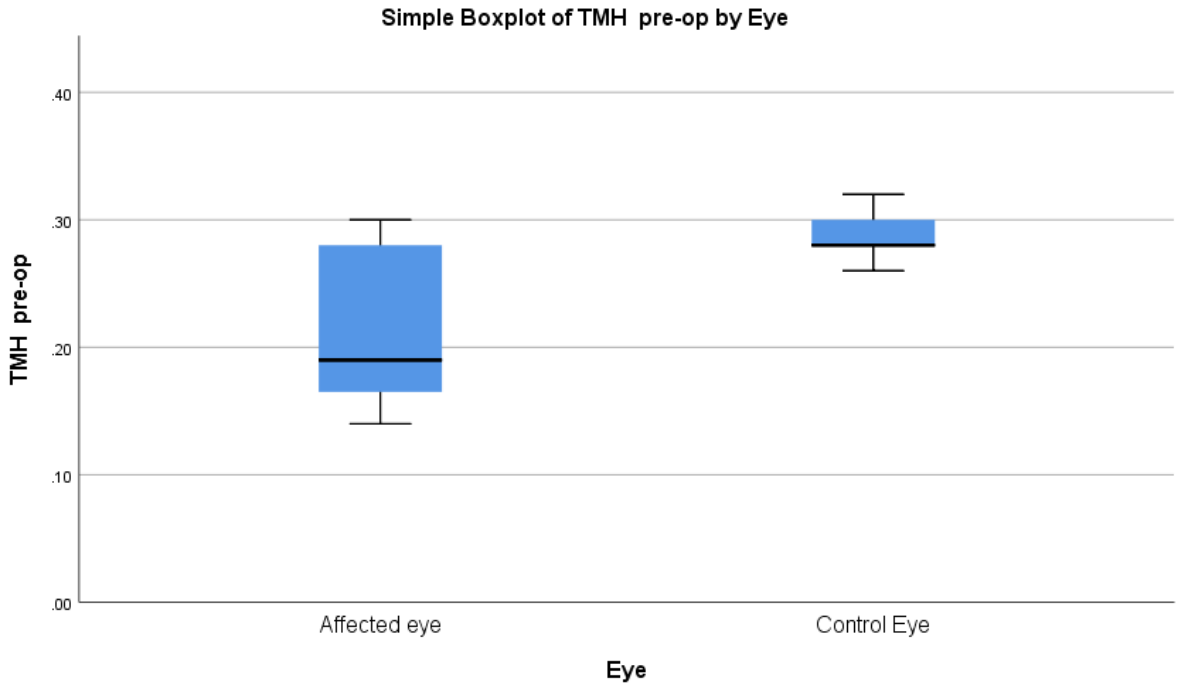


TMH was lower in the affected eye than the control eye at pre-op, and 1 week following post-op, which was significant. At 4 weeks and 6 weeks between the affected and control eyes, TMH showed no significant variation.

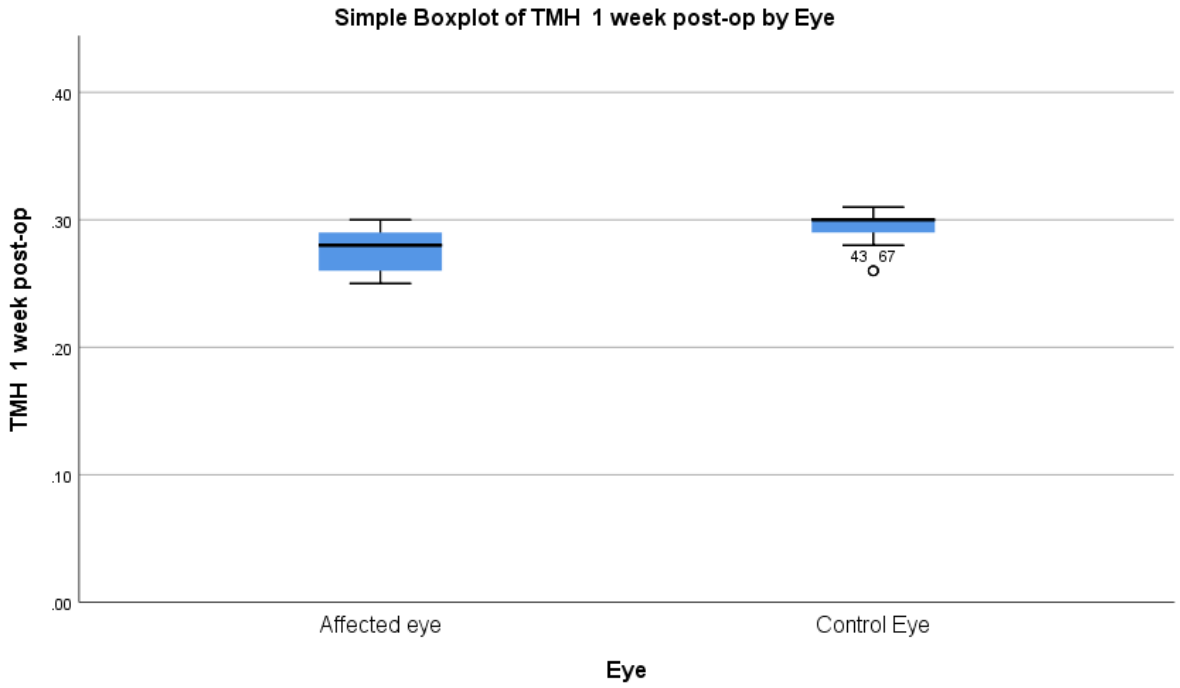
Table:9 - Comparison of Ranks for Tear Meniscus Height (TMH) Between Affected and Control Eyes

Ranks					
	Eye	N	Mean Rank	Sum of Ranks	p value
TMH pre	Affected	39	27.87	1087.00	**<0.001**
	Control	39	51.13	1994.00	
	Total	78			
TMH post1w	Affected	39	28.53	1112.50	**<0.001**
	Control	39	50.47	1968.50	
	Total	78			
TMH post4w	Affected	39	40.31	1572.00	0.741
	Control	39	38.69	1509.00	
	Total	78			
TMH post6w	Affected	39	37.17	1449.50	0.349
	Control	39	41.83	1631.50	
	Total	78			

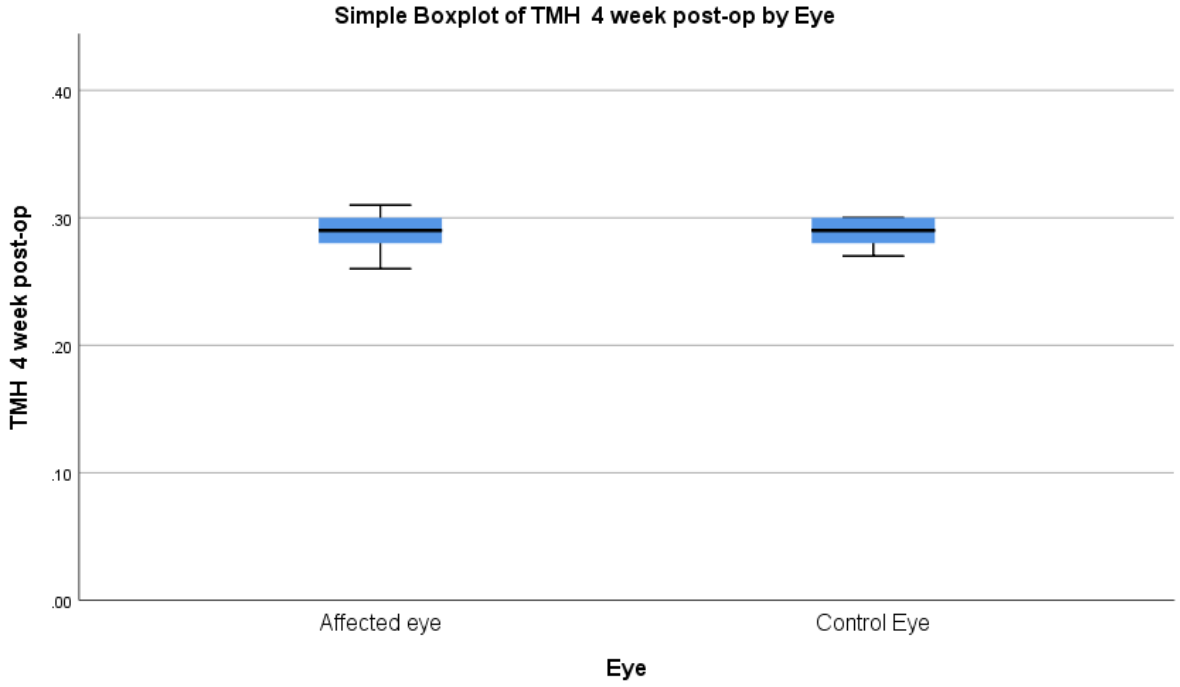
Graph:16- Simple Boxplot of TMH, pre op



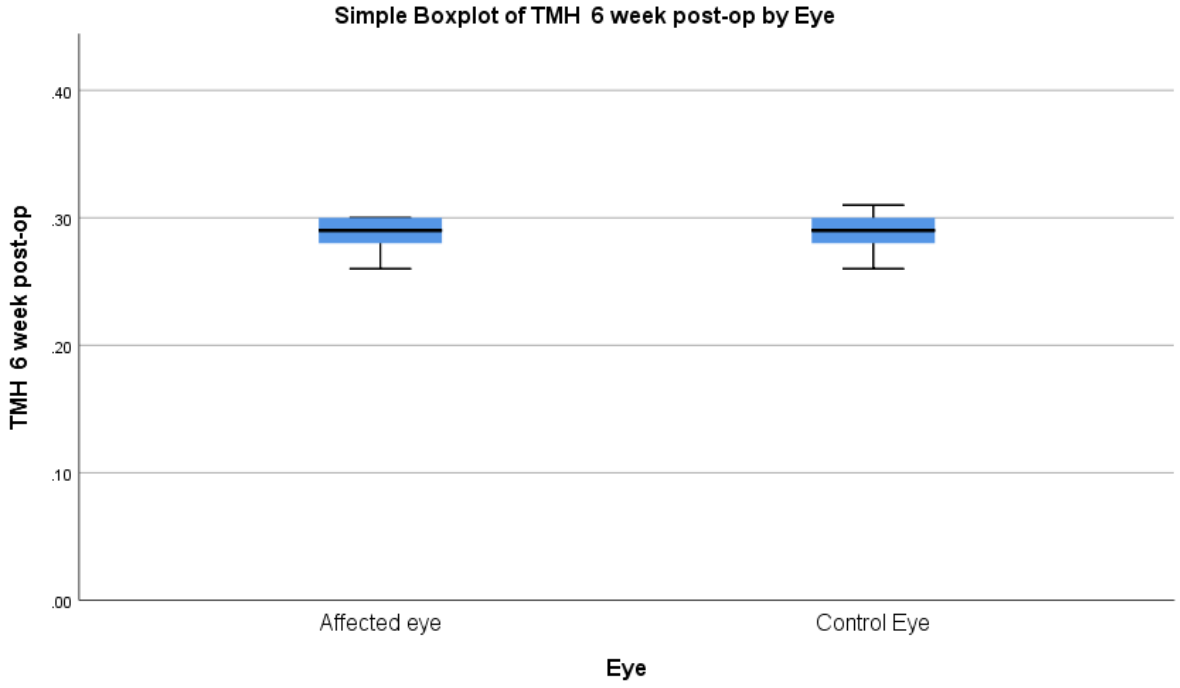
Graph:17 - Simple Boxplot of TMH, 1 week postop



Graph:18 - Simple Boxplot of TMH, 4 weeks postop



Graph:19 - Simple Boxplot of TMH, 6 weeks postop



In Affected eyes Change in the Tear film indices after surgery in comparison with pre-op values

As per Schimers test 1, among the affected eye, the tear film function significantly improved at one week, four weeks and six weeks following the surgery in comparison to pre-op values.

As per Schimers test 2, among the affected eye, the tear film function significantly improved at one week and four weeks following the surgery in comparison to pre-op values.

As per TBUT, among the affected eye, the tear film function significantly improved at one week, four weeks and six weeks following the surgery in comparison to pre-op values.

As per TMH, among the affected eye, the tear film function significantly improved at one week, four weeks and six weeks following the surgery in comparison to pre-op values.

Table:10 - Comparison of Ranks Between Post-operative and Pre-operative Values

Ranks					
		N	Mean Rank	Sum of Ranks	p value
ST 1 Case post1w - ST 1 Case pre	Negative Ranks	1	3.50	3.50	**<0.001**
	Positive Ranks	37	19.93	737.50	
	Ties	1			
	Total	39			
ST 1 Case post4w - ST 1 Case pre	Negative Ranks-	0	0	0	**<0.001**
	Positive Ranks-	39	20	780	
	Ties	0			
	Total	39			
ST 1 Case post6w - ST 1 Case pre	Negative Ranks-	0	0	0	**<0.001**

	Positive Ranks-	38	19.50	741.00	
	Ties	1			
	Total	39			
ST 2 Case post1w - ST 2 Case pre	Negative Ranks	1	1.50	1.50	**<0.001**
	Positive Ranks	31	16.98	526.50	
	Ties	7			
	Total	39			
ST 2 Case post4w - ST 2 Case pre	Negative Ranks	1	3.50	3.50	**<0.001**
	Positive Ranks	37	19.93	737.50	
	Ties	1			
	Total	39			
ST 2 Case post6w - ST 2 Cont pre	Negative Ranks	11	13.27	146.00	0.115
	Positive Ranks	9	7.11	64.00	
	Ties	19			
	Total	39			
TBUT Case post1w - TBUT Case pre	Negative Ranks-	1	3.00	3.00	**<0.001**
	Positive Ranks-	37	19.95	738.00	
	Ties	1			
	Total	39			
TBUT Case post4w - TBUT Case pre	Negative Ranks-	0	0	0	**<0.001**
	Positive Ranks-	36	18.5	666.0	
	Ties	3			
	Total	39			
TBUT Case post6w - TBUT Case pre	Negative Ranks	2	3.00	6.00	**<0.001**

	Positive Ranks	37	20.92	774.00	
	Ties	0			
	Total	39			
TMH Case post1w - TMH Case pre	Negative Ranks	4	8.25	33.00	**<0.001**
	Positive Ranks	31	19.26	597.00	
	Ties	4			
	Total	39			
TMH Case post4w - TMH Case pre	Negative Ranks	3	6.00	18.00	**<0.001**
	Positive Ranks	34	20.15	685.00	
	Ties	2			
	Total	39			
TMH Case post6w - TMH Case pre	Negative Ranks	7	9.29	65.00	**<0.001**
	Positive Ranks	28	20.18	565.00	
	Ties	4			
	Total	39			

Comparision of parametres at 1,4 & 6 weeks between preop and post op in type 1 pterygium

As per Schirmers test 1, among the affected eye, the tear film function significantly improved at one week, four weeks and six weeks following the surgery in comparison to pre-op values.

As per Schirmers test 2, among the affected eye, the tear film function significantly improved at one week, and four weeks following the surgery in comparison to pre-op values.

As per TBUT, among the affected eye, the tear film function significantly improved at one week, four weeks and six weeks following the surgery in comparison to pre-op values.

As per TMH, among the affected eye, the tear film function significantly improved at 1 week, 4 weeks and 6 weeks following the surgery in comparison to pre-op values.

Table:11 - Comparison of Ranks Between Post-operative and Pre-operative Values

Ranks					
		N	Mean Rank	Sum of Ranks	p value
ST 1 Case post1w - ST 1 Case pre	Negative Ranks-	0	0	0	**<0.001**
	Positive Ranks-	30	15.5	465	
	Ties-	0			
	Total-	30			
ST 1 Case post4w - ST 1 Case pre	Negative Ranks-	0	0	0	**<0.001**
	Positive Ranks-	30	15.50	465.00	
	Ties-	0			
	Total-	30			
ST 1 Case post6w - ST 1 Case pre	Negative Ranks-	0	0	0	**<0.001**
	Positive Ranks-	30	15.50	465.00	
	Ties-	0			
	Total-	30			
ST 2 Case post1w - ST 2 Case pre	Negative Ranks-	0	0	0	**<0.001**
	Positive Ranks-	30	15.50	465.00	
	Ties-	0			
	Total-	30			
ST 2 Case post4w - ST 2 Case pre	Negative Ranks-	0	0	0	**<0.001**

	Positive Ranks-	30	15.50	465.00	
	Ties-	0			
	Total-	30			
ST 2 Case post6w - ST 2 Cont pre	Negative Ranks-	8	11.50	92.00	**0.061**
	Positive Ranks-	7	4.00	28.00	
	Ties-	15			
	Total-	30			
TBUT Case post1w - TBUT Case pre	Negative Ranks-	0	0	0	**<0.001**
	Positive Ranks-	30	15.50	465.00	
	Ties-	0			
	Total-	30			
TBUT Case post4w - TBUT Case pre	Negative Ranks-	0	0	0	**<0.001**
	Positive Ranks-	30	15.50	465.00	
	Ties-	0			
	Total-	30			
TBUT Case post6w - TBUT Case pre	Negative Ranks-	0	0	0	**<0.001**
	Positive Ranks-	30	15.50	465.00	
	Ties-	0			
	Total-	30			
TMH Case post1w - TMH Case pre	Negative Ranks-	2	4.75	9.50	**<0.001**
	Positive Ranks-	26	15.25	396.50	
	Ties-	2			

	Total-	30			
TMH Case post4w - TMH Case pre	Negative Ranks-	2	3.50	7.00	**<0.001**
	Positive Ranks-	27	15.85	428.00	
	Ties-	1			
	Total-	30			
TMH Case post6w - TMH Case pre	Negative Ranks-	4	5	20	**<0.001**
	Positive Ranks-	24	16.08	386	
	Ties-	2			
	Total-	30			

DISCUSSION

DISCUSSION

This research assessed the enhancement of dry eye symptoms through established evaluations like Schimers tests (ST) 1 and 2, TBUT and TMH. The participants were monitored and contrasted before and after surgery, as well as at one, four, and six weeks following the procedure.

Demographic characteristics:

In the research conducted by Li et al., to assess the immediate impact of pterygium removal on the tear film, half of the participants were women, with an average age of 54 years ± 15. In the current investigation, 70% of the participants were women, averaging 51.3 years ± 13.3.59

Patkar et al. conducted a study at a hospital examining how pterygium and its removal surgery, using the conjunctival autograft technique, impacts tear films. The average age of the participants in this research was 52.84±11.99 years, with 53% being women.[66]

In the study by Sharma et al., two techniques for surgical removal (Bare sclera and autograft) were evaluated, involving a combined group of 68 individuals, with a median age of 53.32 years for the female participants and 48.4 years for the males.[7] The average age across both groups was found to be similar.

Table:12 - Comparison of age of our study with other studies

Study	Mean Age
Our study	51.3 years
Li et al	54 years
Patkar et al	52.84 years
Sharma et al	53.32 years (females) 48.4 years (males)
Li et al	54±15 years
Patkar et al	52.84±11.99 years

ST and TBUT

The results of ST and the TBUT were assessed both before and after the pterygium surgery by Kampitak et al. Interestingly, there was no substantial change in ST and TBUT measurements between the two-time points.[63] The Schirmer's test results indicated an average ± standard deviation of 9.2 ± 4.3 and 10.0 ± 6.3 millimeters one month after the surgery, compared to before the surgery. In this study, ST was performed at four different time intervals. The test demonstrated an improvement from 8.3 ± 6.4 to 22 ± 1.6 millimeters one month after the surgery. The TBUT measurements revealed times of 7.5 ± 3.0 and 7.9 ± 3.1 seconds, respectively. Although the Kampitak et al. research did not observe any changes in TBUT,[63] our findings indicated a notable increase in the average TBUT from 8.4 ± 4 to 16.4 ± 2.2 seconds one month after the surgery. The variation in the results could be attributed to the fact that the Kampitak et al. study utilized a wet amniotic membrane graft on the scleral bed following the pterygium removal, whereas our study employed a conjunctival limbal autograft.[63]

Sharma et al. looked into how tear film characteristics changed when comparing patients with pterygium surgery to the traditional bare sclera method or the newer conjunctival autograft technique.[7] Before the surgery, the average ST-I score was 9.333 millimetre, that rose to 12.203 millimetre following the pterygium removal. In the group that received the conjunctival autograft, the average times for TBUT and Schirmer's I scores before and after the surgery were 7.253 secs and 14.0 secs, with scores of 9.178 mm and 12.678 mm. The patients who had surgery with the traditional bare sclera method also saw improvements in their Schirmer's I and TBUT scores, with scores increasing from 9.500 mm to 11.692 mm for Schirmer's I and from 7.169 seconds to 12.046 seconds for TBUT. In a similar manner, the Schirmer's I score rose from 8.3±6.4 to 22±1.6 over the course of one month after the surgery. Schirmers' second test before surgery had a range of 19±7, but it improved to 22.3±1.4 one week after the operation, 25±1.1 one month later, and 25.6±1.7 six weeks later. Sharma et al.' research indicated that the total time spent under anesthesia (TBUT) before surgery was 7.212 seconds.[7] Following the removal of the pterygium, this value rose to 13.059 seconds. In a similar way, the average TBUT increased from 8.4±4 in the days before the operation to 16.4±2.2 seconds one month after the procedure. Regardless of the specific method used, both Schirmers' test scores and TBUT values showed an upward trend over time after the surgical intervention.[7]

Li et al. evaluated the immediate effects of removing a pterygium on the goblet cells count in the conjunctiva and the function of the tear glands. They found that the time it took for the tear glands to recover, as estimated by the TBUT, was significantly longer after the surgery compared to before (9.74±3.43” vs. 11.49±3.76”). However, the Schirmer test showed no notable difference in tear production before and after the procedure. The removal of a pterygium seemed to enhance tear function in people with a primary pterygium, indicating a strong connection between the pterygium and dry eye. In a similar way, the tear breakup time

increased from 8.4±4 to 15.8±2.1 in the first week, 16.4±2.2 in the second month, and 17.1±1.8 in the sixth week after surgery. The Schirmer I Test remained the same in both groups from Li et al.'s research, which mirrored our findings, showing no difference in tear production across the affected and control eyes at 4 weeks and 6 weeks.[64]

Table:13 - Comparison of Schirmer's test I with other studies

Study	ST-I value Changes
Our study	8.3 ± 6.4 (Baseline) and 22 ± 1.6 (1 months after surgery)
Kampitak et al	9.2 ± 4.3 (baseline) and 10.0 ± 6.3 (1 month after)
Sharma et al	Overall: 9.333 mm (baseline), 12.203 mm (1 month) Conjunctival autograft group: 9.178 mm and 12.678 mm Bare sclera group: 9.500 mm and 11.692 mm
Patkar et al	Baseline: 13±2.47 mm, 22±1.6 one month
Singh et al	Non-recurrence vs recurrence Baseline 10.68 (3.18) vs 10.67 (3.74) 1 month 10.96 (3.30) vs 11.56 (3.05) 3 months 11.18 (3.14) vs 11.67 (2.78) 6 months 11.51 (2.96) vs 11.56 (2.79)
Manhas et al	Cases:13.17±4.57 mm Controls: 16.40±5.21 mm

Patkar et al. examined the impact of pterygium surgery, specifically the conjunctival autograft method, on the tear film. They selected one eye with pterygium as the case eye and another, unaffected eye was considered to be the control. Before and after the surgery, tests for TBUT, ST-I &II, were conducted on the eyes on days 10, 30, and 60. Before the operation, the case eye's tear breakup time was 9.71±1.35 secs, while the control eye's was

10.64±1.32 seconds. Before the operation, the case eye's Schirmer's I test showed an average of 13±2.47 mm, compared to 14.54±2.45 mm in the normal eye. Similarly, the case eye's ST-II test was 9.85±2.33 mm in the affected, and the control eye's had 10.44±2.54 mm. This showed that the eye with the pterygium removed eventually had a tear film of higher stability than the eye without surgery, which was the same as the comparison eye. In a similar way, the TBUT in our research went up from 8.4±4 in the time before surgery to 15.8±2.1 in one week, 16.4±2.2 in one month after surgery, and 17.1±1.8 in six weeks after surgery. Likewise, the Schirmer's test showed an increase from 8.3±6.4 before surgery to 22±1.6 one month after surgery. The Schirmer's test II before surgery was 19±7, but it improved to 22.3±1.4 one week after surgery, 25±1.1 one month after surgery, and 25.6±1.7 six weeks after surgery. The similarity in the results of the study could be attributed to the similar number of participants, the design of the study, and the method used, including the procedure of pterygium removal with conjunctival limbal autograft.[66]

Table:14 - Comparison of Schirmer's test II

Study	ST-II value Changes
Our study	Before surgery:19±7, 22.3±1.4 one week after surgery 25±1.1 one month after surgery 25.6±1.7 six weeks after surgery
Patkar et al	Baseline: 9.85±2.33 mm, 22.3±1.4 one week after surgery, 25±1.1 one month after surgery, and 25.6±1.7 six weeks
Singh et al	Non-recurrence vs recurrence Baseline 9.50 ((3.02)vs 9.33 (2.78) 1 month 9.80 (2.63) vs 10.00 (2.24) 3 months 10.22 (2.33) vs 10.33 (2.18) 6 months 10.57 (2.59) vs 10.33 (2.12)

Singh et al. evaluate the changes in the eye's tear layer before and after surgery for pterygium removal (conjunctival autograft). Out of 75 patients who underwent conjunctival autografting and pterygium removal, 9 (12%) experienced a recurrence within three to six months. Following the pterygium removal surgery with conjunctival autograft, among those who did not experience a recurrence, the TBUT increased from 8.26 ± 2.37 seconds to 10.06 ± 2.36 seconds one month after the procedure. The TBUT increased from 8.33 ± 2.12 seconds before the surgery to 10.44 ± 2.0 seconds one month after the surgery in patients who later experienced a recurrence. There was a significant difference in these measurements. Following the surgery for pterygium, the Schirmer-1 and Schirmer-2 tests showed a slight enhancement in all patients, though these changes were not deemed statistically meaningful. Nonetheless, in the current research, the Schirmer-1 test was notably reduced in the eye where surgery was performed compared to the non-operated eye both before and one week after the operation, and there was no notable disparity in the ST-1 results between the operated and non-operated eyes at four and six weeks post-surgery. A similar trend was noted in the Schirmer-2 test. Singh et al. explored and analyzed the composition or quality of the tear fluid in relation to the TBUT, a factor not examined in the current study.[68]

The average of tear TBUT before surgery in eyes affected by pterygium was 8.26 seconds, among those who did not experience any recurrence following the procedure. A research study by Manhas A et al found that the average TBUT of the tear film in eyes affected by pterygium before surgery was 9.9 seconds. Other research on pterygium also reported an average TBUT of 10.4 seconds in eyes without pterygium, in comparison with 5.6 seconds in eyes affected by pterygium. The average TBUT before surgery was similar in the current study, with a TBUT time of 8.4 ± 4.4 seconds.[68,71]

Singh et al. found that, when compared to the average tear break-up time (TBUT) one month after surgery (10.44 seconds), the average TBUT three months after surgery decreased to 8.56

seconds, indicating a disruption in the tear film stability, once again. This could be due to the fact that the recurrence began to affect the normal spread of the tear film at three months. Nonetheless, the current research only looked at TBUT up to 45 days, so the impact of the recurrence on tear film stability beyond this period was not investigated.[68]

Manhas et al. carried out a study comparing patients with pterygium to those without, aiming to explore how common dry eye is among these groups and to determine if there's a link between the two conditions. They found that the average time it took for the TBUT was 9.88 seconds in those with pterygium and 14.22 seconds in the comparison eyes. This difference was found to be statistically significant. The average gap in TBUT was 4.34 seconds. The average difference in TBUT before surgery was more than 6 seconds. In this study, TBUT was assessed to be significantly lower in the affected eye compared to the control eye both before and after surgery. However, there was no notable difference in TBUT between the affected and control eyes at 1 week and 6 weeks after surgery.[71]

Table:15 - Tear Break-up Time (TBUT) in our study with other studies

	Tear Break-up Time (TBUT)
Our study	8.4 ± 4 to 16.4 ± 2.2 (1month after surgery)
Sharma et al	Overall: 7.212 seconds (baseline) and 13.059 seconds (1 month) Conjunctival autograft group: 7.253 seconds and 14.0 seconds Bare sclera group: 7.169 seconds and 12.046 seconds
Kampitak et al	7.5 ± 3.0 (baseline), 7.9 ± 3.1 (post surgery)
Li et al	9.74±3.43 (baseline) vs. 11.49±3.76 (1month)
Patkar et al	Baseline: 9.71±1.35 seconds, 15.8±2.1 in one week, 16.4±2.2 in one month after surgery, 17.1±1.8 in six weeks after surgery.
Singh et al	Non recurrence group:

	8.26 ±2.37 (baseline) 10.06 ±2.36 (1 month) 10.27 ±2.24 (3 month) 10.77 ±2.23 (6 month) Recurrence group: 8.33 ±2.12 (base) 10.44 ±2.01 (1mon) 8.56 ±2.01 (3mon) 8.89 ±1.83 (6mon)
Manhas et al	Cases: 9.88±3.39 Controls: 14.22±3.99

Tear meniscus height (TMH):

In the research conducted by Li et al., the Tear meniscal Height (TMH) showed no significant change, with an average difference of approximately 0.23±0.10 observed one to six months after surgery, in comparison with the control eyes. Similarly, there was no notable disparity across the groups. Our research found that the TMH was noticeably lower in the operated eye compared to the non-operated eye both before and one week after surgery. However, there was no significant variation in TMH between the operated and non-operated eyes at four and six weeks post-surgery. The comparison of TMH between the two groups of eyes (surgery done and surgery not done), in the post-surgery period remained consistent throughout the study.[64]

Table:16 - Comparison of Tear Meniscus Height (TMH) Changes

Study	TMH
Our study	0.22 pre op to 0.29 6 weeks after surgery
Li et al	Difference of 0.23 at 6 months after surgery

CONCLUSION

CONCLUSION

Our research found that after the pterygium was removed, the measurements, such as ST and TBUT, showed improvement over time. After a month after the operation in the affected eye, the ST and TBUT were almost as close to the control eye's values. This suggests that the dry eye symptoms related to the pterygium got better after the surgery. Nonetheless, our research did not include a long-term check-up to explore if the pterygium would come back and how it might affect the tear film's function.

Recommendations:

We suggest research projects that involve ongoing monitoring over an extended period to calculate the percentage of recurrence after the surgical removal of pterygium and to determine the functioning of the tear film in individuals who experience pterygium recurrence.

SUMMARY

SUMMARY

- The effects of pterygium excision on ocular surface epithelium and refraction have been studied in great detail; however, little is known about the relationships between pterygium characteristics and excision prognosis.
- The present study was performed to assess precorneal tear film before and after pterygium surgery among the 39 adult patients with unilateral pterygium
- The study followed prospective observational design and was conducted at ophthalmology OPD at R L Jalappa hospital in Kolar from August 2022 to December 2023
- Average age of the patients was 51.33 years. Majority of the patients were females (69.2%)
- Majority of the patients had grade 2 Progressive nasal pterygium (51.3%).
- Affected eyes had statistically lower Schirmers test 1 and TMH than the control eye at pre-op and 1 week following procedure.
- Affected eyes had statistically lower Schirmers test 2 than the control eye at pre-op and 1, 4 weeks following procedure
- Affected eyes had statistically lower TBUT than the control eye at pre-op and 4 weeks following procedure
- As per Schirmers test 1 and TBUT, among the affected eye, the tear film function significantly improved at one week, four weeks and six weeks following the surgery in comparison to pre-op values.
- As per Schirmers test 2, among the affected eye, the tear film function significantly improved at one week and four weeks following the surgery in comparison to pre-op values.

- As per TMH, among the affected eye, the tear film function significantly improved at one week, four weeks and six weeks following the surgery in comparison to pre-op values.
- Overall, after the pterygium was removed, the measurements, such as ST and TBUT, showed improvement over time.

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ANNEXURE

ANNEXURE-1

CASE PROFORMA

Name: Case No:

Age: Date:

Sex: 1P No:

Occupation: DOS:

Address:

Chief complaints:

Past history:

DM / HTN / BA / Epilepsy

Family history:

Personal history:

Appetite – Sleep – Bowel –

Diet – Habits – Bladder –

GPE:

Pallor / Edema /Icterus / Cyanosis / Clubbing / Lymphadenopathy

Vital signs:

a. Pulse – c) RR –

b. BP – d) Temp –

Systemic examination:

a. CVS – c. RS –

b. PA – d. CNS –

OCULAR EXAMINATION		
	RE	**LE**
1. **Head Posture** 2. **Ocular Posture** 3. **Facial Symmetry**		
4. **Ocular Movements**		
5. **Visual Acuity** a) Distant b) Near		
6. **Anterior Segment**		
7. **Fundus (IDO & Slit Lamp +90D)**		
8. **Intraocular pressure**		
9. **Lab Investigations** a. RBS b. Blood urea c. Serum Creatinine d. CBC		

TESTS PERFORMED	**PRE-OP**	**1 WEEK**	**4 WEEKS**	**6 WEEKS**
TBUT				
SCHIRMER'S TEST 1				
SCHIRMER'S TEST 2				
TMH				

ANNEXURE-II

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, TAMAKA, KOLAR - 563101.

INFORMED CONSENT FORM

Case no:

IP no:

TITLE: " EFFECT OF PTERYGIUM SURGERY ON PRECORNEAL TEAR FILM "

I, the undersigned, agree to participate in this study and authorize the collection and disclosure of personal information as outlined in this consent form.

I understand the purpose of this study, the risks and benefits of the technique and the confidential nature of the information that will be collected and disclosed during the study. The information collected will be used only for research.

I have had the opportunity to ask questions regarding the various aspects of this study and my questions have been answered to my satisfaction.

I understand that I remain free to withdraw the participation from this study at any time and this will not change the future care.

Participation in this study does not involve any extra cost to me.

Name	Signature	Date	Time
Patient:			
Witness:			
Primary Investigator/ Doctor:			

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION ANDRESEARCH, TAMAKA, KOLAR - 563101.

ತಿಳಿವಳಿಕೆಯ ಸಮ್ಮತಿ ನಮೂನೆ

ಶೀರ್ಷಿಕೆ: ಪ್ರೈಕಾರ್ನಲ್ ಟಿಯರ್ ಫಿಲ್ಮ್ ಮೇಲೆ ಟೆರಿಜಿಯಮ್ ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ಪರಿಣಾಮ

ಐಪಿ ಸಂಖ್ಯೆ:

ಅಂಗೀಕರಿಸಿದ ನಾನು, ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಲು ಒಪ್ಪುತ್ತೇನೆ ಮತ್ತು ಈ ಸಮ್ಮತಿಯ ರೂಪದಲ್ಲಿ ವಿವರಿಸಿರುವಂತೆ ನನ್ನ ವೈಯಕ್ತಿಕ ಮಾಹಿತಿಯ ಸಂಗ್ರಹಣೆ ಮತ್ತು ಬಹಿರಂಗಪಡಿಸುವಿಕೆಯನ್ನು ದೃಢೀಕರಿಸುತ್ತೇನೆ.

ನಾನು ಈ ಅಧ್ಯಯನದ ಉದ್ದೇಶ, ತಂತ್ರಗಳ ಅಪಾಯಗಳು ಮತ್ತು ಪ್ರಯೋಜನಗಳನ್ನು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿಸಂಗ್ರಹಿಸಿದ ಮತ್ತು ಬಹಿರಂಗಪಡಿಸುವ ಮಾಹಿತಿಯ ಗೌಪ್ಯತೆಗೆ ನಾನು ಅರ್ಥಮಾಡಿಕೊಂಡಿದ್ದೇನೆ.

ಸಂಗ್ರಹಿಸಿದ ಮಾಹಿತಿಯನ್ನು ಸಂಶೋಧನೆಗೆ ಮಾತ್ರ ಬಳಸಲಾಗುತ್ತದೆ.

ಈ ಅಧ್ಯಯನದ ವಿವಿಧ ಅಂಶಗಳನ್ನು ಕುರಿತು ಪ್ರಶ್ನೆಗಳನ್ನು ಕೇಳಲು ನನಗೆ ಅವಕಾಶವಿದೆ ಮತ್ತು ನನ್ನ ತೃಪ್ತಿಗೆ ನನ್ನ ಪ್ರಶ್ನೆಗಳಿಗೆ ಉತ್ತರ ನೀಡಲಾಗಿದೆ.

ಈ ಸಂಶೋಧನೆಯಿಂದ ಹೊರಬರುವ ಮಾಹಿತಿಯನ್ನು ವೈದ್ಯರು ಯಾವುದೇ ಜರ್ನಲ್ನಲ್ಲಿ ಅಥವಾ ಕಾನ್ಫೆರೆನ್ಸ್ನಲ್ಲಿ ಪ್ರಕಟಿಸಲು ಅನುಮತಿ ಸೂಚಿಸಿರುತ್ತೇನೆ

ನಾನು ಈ ಅಧ್ಯಯನದಿಂದ ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ಹಿಂತೆಗೆದುಕೊಳ್ಳಲು ಮುಕ್ತವಾಗಿರುತ್ತೇನೆ ಮತ್ತು ಇದು ನನ್ನ ಮುಂದಿನ ಕಾಳಜಿಯನ್ನು ಬದಲಿಸುವುದಿಲ್ಲ ಎಂದು ನಾನು ಅರ್ಥಮಾಡಿಕೊಂಡಿದ್ದೇನೆ.

ಈ ಸಂಶೋಧನಾ ಯೋಜನೆಯ ಭಾಗವಹಿಸುವಿಕೆ ನನಗೆ ಯಾವುದೇ ಹಣಕಾಸಿನ ಹೊರೆ ಒಳಗೊಂಡಿರುವುದಿಲ್ಲ.

ಹೆಸರು	ಸಹಿ	ದಿನಾಂಕ	ಸಮಯ

ರೋಗಿಯ:

ಸಾಕ್ಷಿ 1:

ಸಾಕ್ಷಿ 2:

ಪ್ರಾಥಮಿಕ ತನಿಖೆದಾರ / ಡಾಕ್ಟರ್:

ANNEXURE-III

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, TAMAKA, KOLAR - 563101.

PATIENT INFORMATION SHEET

This information is to help you understand the purpose of the study " **EFFECT OF PTERYGIUM SURGERY ON PRECORNEAL TEAR FILM** ". You are invited to take part voluntarily in this research study, it is important that you read and understand the purpose, procedure, benefits and discomforts of the study.

Pterygium causes disturbed precorneal tearfilm resulting in dry eye symptoms hence here we are assessing how pterygium surgery affects the precorneal tearfilm and thus reducing symptoms. If you are willing to take part in this study, you need to give clinical information and following procedures will be carried out:

1. Visual acuity by Snellens chart for distant vision(converted to logMAR)
2. Near vision – jaeger chart.
3. Slit lamp biomicroscopy.
4. Fundus examination by 90D slit lamp biomicroscopy and indirect ophthalmoscopy, including optic disc evaluation.
5. Schirmers test
6. TBUT
7. TMH

You will not be charged for any of the tests. All the tests are routine tests and absolutely no risks are associated with various investigations.

If during the procedure, any unexpected event occurs like redness of eyes, itching, blurring, Doctor will take care of it.

If you participate in the study, the generated data might be helpful for further treatment protocol or to avoid complications. The collected data will be used for presentation in medical conferences and identity will not be revealed. Your medical information will be kept confidential by the study doctor and staff and will not be made publicly available. Your original records may be reviewed by your doctor or ethics review board.

You may refuse to take part in the study or you may stop your participation in the study at any time, without a penalty or loss of any benefits to which you were otherwise entitled before taking part in this study.

Extra monetary benefits or money will not be paid for taking part in the study.

For further information/ clarification please contact

DR. CHAVA PREETHI (Contact no.: 9493316567)

ಶ್ರೀ ದೇವರಾಜ್ ಅರಸ್ ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನಾ ಸಂಸ್ಥೆ,

ಟಮಕ, ಕೋಲಾರ – 563101.

ರೋಗಿಯ ಮಾಹಿತಿ ಪತ್ರ

ಈ ಮಾಹಿತಿಯು "ಪ್ರೀಕಾರ್ನಿಯಲ್ ಟಿಯರ್ ಫಿಲ್ಮ್‌ನ ಮೇಲೆ ಪೆಟರಿಜಿಯಮ್ ಸರ್ಜರಿಯ ಪರಿಣಾಮ" ಅಧ್ಯಯನದ ಉದ್ದೇಶವನ್ನು ಅರ್ಥಮಾಡಿಕೊಳ್ಳಲು ನಿಮಗೆ ಸಹಾಯ ಮಾಡುತ್ತದೆ. ಈ ಸಂಶೋಧನಾ ಅಧ್ಯಯನದಲ್ಲಿ ಸ್ವಯಂಪ್ರೇರಣೆಯಿಂದ ಪಾಲ್ಗೊಳ್ಳಲು ನಿಮ್ಮನ್ನು ಆಹ್ವಾನಿಸಲಾಗಿದೆ, ಅಧ್ಯಯನದ ಉದ್ದೇಶ, ಕಾರ್ಯವಿಧಾನ, ಪ್ರಯೋಜನಗಳು ಮತ್ತು ಅನಾನುಕೂಲಗಳನ್ನು ನೀವು ಓದುವುದು ಮತ್ತು ಅರ್ಥಮಾಡಿಕೊಳ್ಳುವುದು ಮುಖ್ಯವಾಗಿದೆ.

ಪ್ಯಾಟರಿಜಿಯಮ್ ತೊಂದರೆಗೊಳಗಾದ ಪ್ರಿಕಾರ್ನಿಯಲ್ ಟಿಯರ್‌ಫಿಲ್ಮ್ ಅನ್ನು ಉಂಟುಮಾಡುತ್ತದೆ ಮತ್ತು ಒಣ ಕಣ್ಣಿನ ರೋಗಲಕ್ಷಣಗಳಿಗೆ ಕಾರಣವಾಗುತ್ತದೆ ಆದ್ದರಿಂದ ಇಲ್ಲಿ ನಾವು ಪ್ಯಾಟರಿಜಿಯಮ್ ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯು ಪ್ರಿಕಾರ್ನಿಯಲ್ ಟಿಯರ್‌ಫಿಲ್ಮ್‌ನ ಮೇಲೆ ಹೇಗೆ ಪರಿಣಾಮ ಬೀರುತ್ತದೆ ಮತ್ತು ರೋಗಲಕ್ಷಣಗಳನ್ನು ಕಡಿಮೆ ಮಾಡುತ್ತದೆ ಎಂದು ನಿರ್ಣಯಿಸುತ್ತಿದ್ದೇವೆ. ನೀವು ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಲು ಸಿದ್ಧರಿದ್ದರೆ, ನೀವು ಕ್ಲಿನಿಕಲ್ ಮಾಹಿತಿಯನ್ನು ನೀಡಬೇಕಾಗುತ್ತದೆ ಮತ್ತು ಕೆಳಗಿನ ಕಾರ್ಯವಿಧಾನಗಳನ್ನು ಕೈಗೊಳ್ಳಲಾಗುತ್ತದೆ:

1. ದೂರದ ದೃಷ್ಟಿಗಾಗಿ ಸ್ನೆಲೆನ್ಸ್ ಚಾರ್ಟ್‌ನಿಂದ ದೃಷ್ಟಿ ತೀಕ್ಷ್ಣತೆ (ಲಾಗ್‌ಮಾರ್‌ಗೆ ಪರಿವರ್ತಿಸಲಾಗಿದೆ)
2. ಸಮೀಪ ದೃಷ್ಟಿ - ಜೇಗರ್ ಚಾರ್ಟ್.
3. ಸ್ಲಿಟ್ ಲ್ಯಾಂಪ್ ಬಯೋಮೈಕ್ರೋಸ್ಕೋಪಿ.
4. ಆಪ್ಟಿಕ್ ಡಿಸ್ಕ್ ಮೌಲ್ಯಮಾಪನ ಸೇರಿದಂತೆ 90D ಸ್ಲಿಟ್ ಲ್ಯಾಂಪ್ ಬಯೋಮೈಕ್ರೋಸ್ಕೋಪಿ ಮತ್ತು ಪರೋಕ್ಷ ನೇತ್ರದರ್ಶಕದಿಂದ ಫಂಡಸ್ ಪರೀಕ್ಷೆ.
5. ಸ್ಕಿರ್ಮರ್ಸ್ ಪರೀಕ್ಷೆ
6. ಟಿಬಿಯುಟಿ
7. ಟಿಯರ್ ಮೆನಿಸ್ಕಲ್ ಎತ್ತರ

ಯಾವುದೇ ಪರೀಕ್ಷೆಗಳಿಗೆ ನಿಮಗೆ ಶುಲ್ಕ ವಿಧಿಸಲಾಗುವುದಿಲ್ಲ. ಎಲ್ಲಾ ಪರೀಕ್ಷೆಗಳು ವಾಡಿಕೆಯ ಪರೀಕ್ಷೆಗಳು ಮತ್ತು ಸಂಪೂರ್ಣವಾಗಿ ಯಾವುದೇ ಅಪಾಯಗಳು ವಿವಿಧ ತನಿಖೆಗಳೊಂದಿಗೆ ಸಂಬಂಧ ಹೊಂದಿಲ್ಲ.

ಕಾರ್ಯವಿಧಾನದ ಸಮಯದಲ್ಲಿ, ಕಣ್ಣುಗಳು ಕೆಂಪಾಗುವುದು, ತುರಿಕೆ, ಮಸುಕು ಮುಂತಾದ ಯಾವುದೇ ಅನಿರೀಕ್ಷಿತ ಘಟನೆ ಸಂಭವಿಸಿದಲ್ಲಿ, ವೈದ್ಯರು ಅದನ್ನು ನೋಡಿಕೊಳ್ಳುತ್ತಾರೆ.

ನೀವು ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಿದರೆ, ರಚಿತವಾದ ಡೇಟಾವು ಹೆಚ್ಚಿನ ಚಿಕಿತ್ಸಾ ಪ್ರೋಟೋಕಾಲ್‌ಗೆ ಅಥವಾ ತೊಡಕುಗಳನ್ನು ತಪ್ಪಿಸಲು ಸಹಾಯಕವಾಗಬಹುದು. ಸಂಗ್ರಹಿಸಿದ ಡೇಟಾವನ್ನು ವೈದ್ಯಕೀಯ ಸಮ್ಮೇಳನಗಳಲ್ಲಿ

ಪ್ರಸ್ತುತಿಗಾಗಿ ಬಳಸಲಾಗುತ್ತದೆ ಮತ್ತು ಗುರುತನ್ನು ಬಹಿರಂಗಪಡಿಸಲಾಗುವುದಿಲ್ಲ. ನಿಮ್ಮ ವೈದ್ಯಕೀಯ ಮಾಹಿತಿಯನ್ನು ಅಧ್ಯಯನ ವೈದ್ಯರು ಮತ್ತು ಸಿಬ್ಬಂದಿ ಗೌಪ್ಯವಾಗಿಡುತ್ತಾರೆ ಮತ್ತು ಸಾರ್ವಜನಿಕವಾಗಿ ಲಭ್ಯವಾಗುವಂತೆ ಮಾಡಲಾಗುವುದಿಲ್ಲ. ನಿಮ್ಮ ಮೂಲ ದಾಖಲೆಗಳನ್ನು ನಿಮ್ಮ ವೈದ್ಯರು ಅಥವಾ ಎಥಿಕ್ಸ್ ರಿವ್ಯೂ ಬೋರ್ಡ್ ಪರಿಶೀಲಿಸಬಹುದು.

ನೀವು ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಲು ನಿರಾಕರಿಸಬಹುದು ಅಥವಾ ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳುವ ಮೊದಲು ನೀವು ಅರ್ಹರಾಗಿದ್ದ ಯಾವುದೇ ಪ್ರಯೋಜನಗಳ ದಂಡ ಅಥವಾ ನಷ್ಟವಿಲ್ಲದೆಯೇ ನೀವು ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸುವುದನ್ನು ನಿಲ್ಲಿಸಬಹುದು.

ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಿದ್ದಕ್ಕಾಗಿ ಹೆಚ್ಚುವರಿ ವಿತ್ತೀಯ ಪ್ರಯೋಜನಗಳು ಅಥವಾ ಹಣವನ್ನು ಪಾವತಿಸಲಾಗುವುದಿಲ್ಲ.

ಹೆಚ್ಚಿನ ಮಾಹಿತಿ / ಸ್ಪಷ್ಟೀಕರಣಕ್ಕಾಗಿ ದಯವಿಟ್ಟು ಸಂಪರ್ಕಿಸಿ

DR. ಚಾವ ಪ್ರೀತಿ (ಸಂಪರ್ಕ ಸಂಖ್ಯೆ: 9493316567)

ANNEXURE-IV

Photograph 1: TBUT and TMH evaluation by Slit lamp

Photograph 2: Performing schirmers test

Photograph 3 : Schirmers test

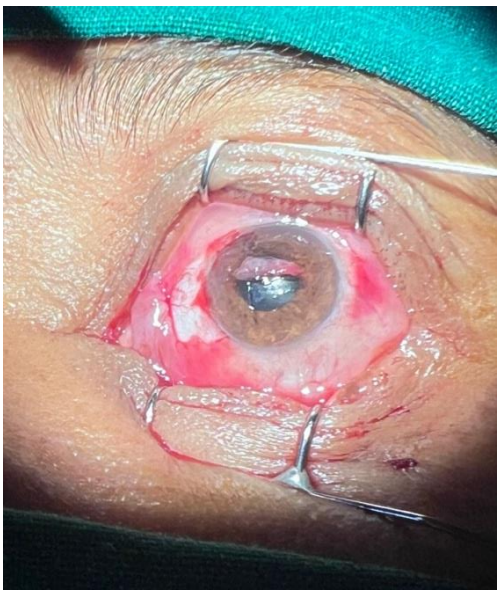

Figure 4A - Pterygium excision

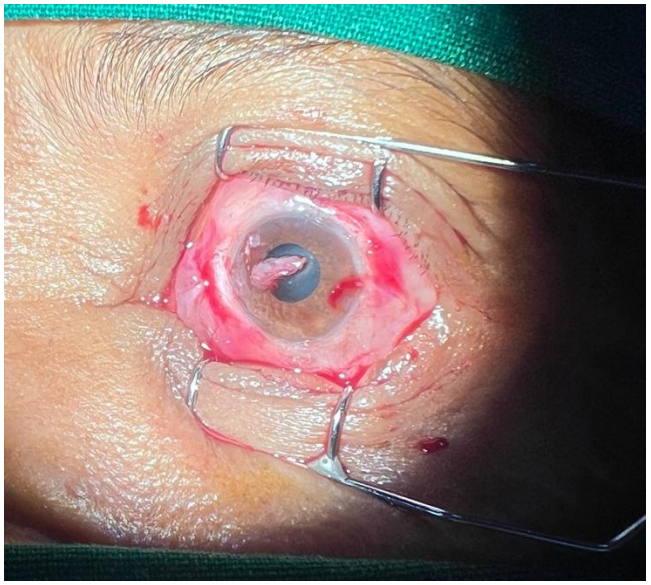

Figure 4B - Conjunctival limbal autograft over cornea

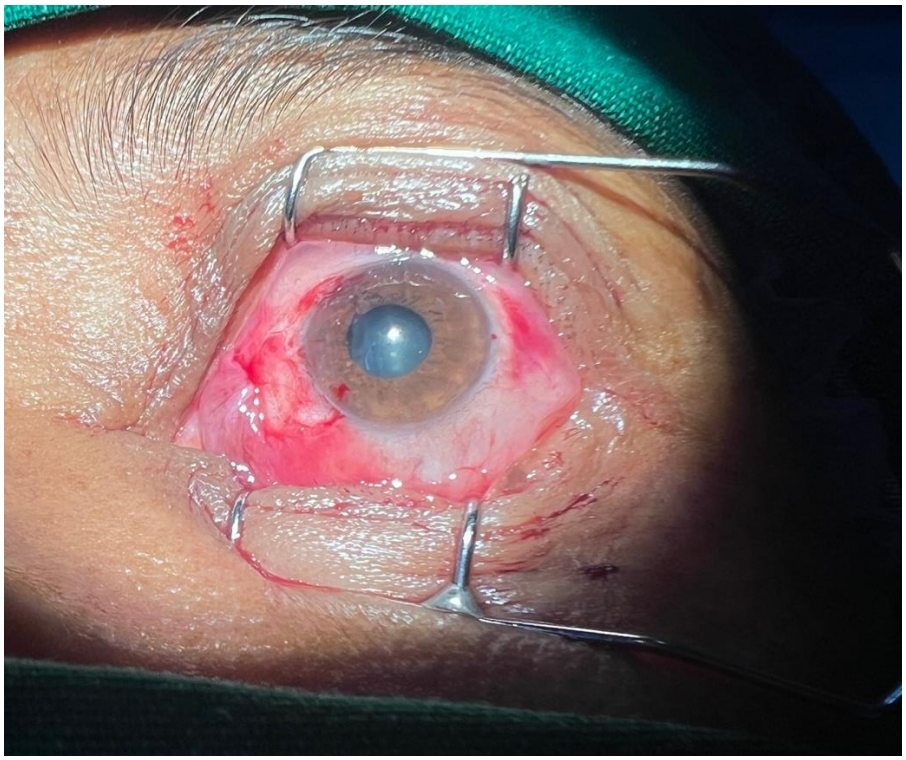

Figure 4C - Graft placed over bare sclera

MASTER CHART

KEY TO MASTER CHART

M- Male

F-Female

C- Case

CL- Control

G 1 PNP – Grade 1 progressive nasal pterygium

G 2 PNP – Grade 2 progressive nasal pterygium

G 3 PNP – Grade 3 progressive nasal pterygium

S.no	age/gender	UHID	DIAGNOSIS	EYE	SCIRMERS TEST 1								SCHIRMERS TEST 2								TBUT								TMH							
					PREOP		POST OP						PREOP		POST OP						PREOP		POST OP						PREOP		POST OP					
							1 WEEK		4 WEEKS		6 WEEKS				1 WEEK		4 WEEKS		6 WEEKS				1 WEEK		4 WEEKS		6 WEEKS				1 WEEK		4 WEEKS		6 WEEKS	
					CASE	CONTROL	CASE	CONTROL	CASE	CONTROL	CASE	CONTROL	CASE	CONTROL	CASE	CONTROL	CASE	CONTROL	CASSE	CONTROL	CASE	CONTROL	CASE	CONTROL	CASE	CONTROL	CASE	CONTROL	CASE	CONTROL	CASE	CONTROL	CASE	CONTROL	CASE	CONTROL
1	40/F	94563	Grade 2 PNP	LE	5	20	15	22	20	20	22	22	6	28	22	24	24	26	24	24	6	15	14	16	14	18	14	14	0.15	0.29	0.29	0.3	0.3	0.3	0.3	0.3
2	73/F	203487	Grade 2 PNP	RE	4	24	20	22	22	24	24	24	8	26	24	26	26	26	26	26	5	14	16	16	18	20	18	18	0.17	0.28	0.25	0.29	0.28	0.29	0.29	0.29
3	50/F	216120	Grade 2 PNP	LE	5	22	20	22	22	22	26	26	7	26	20	26	24	24	28	28	7	16	14	14	20	22	20	20	0.14	0.27	0.26	0.28	0.28	0.28	0.28	0.28
4	52/F	216116	Grade 2 PNP	LE	6	24	22	24	22	22	24	24	6	24	22	24	26	26	24	24	8	18	20	22	14	16	18	18	0.16	0.26	0.25	0.26	0.26	0.27	0.26	0.26
5	58/F	215290	Grade 2 PNP	RE	5	20	15	22	20	20	22	22	6	28	22	24	24	26	24	24	9	18	16	16	18	18	16	16	0.19	0.3	0.26	0.29	0.28	0.3	0.29	0.3
6	29/F	160934	Grade 2 PNP	RE	4	24	20	22	22	24	24	24	8	26	24	26	26	26	26	26	4	15	13	15	14	16	17	17	0.18	0.32	0.28	0.31	0.29	0.3	0.3	0.31
7	47/F	167219	Grade 2 PNP	RE	5	22	20	22	22	22	26	26	7	26	20	26	24	24	28	28	6	15	14	16	14	18	14	14	0.15	0.29	0.29	0.3	0.3	0.3	0.3	0.3
8	65/M	135736	Grade 2 PNP	LE	6	24	22	24	22	22	24	24	6	24	22	24	26	26	24	24	5	14	16	16	18	20	18	18	0.17	0.28	0.25	0.29	0.28	0.29	0.29	0.29
9	57/F	135755	Grade 2 PNP	LE	5	20	15	22	20	20	22	22	6	28	22	24	24	26	24	24	7	16	14	14	20	22	20	20	0.14	0.27	0.26	0.28	0.28	0.28	0.28	0.28
10	40/F	278487	Grade 2 PNP	LE	4	24	20	22	22	24	24	24	8	26	24	26	26	26	26	26	8	18	20	22	14	16	18	18	0.16	0.26	0.25	0.26	0.26	0.27	0.26	0.26
11	43/F	275203	Grade 2 PNP	LE	5	22	20	22	22	22	26	26	7	26	20	26	24	24	28	28	9	18	16	16	18	18	16	16	0.19	0.3	0.26	0.29	0.28	0.3	0.29	0.3
12	60/F	293561	Grade 2 PNP	LE	6	24	22	24	22	22	24	24	6	24	22	24	26	26	24	24	4	15	13	15	14	16	17	17	0.18	0.32	0.28	0.31	0.29	0.3	0.3	0.31
13	54/F	291506	Grade 2 PNP	LE	5	20	15	22	20	20	22	22	6	28	22	24	24	26	24	24	6	15	14	16	14	18	14	14	0.15	0.29	0.29	0.3	0.3	0.3	0.3	0.3
14	75/F	275215	Grade 2 PNP	LE	4	24	20	22	22	24	24	24	8	26	24	26	26	26	26	26	5	14	16	16	18	20	18	18	0.27	0.3	0.28	0.3	0.28	0.28	0.28	0.28
15	60/F	277116	Grade 2 PNP	LE	5	22	20	22	22	22	26	26	7	26	20	26	24	24	28	28	7	16	14	14	20	22	20	20	0.28	0.3	0.28	0.31	0.3	0.27	0.26	0.26
16	60/F	317703	Grade 2 PNP	LE	6	24	22	24	22	22	24	24	6	24	22	24	26	26	24	24	8	18	20	22	14	16	18	18	0.29	0.28	0.28	0.31	0.3	0.3	0.29	0.3
17	35/F	337231	Grade 2 PNP	RE	5	20	15	22	20	20	22	22	6	28	22	24	24	26	24	24	9	18	16	16	18	18	16	16	0.3	0.28	0.28	0.3	0.31	0.3	0.3	0.31
18	52/F	338986	Grade 2 PNP	RE	4	24	20	22	22	24	24	24	8	26	24	26	26	26	26	26	4	15	13	15	14	16	17	17	0.27	0.28	0.3	0.3	0.31	0.3	0.3	0.3
19	37/M	217932	Grade 2 PNP	LE	5	22	20	22	22	22	26	26	7	26	20	26	24	24	28	28	6	15	14	16	14	18	14	14	0.28	0.3	0.3	0.3	0.3	0.29	0.29	0.29
20	34/M	340810	Grade 2 PNP	LE	6	24	22	24	22	22	24	24	6	24	22	24	26	26	24	24	5	14	16	16	18	20	18	18	0.29	0.28	0.3	0.3	0.28	0.28	0.28	0.28
21	73/M	340812	Grade 3 PNP	LE	5	20	15	22	20	20	22	22	6	28	22	24	24	26	24	24	7	16	14	14	20	22	20	20	0.3	0.28	0.3	0.28	0.3	0.27	0.26	0.26
22	32/M	333750	Grade 3 PNP	RE	4	24	20	22	22	24	24	24	8	26	24	26	26	26	26	26	8	18	20	22	14	16	18	18	0.27	0.3	0.28	0.3	0.28	0.28	0.28	0.28
23	40/F	321230	Grade 3 PNP	RE	5	22	20	22	22	22	26	26	7	26	20	26	24	24	28	28	9	18	16	16	18	18	16	16	0.29	0.28	0.3	0.3	0.28	0.28	0.28	0.28
24	51/F	272788	Grade 3 PNP	RE	6	24	22	24	22	22	24	24	6	24	22	24	26	26	24	24	4	15	13	15	14	16	17	17	0.18	0.32	0.28	0.31	0.29	0.3	0.3	0.31
25	44/M	292201	Grade 3 PNP	RE	5	20	15	22	20	20	22	22	6	28	22	24	24	26	24	24	6	15	14	16	14	18	14	14	0.15	0.29	0.29	0.3	0.3	0.3	0.3	0.3
26	32/F	356541	Grade 3 PNP	LE	4	24	20	22	22	24	24	24	8	26	24	26	26	26	26	26	5	14	16	16	18	20	18	18	0.17	0.28	0.25	0.29	0.28	0.29	0.29	0.29
27	67/F	359728	Grade 3 PNP	RE	5	22	20	22	22	22	26	26	7	26	20	26	24	24	28	28	7	16	14	14	20	22	20	20	0.14	0.27	0.26	0.28	0.28	0.28	0.28	0.28
28	21/M	355900	Grade 3 PNP	LE	6	24	22	24	22	22	24	24	6	24	22	24	26	26	24	24	8	18	20	22	14	16	18	18	0.16	0.26	0.25	0.26	0.26	0.27	0.26	0.26
29	53/M	357351	Grade 3 PNP	RE	5	20	15	22	20	20	22	22	6	28	22	24	24	26	24	24	9	18	16	16	18	18	16	16	0.19	0.3	0.26	0.29	0.28	0.3	0.29	0.3
30	71/M	348996	Grade 3 PNP	RE	4	24	20	22	22	24	24	24	8	26	24	26	26	26	26	26	4	15	13	15	14	16	17	17	0.18	0.32	0.28	0.31	0.29	0.3	0.3	0.31
31	51/F	356569	Grade 1 PNP	RE	20	24	22	24	22	24	26	24	22	26	22	24	24	24	24	24	12	14	16	16	16	18	16	18	0.27	0.3	0.28	0.3	0.28	0.28	0.28	0.28
32	64/M	321226	Grade 1 PNP	LE	22	22	24	22	24	24	26	26	24	28	22	26	26	28	26	28	14	16	16	16	16	18	18	18	0.28	0.3	0.28	0.31	0.3	0.27	0.26	0.26
33	58/M	332594	Grade 1 PNP	LE	24	24	22	26	26	24	24	24	22	26	22	28	28	28	28	28	16	18	16	16	16	18	17	16	0.29	0.28	0.28	0.31	0.3	0.3	0.29	0.3
34	42/M	334453	Grade 1 PNP	LE	20	22	20	28	28	26	24	26	24	28	24	24	22	24	28	28	18	14	16	18	18	16	15	20	0.3	0.28	0.28	0.3	0.31	0.3	0.3	0.31
35	52/F	247236	Grade 1 PNP	LE	18	20	22	24	22	24	26	24	22	24	24	26	24	28	28	28	16	16	18	18	18	16	18	20	0.27	0.28	0.3	0.3	0.31	0.3	0.3	0.3
36	70/F	252420	Grade 1 PNP	RE	16	26	24	22	24	26	24	26	24	26	24	28	26	30	26	28	14	16	18	18	18	16	18	18	0.28	0.3	0.3	0.3	0.3	0.29	0.29	0.29
37	55/F	185817	Grade 1 PNP	LE	18	22	20	26	26	26	26	26	24	28	24	24	28	28	26	28	16	16	18	18	18	16	19	19	0.29	0.28	0.3	0.3	0.28	0.28	0.28	0.28
38	49/F	269719	Grade 1 PNP	RE	20	24	22	24	22	26	24	26	24	26	24	28	24	26	26	28	16	16	18	20	16	16	15	19	0.3	0.28	0.3	0.28	0.3	0.27	0.26	0.26
39	56/F	188250	Grade 1 PNP	LE	20	24	22	24	22	24	26	24	22	26	22	24	24	24	24	24	12	14	16	16	16	18	16	18	0.27	0.3	0.28	0.3	0.28	0.28	0.28	0.28