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St. Paul's Hospital Millennium Medical College

DEPARTMENT OF OPHTHALMOLOGY.

**Comparison of Corneal Astigmatism Before and After Pterygium Excision
and Associated Factors Among Patients Attending the Ophthalmology
Department of St. Paul's Hospital Millennium Medical College, Addis Ababa
,Ethiopia,2026.**

Investigator: Dr. Tadesse Edessa (Year 4 resident).

**A research thesis was submitted to the department of ophthalmology at Saint.
Paul's Hospital Millennium Medical College in partial fulfillment of the
requirements for the degree of specialty certificate in ophthalmology.**

January, 2026.

Addis Ababa, Ethiopia.

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Advisors:

- 1. Dr. Dawit (Assistant professor of ophthalmology and Corneal Subspecialist).**
- 2. Dr. Tewodros (Assistant professor of ophthalmology and Corneal Subspecialist).**
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- 4. Mr.Tesfalem Teshome(MPH consultant).**

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ACRONYMS.

ANOVA-Analysis of variance.

AOR-adjusted odd ratio.

BCVA- Best corrected visual acuity.

CAG- Conjunctival out graft.

CI –Confidence interval.

ETB- Ethiopian birr.

G.C- Gregorian calendar.

Log MAR- Logarithm of the Minimum Angle of Resolution.

MMC- Mitomycin-C.

NGO- Non-governmental organization.

OSDI- Ocular Surface Disease Index.

S/N- Serial number.

SPHMMC- Saint Paul hospital Millennium College.

SPSS- Statistical package of social sciences.

UVA- Uncorrected visual acuity.

UV- Ultraviolet.

VA- Visual acuity.

W/V- Weight by volume.

ABSTRACT.

Background: Pterygium is a wing-shaped fibrovascular growth of the conjunctiva that extends onto the cornea, often leading to corneal distortion, astigmatism, and reduced visual acuity.

Although surgical excision remains the mainstay of treatment, recurrence and inconsistent outcomes regarding corneal astigmatism reduction remain challenges. In Ethiopia, the prevalence of pterygium is high, particularly among outdoor workers exposed to ultraviolet (UV) radiation, yet limited data exist on the effect of excision on astigmatism and vision in Addis Ababa.

Objective: To assess the mean change in corneal astigmatism before and after pterygium excision and to identify associated factors among patients attending the ophthalmology department at St. Paul's Hospital Millennium Medical College (SPHMMC).

Methodology: A hospital-based cross-sectional study was conducted among 65 eyes of 65 patients diagnosed with primary pterygium. Consecutive sampling was applied. Pre- and postoperative corneal astigmatisms were measured using an automated autorefractometer, while visual acuity was assessed with a Snellen's E chart and converted to logMAR. Data were collected via structured questionnaires and ocular examinations, then analyzed using SPSS version 26. Paired t-tests compared pre- and postoperative corneal astigmatism mean, and multiple linear regressions identified associated risk factors. Statistical significance was set at $p < 0.05$.

Results: Of the 65 patients, 61.5% were females, with a mean age of 37.8 years. Most resided in urban areas (72.3%), and merchants formed the largest occupational group (26.2%). Nasal pterygia were the most dominant (90.8%), and grade II lesions were most frequent (40%). Outdoor activity (73.8%) and sun exposure (66.2%) were common. Mean corneal astigmatism decreased significantly from 0.83 D preoperatively to 0.59 D at 1 month and 0.27 D at 3 months ($p < 0.000$). UCVA improved from 0.21 logs MAR preoperatively to 0.14 at 1 month and 0.12 at 3 months ($p < 0.000$).

Conclusion: Pterygium excision with conjunctival autograft significantly reduces corneal astigmatism and improves visual acuity, supporting its role in restoring ocular function. Preventive strategies such as UV protection and early surgical intervention are essential, particularly for high-risk groups. This study provides baseline evidence for Addis Ababa and contributes to improved clinical management and preventive measures against pterygium-related visual impairment.

Keywords: Corneal astigmatism, Pterygium, Conjunctival autograft.

1: INTRODUCTIONS.

1.1 Background.

Pterygium is a wing-shaped fibrovascular growth that extends from the conjunctiva toward the cornea, causing corneal distortions that significantly increase astigmatism (1). A pterygium-related decrease in visual acuity might result from the following causes: (i) Pterygium encroaching on the pupillary area; (ii) astigmatism. (iii) Limitation of the medial rectus muscle (2).

The various established risk factors for pterygium include the activity of the immune system, genetic predisposition, prolonged exposure to irritating environmental factors such as UV radiation, wind, hot, dry weather, a dusty atmosphere, and the length of time spent in such conditions. The most frequent cause is prolonged exposure to UV radiation from the sun, which is followed by dry, dusty environments that cause chronic ocular irritation (1).

Though the exact pathogenesis of pterygium is unknown, several mechanisms have been proposed. A UV ray causes the cornea's limbal stem cell insufficiency. It also causes activation of the tissue growth factors, which further lead to angiogenesis and cell proliferation. The limbal stem cells are damaged by the UV rays that cause conjunctivalization of the cornea, and the cornea is invaded by aggressive fibroblasts. UV radiation may cause mutations in the p53 tumor suppressor gene, resulting in the abnormal pterygial epithelium (3).

Though pterygium is treated mainly by surgery, early in the disease process, physicians often take a conservative approach, including UV-blocking sunglasses and a broad-brimmed hat for patients who have prolonged sun exposure. Medical treatment with artificial tears can alleviate the associated ocular irritation. Indications for pterygium surgery include ocular discomfort, conjunctival inflammation, and decreased vision secondary to induced astigmatism, progression of the pterygium toward the visual axis, restricted ocular motility, and cosmetics. The goal of pterygium surgery is to achieve a relatively clear and topographically regular ocular surface (4).

Early surgical intervention can therefore reduce the effects of corneal morbidity due to pterygium-induced corneal distortion and visual disturbance arising from the encroachment of the pterygium into the visual axis. Early or late surgical intervention for excision of the

pterygium leads to a reduction in astigmatism, which leads to significant improvement in vision (5).

Nasal pterygia are more common than temporal, probably because light exposure to the nasal limbus through the cornea is unobstructed, while light exposure to the temporal limbus is reduced by the noses. The prevalence of pterygia increases with geographic proximity to the equator, and the condition is more common in men than women and in people who work outdoors. The onset of the condition is typically between the ages of 20 and 40.

The main challenge to successful surgical treatment of pterygium is recurrence. Many surgical techniques have been used, though none is universally accepted because of variable recurrence rates (7). Some of the surgical techniques for pterygium include: the bare scleral technique, amniotic membrane grafting and a conjunctival auto graft technique (8, 9).

1.2. Statement of the problem.

The prevalence of pterygium varies widely across different populations, with higher rates reported in individuals living in tropical and subtropical regions, including Ethiopia. Pterygium excision is a widely accepted treatment option (10). The prevalence of pterygium varies from 0.07% to 53% worldwide and from 8.0% to 38.7% in Africa (15, 16). In Ethiopia, the prevalence was 31.8% in Gambella town, Southern Ethiopia, and 38.7% in Gondar City, Northwest Ethiopia (9–11).

Pterygium excision has been shown to improve visual acuity and reduce symptoms associated with pterygium, but its effect on corneal astigmatism is still debated (12). Several studies have investigated the effect of pterygium excision on corneal astigmatism, but their results are inconsistent. Some studies have reported a significant reduction in corneal astigmatism after pterygium excision (12, 13), while others have found no significant change (14, 15). These discrepancies may be due to differences in study design, sample size, and follow-up duration.

In addition to comparing corneal astigmatism before and after pterygium excision, this study will also examine the association between pterygium and various factors, such as age, sex, occupation, and environmental factors. Previous studies have suggested that pterygium is more common in older individuals, males, outdoor workers, and those living in areas with high UV radiation exposure (14, 15). Understanding these risk factors can help identify individuals who are at higher risk of developing pterygium and inform preventive measures. The progression of a pterygium onto the cornea causes a significant corneal distortion, which eventually results in astigmatism. Reduced visual acuity, glare sensitivity, and monocular diplopia are among the visually significant complaints caused by pterygium-induced astigmatism (11).

The most frequently affected form of astigmatism by pterygium is rule astigmatism (76%), which is followed by oblique astigmatism (20%) and against rule astigmatism (3.3%) (10). The grade of pterygium correlates with an increase in astigmatism. The mean astigmatism was 2.92D in eyes with grade II pterygium, 3.83D in eyes with grade III pterygium, and 9.42D in eyes with grade IV pterygium. The preoperative mean visual acuity was 0.53 D (4).

The visual acuity of eyes with pterygium was worse than for eyes without pterygium, and it varies with the grade of pterygium. The median VA for grade I pterygium was 0.63, grade II was 0.56, grade III was 0.47, and grade IV was 0.13 (2).

This study aims to assess the effect of pterygium excision on corneal astigmatism and visual acuity, while also exploring demographic, occupational, and environmental factors associated with pterygium induced corneal astigmatism. By addressing the high prevalence of pterygium in Ethiopia and clarifying the inconsistent findings of previous research, the study seeks to determine whether surgical removal leads to significant improvement in vision. Furthermore, identifying risk factors such as age, sex, occupation, and UV exposure will provide evidence to guide preventive strategies and enhance clinical management of individuals at risk of pterygium-related visual impairment.

1.3: Significance of the study.

The study can provide valuable insights into the effectiveness of pterygium excision in improving corneal astigmatism and visual function in patients with pterygium. It can have significant implications for clinical practice, including improving patient selection, surgical planning, and postoperative care. Additionally, this study can contribute to the existing knowledge on the effect of pterygium excision on corneal astigmatism and its associated risk factors. Ultimately, this study can help improve the quality of life of patients with pterygium.

As far as my knowledge there is no study has been conducted in Addis Ababa, Ethiopia, to analyze and measure the improvement in astigmatism following pterygium excision with conjunctival autograft. Finally, the results of this study can serve as baseline data for further research in this area.

2: LITERATURE REVIEW.

Pterygium is a common disorder of the ocular surface. It manifests as a wing-shaped fibrovascular growth that extends from the bulbar conjunctiva to the cornea. UV exposure has been identified as the main environmental factor influencing the development of pterygium (3).

2.1. Comparison of corneal astigmatism and visual acuity before and after pterygium excision.

According to a hospital-based prospective study done in India, the mean astigmatism after pterygium surgery with CAG was reduced from 3.24 ± 2.01 to 1.47 ± 1.20 (P-value ≤ 0.001). After surgery, the preoperative mean astigmatism in eyes with grades I was reduced from 2.32 ± 0.42 D to 0.94 ± 0.52 D, which was not statistically significant ($p = 0.575$). In eyes with Grade II, pterygium astigmatism was reduced from 2.84 ± 1.26 D to 1.20 ± 0.82 D and in eyes with Grade III, pterygium astigmatism was reduced from 3.64 ± 1.20 D to 3.62 ± 1.72 D, statistically significant ($p \leq 0.001$). After pterygium excision, BCVA was improved from 0.54 ± 0.48 to 0.69 ± 0.50 , which was statistically significant (P-value ≤ 0.001) (21).

According to another hospital-based prospective study done in India, after participants underwent pterygium excision with CAG, the mean preoperative astigmatism value in group I was reduced from 3.45D to 1.60D, in group II was reduced from 3.52D to 0.92D, and in group III was reduced from 3.49D to 0.81D at 3 months of surgery, which was statistically significant ($P < 0.05$). The mean uncorrected visual acuity preoperatively was 0.57, which improved to 0.34 after 1 month of surgery and to 0.35 after 3 months of surgery, which was significant ($P < 0.05$) (22).

According to the Quasi Experimental Study conducted in Pakistan after pterygium excision with CAG, the mean corneal astigmatism was reduced from 3.70 ± 1.36 D to 1.91 ± 0.97 D at 3 months of surgery, which was significant ($p = 0.0005$). In eyes with grade II, there was a reduction in mean corneal astigmatism from 2.58 ± 0.51 D to 1.42 ± 0.59 D ($P < 0.0005$). In grade III, from 3.70 ± 0.14 D to 1.44 ± 0.29 D ($P < 0.0005$) and in grade IV, from 5.77 ± 0.97 D to 2.47 ± 0.13 D ($P < 0.001$) (23).

According to a hospital-based prospective study conducted in Nepal, following surgery with CAG, the mean astigmatism reduced from 2.8 D to 0.80 D, and the overall change in mean

astigmatism was 1.0 D at 3 months of surgery. After 1 month of surgery, the mean preoperative astigmatism was reduced from $2.8 \pm 3.9D$ to $1.1 \pm 2.2D$ ($P < 0.001$), in grade I, from 0.96D to 0.55D, in grade II, from 2.17D to 0.73D, and in grade III, from 10.71 to 4.8D, which were statistically significant ($P < 0.001$). After 3 months of surgery, grade I was reduced from 0.96D to 0.46D, grade II was reduced from 2.17D to 0.51D, and grade III was reduced from 10.71D to 3.08D, which were statistically significant ($P < 0.001$). The mean astigmatism at 1 month of surgery was 1.1D, and it was reduced to 0.8D at 3 months of surgery (17).

After surgery, the preoperative mean astigmatism in grades I, II, and III decreased from 0.96D to 0.46D, 1.99D to 0.54D, and 10.17D to 3.10D, respectively, which was statistically significant. The mean astigmatism before surgery was reduced from 2.8D to 1.1D after 1 month of pterygium excision (17). According to a study conducted at Stanley Medical College and Hospital of India, among patients who underwent pterygium excision with CAG, the mean preoperative astigmatism was reduced from $3.2 \pm 2.44 D$ to $1.98 \pm 1.06 D$ at 1 month of surgery, which is statistically significant ($p < 0.018$) (24).

According to the prospective longitudinal study conducted at the Department of Ophthalmology of a tertiary care in north India, participants who underwent pterygium excision with CAG suture less had a pre-operative visual acuity of 0.45 ± 0.23 that significantly improved to 0.11 ± 0.10 log MAR units at the 1 month of surgery and to 0.02 ± 0.07 at the 3 month of surgery ($P < 0.0001$). The preoperative mean astigmatism of $2.19 \pm 0.87 D$ was significantly reduced to $0.58 \pm 0.26D$ at 1 month and to $0.025 \pm 0.09D$ at 3 months of surgery ($P < 0.001$) (25).

According to a study done in Sofia, Bulgaria, among participants who underwent pterygium excision with CAG, the mean corneal astigmatism preoperatively was 1.26 and decreased to 0.84 D 3 months after surgery ($p < 0.001$). The mean UCVA preoperatively was 0.75, improving to 0.77; the mean BCVA before surgery was 0.86, improving to 0.87 after the procedure (9). According to a study conducted in Pakistan, surgical treatment of the pterygium significantly improves a wide range of parameters, including corneal astigmatism, spherical and cylinder refractive error, higher-order aberration, uncorrected and best-corrected visual acuity, and 3 and 5 mm central zone corneal irregularities. The mean refractive sphere before surgery was significantly reduced from 1.67 D to 0.89 D postoperatively (5).

In a prospective cohort study at Mansoura University in Egypt, the pre-operative mean corneal astigmatism of patients who had pterygium excision with CAG was found to have decreased from $3.33 \pm 1.01\text{D}$ to $1.90 \pm 0.58\text{D}$ one month after surgery and to $1.53 \pm 0.53\text{D}$ three months after surgery. The mean refractive astigmatism decreased statistically significantly ($p < 0.001$) after surgery. But there were no statistically significant variations between the results after three months ($P = 0.061$) and one month ($P = 0.411$). Uncorrected visual acuity (UCVA) improved from 0.75 ± 0.15 pre-operatively to 0.43 ± 0.12 one month after surgery and to 0.33 ± 0.11 three months after surgery. There was a statistically significant improvement in the pre-operative mean BCVA from 0.49 ± 0.12 to 0.24 ± 0.10 one month after surgery and to 0.15 ± 0.09 three months after surgery (25).

A study carried out in Ghana revealed that, 6 weeks after surgery, the mean preoperative astigmatism was significantly reduced from 5.00 D to 1.30 D, and the mean preoperative UVA and BCVA were improved by log MAR (0.07) and (0.09), respectively at 6 weeks of surgery(26).

2.2. Associated factors of pterygium.

According to a study done in Dali, China, the overall prevalence of pterygium was 39.0% and increased with increasing age and outdoor activities. Pterygium was more common in women twice as often as in men (14). A study conducted in Tehran, Iran, revealed that the prevalence of pterygium was 13.11%, with men more likely to have it than women. The prevalence of pterygium increased linearly with age until 70 years of age and then declined; 28.57% of participants were between the ages of 61 and 70, and 20.33% were older than 70 (16).

According to a study done in Nepal, 71.43% of patients presented with a foreign body sensation, 10.71% with decreased vision, and 7.14% presented with other complaints like redness and ocular discomfort (17). According to a study conducted in Uganda, 13.6% of people have pterygium. Age, education level, alcohol consumption, dust exposure, and family history all remained statistically significant correlates of pterygium (18).

In Ethiopia, the prevalence of pterygium was 38.7% in Gondar town and 31.8% in Gambella town, and the mean age was 39.9 years. The nasal side pterygium was more common than the temporal side. The prevalence increased with age and outdoor activity, but wearing a hat or sunglasses provided protection. Over half (54.33%) of the pterygium was bilateral, while the remaining 45.67% was unilateral. Being male, a working area being out of the way, sun exposure, and wearing sunglasses or hats were independently associated with the occurrence of pterygium. Pterygium is more likely to develop in nearly 53.00% of patients who have previously been exposed to the sun for five or more hours each day (19, 20).

3: OBJECTIVES.

3.1. General Objective:

To assess the mean change in corneal astigmatism before and after pterygium excision and associated factors among patients attending the ophthalmology department of St. Paul's Hospital Millennium Medical College from March 2024 to November 2025.

3.2. Specific objective:

To determine the mean change in corneal astigmatism before and after pterygium excision among patients attending the ophthalmology department of St. Paul's Hospital Millennium Medical College from March 2024 to November 2025.

To identify the associated factors of pterygium-related corneal astigmatism among patients attending the ophthalmology department of St. Paul's Hospital Millennium Medical College from March 2024 to November 2025.

4: METHODS.

4.1. Study area and period.

The study was conducted at the Saint Paul's Hospital Millennium Medical College ophthalmology department from March 2024 to November 2025, which is located in Addis Ababa, the capital city of Ethiopia, around Swaziland Street. It was established in 1969 G.C. by Emperor Haile Selassie with the help of German evangelical church, it was aimed at serving the poor.

SPHMMC became a medical college in 2007 G.C. It is one of the largest teaching and referral centers in the country, having about 7 million catchment populations.

As a tertiary center, it receives patients from every corner of the country; most of them come from the central areas of the country.

The ophthalmology department of SPHMMC is organized in to different clinics: optometry, pediatrics ophthalmology and strabismus, general OPD, anterior segment, glaucoma, oculoplastics and retina. Ophthalmology specialty training has being given for the past 8 years. The anterior segment clinic is functional with subspecialists and general ophthalmologists with residents in training. It provides comprehensive eye care, both medical and surgical services.

4.2. Study Design.

A hospital-based cross sectional study design was conducted.

4.3. Population.

4.3.1. Target Population: All patients above 18 years old with ptergium attended the ophthalmology department of SPHMMC during the study period.

4.3.2. Study of population: All patients above 18 years old who were diagnosed with ptergium requiring excision at the ophthalmology department of SPHMMC during the study period.

4.3.3. Sample population: A selected group of patients with pterygium who met eligible criteria and underwent ptergium excision at SPMMC during the study period.

4.3.4 .Inclusion and exclusion criteria.

4.3.4.1. Inclusion criteria.

1. Age ≥ 18 years.

2. Patients with primary pterygium.

4.3.4.2. Exclusion criteria.

1. Recurrent pterygium.
2. Patients with ocular comorbidity like keratoconus.
3. Pre-existing corneal opacities/scarring.
4. Previous corneal surgeries like PKP.
5. Patients who have incomplete follow up.

4.4 .Sample size determination and sampling technique.

The sample size was not calculated and no sampling technique

All patients with pterygium who met the full inclusion criteria were included during the study period.

4.5. Study variables.

4.5.1. Dependent variable.

- Corneal astigmatism before and after.

4.5.2. Independent Variable.

- Age.
- Sex.
- Educational level.
- Occupation.
- Visual acuity.
- Outdoor activities.
- Indoor activities.
- Grade of pterygium.
- Sun exposure.
- Surgeon experience.

4.6. Operational definitions.

Sun exposure: Participants who were exposed for 2 hours and above per day was considered exposed (27,28) .

Outdoor workers: It includes farmers, gas/electric workers, miners, and others whose activities are away from their house or office for more than 2 and more hours per day for two years and above (28).

With –the –rule astigmatism: when the corneal meridian that has the least refractive power is horizontal ,that is between 160 and 20 degrees(30).

Against the -rule astigmatism: when the corneal meridian that has the least refractive power is vertical (± 20 degrees), that is, between 70 and 110 degrees(30).

Oblique astigmatism: when the corneal meridian that has the least refractive power lies either between 20 and 70 degrees or between 110 and 160 degrees.(30).

Senior residents: Year 3 and 4 ophthalmology residents

Grading of pterygium (24).

Grade I: Pterygium invading 1.5 mm of cornea.

Grade II: Pterygium invading >1.5 mm of cornea.

Grade III: Pterygium invading over half the radius of cornea.

Grade IV: Pterygium reaching almost up to the center of corneal.

4.7. Data collection tool and procedures.

4.7.1 Data collection tool.

The data was collected using a structured questionnaire via face-to-face interviews and ocular examinations. The structured questionnaire, which includes questions related to demographic information, medical history, previous ocular surgery, associated factors, and visual symptoms, was prepared after reviewing similar studies.

A standard Snellen's E chart was used to measure visual acuity. An automated auto refractometer was used to measure corneal astigmatism. A slit lamp biomicroscope and a 90-diopter Volk were used to examine anterior segment examinations, such as the size and location of the pterygium, and posterior segment examinations (1, 10, 21, and 23).

Data was collected by optometrists and respective senior ophthalmology residents in the anterior segment clinic.

4.7.2. Data collection procedures.

Pre-operative data collection procedures:

Diagnosis of pterygium was made based on the presence of a triangular fibrovascular growth with the apex encroaching toward the cornea, as observed using a slit lamp biomicroscope. Participants were recruited from the outpatient department of ophthalmology based on the inclusion criteria for the study.

Demographic profiles of the patients were collected through interviews using a structured questionnaire. A detailed examination was conducted, which included visual acuity assessment and a thorough slit lamp examination to assess the site and size of the pterygia by data collectors. The dimensions of the pterygium were measured from the limbus toward the cornea using a slit lamp caliper in millimeters (mm) to grade its size.

Comprehensive ocular examinations were performed by trained senior ophthalmology residents using a slit lamp biomicroscope. Participants who required surgery based on indications for pterygium excision were selected. An automated autorefractometer was utilized to measure preoperative corneal astigmatism, recording the values of K1 and K2 along their axes. Three consecutive measurements were taken during a single session to average out any variability in the readings that could arise from factors such as patient movement or blinking. The average K1 and K2 values were recorded from the machine.

In cases when patients exhibited fluctuating vision, three consecutive measurements were obtained across three separate sessions to ensure accuracy in the results. The average K1 and K2 values were recorded from these measurements.

The amounts of astigmatism were determined preoperatively based on the K1 and K2 values obtained from the automated autorefractometer. Additionally, the types of astigmatism were classified according to their axes one day before surgery.

Visual acuities were assessed and recorded using a standard Snellen E chart and converted to log MAR by trained optometrists one day before surgery. All surgeries were performed by senior residents and seniors. All pterygium excisions utilized the conjunctival autograft technique with

sutures for all study participants.

Surgical technique.

A retrobulbar injection of 4 mL of 2% lidocaine mixed with 1:100,000 epinephrine was given for anesthesia and akinesia with aseptic precautions.

Eyes marked for surgery was cleaned with 10% povidone iodine, draped, and speculum inserted. The conjunctival tissue over the body of the pterygium to be excised was marked, and the extent of corneal invasion of the pterygium was measured with calipers.

Corneal invasion was taken as the length from the limbus to the cap of the pterygium.

A sharp dissection of the superficial layers of the body of the pterygium following the initial markings was performed.

This was followed by a blunt dissection of the deep layers to separate the body of the pterygium from the underlying sclera and surrounding conjunctiva.

The body of the pterygium, along with the underlying and at least 5 mm of adjacent tenons, was completely excised using blunt-tipped Westcott scissors.

The wound bed was cleaned of any remnant tenon tissue with Vannas scissors, and bleeding vessels was cauterized using wet-field cautery.

Pterygial tissue over the cornea was peeled and scraped clean with Colibri forceps and crescent blades, respectively.

The CAG was harvested from the superotemporal conjunctiva after caliper measurements to ensure a good fit for the recipient's bare scleral site.

The conjunctival graft was placed 2 mm from the limbus, with care taken to maintain the limbal orientation of the graft towards the cornea and also not to turn the epithelial side down.

Grafts were sutured with 8-0 Vicryl sutures and eyes were patched overnight.

Post-operative Assessment (1 Month and 3 Months)

All patients had follow-up appointments for a minimum of 3 months post-operatively before being discharged from clinical care. Absent participants were traced using their phone numbers.

An automated autorefractokeratometer was utilized to measure corneal astigmatism, recording the values of K1 and K2 along their respective axes at 1 month and 3 months following pterygium surgery, as it takes time for the corneal shape to stabilize. Three consecutive measurements were taken during a single session to average out any variability in the readings that could arise from factors such as patient movement or blinking. The average K1 and K2

values were recorded at both 1 month and 3 months post-surgery.

In cases where patients exhibited fluctuating vision, three consecutive measurements were obtained across three separate sessions to ensure accuracy in the results at 1 month and 3 months post-surgery. The average K1 and K2 values from these measurements were recorded at both time points.

The amounts of astigmatism were determined based on the K1 and K2 values obtained from the automated autorefractometer measurements at 1 month and 3 months following pterygium surgery. Additionally, the types of astigmatism were classified according to their axes measurements at these same intervals.

Visual acuities were assessed and recorded using a standard Snellen E chart and converted to log MAR by trained optometrists at 1 month and 3 months post-surgery.

Anterior segment examinations were done by using slit bio-microscope.

The pre-operative and post-operative data were compared using statistical analysis to determine any significant changes in corneal astigmatism and visual acuity following pterygium excision.

4.8. Data Quality Control.

The English version of the questionnaire was translated into a similar form of the Amharic version and Afan Oromo version and orally translated back to English by a language professional to increase the accuracy and consistency of the questionnaire.

Standardized data collection was ensured by using standardized methods and instruments.

Prior to the start of the study, one day training was given to all data collectors.

Any equipment used for measurements was calibrated to ensure accuracy.

Throughout the study period, regular monitoring of data collection processes was conducted to ensure that all procedures are being followed correctly.

Prior to analysis, all collected data were reviewed by primary investigator to check mistakes, legibility, completeness, and consistency of the data.

If there were any data inconsistencies or outliers, the outliers were identified, and the cause was investigated and corrected, ensuring that the data collected is reliable and accurate.

Any discrepancies were investigated and resolved before proceeding with data analysis.

4.9. Data processing and Analysis.

The collected data was cleaned, coded, and entered into Epidata version 4.7, then exported to the statistical package of social sciences (SPSS) version 26 for analysis. The descriptive statistics

was summarized using summary statistics such as frequency tables, graphs, percentages. Mean and standard deviation with a significant test (p-value) and a 95% confidence level was calculated.

Multiple linear regression analyses were performed to identify the risk factors associated with pterygium-related astigmatism.

Paired t-test was used to compare preoperative and postoperative corneal astigmatism measurements.

Finally, those variables with a p-value <0.05 were considered statistically significant.

4.10. Ethical Consideration.

Ethical clearance was obtained from the ethical committee of St. Paul Hospital Millennium Medical College, Institute of Health Research Review Committee.

A letter of permission was obtained from the department head of ophthalmology to get permission from the hospital.

Before starting the examination, informed verbal consent was obtained from each study participant. They were given the full right to participate and to refuse or withdraw at any time they want.

Informed written consent for surgery was obtained from all participants.

Confidentiality of the information obtained was assured by avoiding personal identifiers like a name from the data collection tool and also through coding data.

4.11. Plan for dissemination of the result.

The result of this study was presented to Saint Paul Hospital Millennium Medical College, Ophthalmology Department. The copy was offered to St. Paul Hospital, the Public Health Department, and the Addis Ababa Health Office. It was submitted for publication in reputable journals.

5: RESULTS.

Socio-demographic status of participants.

During the study, 93 eyes of 92 patients were underwent surgery , of which 65 eyes of 65 patients (40(61.5%) females, 25(38.5%) males) were included in the study. The mean age of the participants was 37.8 ± 9.7 years (range 20– 58 years). Regarding occupation of participants, majority of them were merchants 17(26.2%), followed by civil servants 13(20%), house wife 11(16.9%), farmers 11(16.9%), works in industry 8(12.3%) and daily laborer 5 (7.7%). Most of participants live in urban 47(72.3%) while 18(27.7%) live in rural area. Regarding educational status of participants, majority of them were college and above 21(32.3%), followed by secondary school 19(29.2%), primary school 15(23.1%), illiterate 5 (7.7%) and can read and write 5(7.7%) (Table1).

Table 1: Socio-demographic status of participants.

Age in years		
Mean	37.88	
Std .Deviation	9.717	
Minimum	20	
Maximum	58	
Gender distribution		
Sex	Frequency	Percent
Male	25	38.5
Female	40	61.5
Total	65	100.0
Residency		
Urban	47	72.3
Rural	18	27.7
Total	65	100.0

Occupation		
Farmer	11	16.9
civil servant	13	20.0
Daily laborer	5	7.7
House wife	11	16.9
Merchant	17	26.2
works in Industry	8	12.3
Total	65	100.0
Educational status		
Illiterate	5	7.7
can read and write	5	7.7
primary school	15	23.1
secondary school	19	29.2
College and above	21	32.3
Total	65	100.0

Clinical characteristics of participants.

In our study, 36(55.4%) were operated for left eye and 29 (44.6%)

patients were operated for right eye (figure 1). Out of 65 eyes, nasal pterygium was most seen in 59(90.8%), while temporal pterygium was 6(9.2%). Out of 65 participants (eyes), only 7(10.8%) had previous ocular surgery, of which 4(6.2%) of them had dacryocystorhinostomy and 3 (4.6%) of them had eyelid surgery. 19(40%) of study participants had ocular comorbidity, of which 15(23.1%) had dry eye syndrome and 4(6.2%) of them had Ocular hypertension(Table 2).

Table 2: Clinical characteristics of participants.

Pterygium location		
Location	Frequency	Percent

Nasal	59	90.8
Temporal	6	9.2
Total	65	100.0
History of previous ocular surgery		
Yes	7	10.8
No	58	89.2
Total	65	100.0
Ocular Comorbidity		
Yes	19	29.2
No	46	70.8
Total	65	100.0
Dry eye syndrome		
Yes	15	23.1
No	50	76.9
Total	65	100.0
Ocular hypertension		
Yes	4	6.2
No	61	93.8
Total	65	100.0

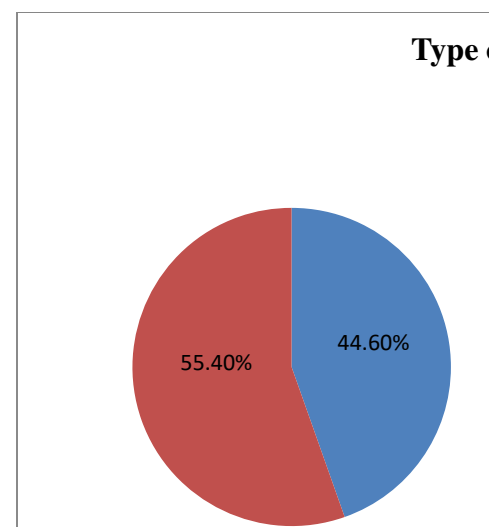


Figure 1: Pie chart shows type of eye operated.

The below bar chart showed that morphologically, depending on the grade of pterygium, majority of patients in this study had grade 2 pterygium (40%) followed by grade 3 pterygium (36.9%) and least had grade 4 pterygium (23.1%).

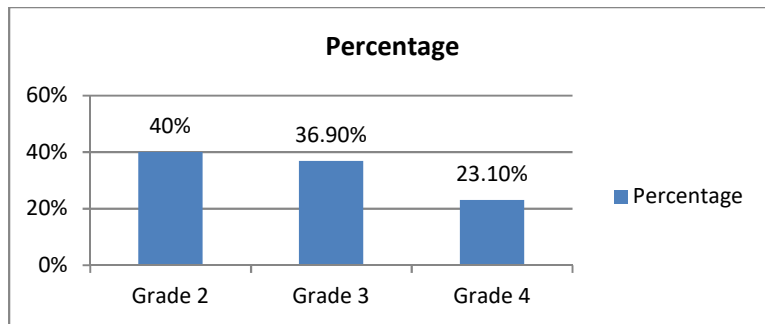


Figure 2: Bar chart shows pterygium grades of participants.

Most of study participants spent in outdoor activities 48(73.8%) and 17 (26.2%) spent in indoor activities. Majority of study participants 43(66.2%) had sun exposure and about 16 (24.6%) of them were exposed to sun for about 4hours, while 22(33.8%) had no sun exposure (figure 3).

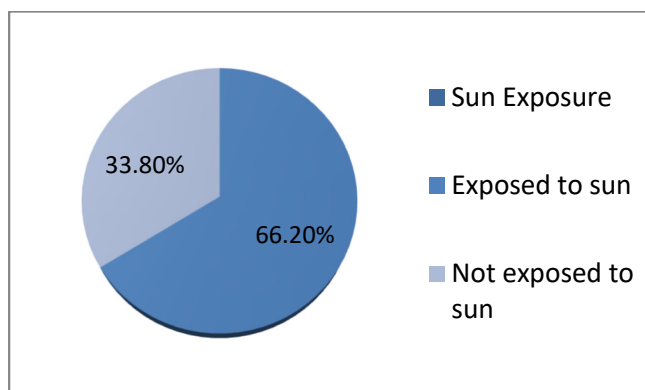


Figure 3: Pie chart shows about sun exposure status of participants.

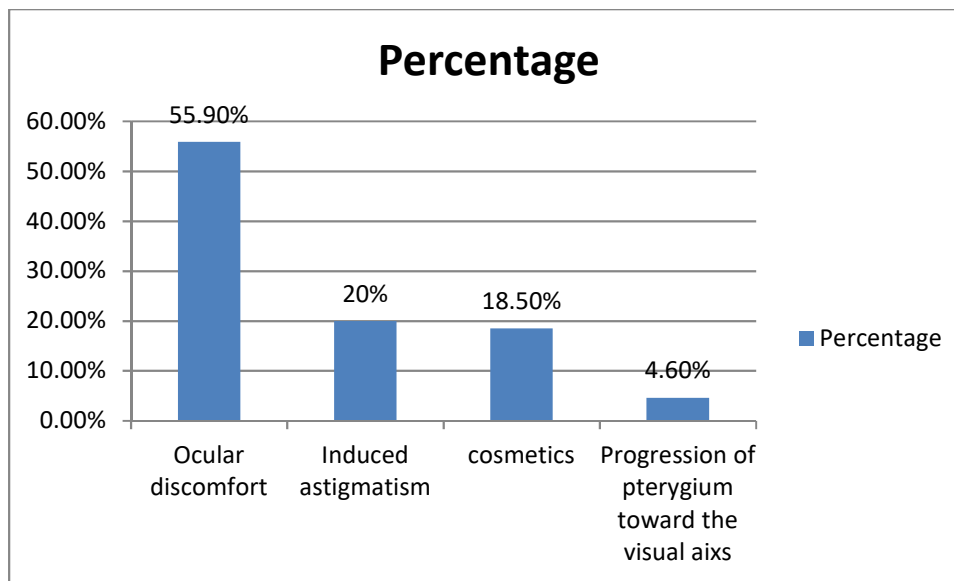
Presenting symptoms.

Regarding the presenting symptoms, out of 65 study participants, majority of them presented with foreign body sensation 30(46.11%) followed by Itching sensation 15(23.1%), redness 13(20%), abnormal growth 5(7.69%) and visual decrement 2(3.1%). The majority of preoperative corneal astigmatism type were with the rule-astigmatism 24(36.9%), followed by oblique astigmatism 21(32.3%) and against the rule –astigmatism 20(30.8%)(Table 3).

Table 3: Presenting Symptoms and Types of Preoperative Corneal Astigmatism.

Presenting symptoms		
Symptoms	Frequency	Percent
Foreign body sensation	30	46.11
Itching	15	23.1
Redness	13	20
Abnormal growth	5	7.69
Visual decrement	2	3.1
Total	65	100.0
Type of preoperative corneal astigmatism		
With the rule astigmatism	24	36.9
Against the rule astigmatism	20	30.8
Oblique astigmatism	21	32.3
Total	65	100.0

The majority of patients underwent pterygium surgery due to ocular discomfort (37(56.9%)), followed by induced astigmatism (13(20%)), cosmetic reasons (12(18.5%)) and progression of the pterygium toward the visual axis (3(4.6%)) (Figure 4).

**Figure 4: Surgical Indications for Pterygium Excision.**

Based on a below table of correlation analysis which was conducted to assess the relationships between pterygium size, preoperative corneal astigmatism, and preoperative uncorrected visual acuity (UCVA) in log MAR. The analysis utilized Pearson correlation coefficients to evaluate the strength and direction of these relationships. There was a strong positive correlation between pterygium size and preoperative corneal astigmatism ($r = 0.600$, $p < 0.01$). The preoperative corneal astigmatism in grade 2 was 0.59D, in grade 3 was 0.61D and in grade 4 was 1.57D from descriptive analysis. This indicates that larger pterygium sizes are associated with higher levels of corneal astigmatism.

A moderate positive correlation was observed between pterygium size and preoperative log MAR UCVA ($r = 0.330$, $p = 0.007$). This suggests that larger pterygium sizes are associated with lower uncorrected visual acuity. A moderate positive correlation was found between preoperative corneal astigmatism and preoperative log MAR UCVA ($r = 0.408$, $p = 0.001$). This indicates that higher levels of corneal astigmatism are associated with lower uncorrected visual acuity (Table 4).

Table 4: Correlations between Pterygium Size, Preoperative Corneal Astigmatism, and Preoperative UCVA.

Correlations		Pterygium size	Preoperative corneal astigmatism	Preoperative UCVA
Pterygium size	Pearson Correlation	1	.600**	.330**
	Sig. (2-tailed)		.000	.007
Preoperative corneal astigmatism	Pearson Correlation	.600**	1	.408**
	Sig. (2-tailed)	.000		.001
Preoperative UCVA	Pearson Correlation	.330**	.408**	1
	Sig. (2-tailed)	.007	.001	
**. Correlation is significant at the 0.01 level (2-tailed).				

The correlation analysis that was conducted to assess the relationships between amount of corneal astigmatism post operatively at 1month and 3months and year of resident. A moderate negative correlation was found between amount of corneal astigmatism both at 1month and 3 months of surgery and year of residents ($r = -0.481$, $p = 0.005$, -0.497 , 0.004 , respectively).

This suggests that as the year increases, the amount of corneal astigmatism at 1month and 3 months of surgery tends to decrease. There was a strong positive correlation between amount of corneal astigmatism at 1month and 3 months of surgery ($r = 0.811$, $p = 0.00$). This suggests that as the value of corneal astigmatism at 1month of surgery increases, the value of corneal astigmatism at 3months of surgery also tends to increase.

From the below ANOVA suggested that approximately 36% of the variability in preoperative corneal astigmatism could be explained by the size of the pterygium. This indicates that while pterygium size is a significant factor, there are other factors influencing astigmatism that are not captured by this model. The relationship between pterygium size and corneal astigmatism was statistically significant (p -value of 0.000) (Table 5). Approximately 16.6% of the variability in preoperative UCVA can be explained by the preoperative amount of corneal astigmatism. There was a significant effect of preoperative amount of corneal astigmatism on preoperative UCVA, $p=0.01$ (Table 6). The effect of pterygium size on the preoperative UCVA was statistically insignificant, $p=0.356$).

Table 5: ANOVA Shows the Effect of Pterygium Size on Preoperative Corneal Astigmatism.

ANOVA Effect of pterygium size on preoperative corneal astigmatism					
Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	7.468	1	7.468	35.447	.000 ^b
Residual	13.273	63	.211		
Total	20.740	64			
a. Dependent Variable: pterygium size					
b. Predictors: (Constant), preoperative amount of corneal astigmatism					

Table 6: ANOVA Shows the Effect of Preoperative Corneal Astigmatism on Preoperative UCVA.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.408 ^a	.166	.153	.18281
a. Predictors: (Constant), Preoperative amount of corneal astigmatism				

ANOVA Effect of preoperative amount of corneal astigmatism on preoperative UCVA					
Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	.420	1	.420	12.575	.001 ^b
Residual	2.105	63	.033		
Total	2.526	64			
a. Dependent Variable: preoperative UCVA					
b. Predictors: (Constant), preoperative amount of corneal astigmatism					

Effect of year of residents on postoperative UCVA.

According linear regression analysis the effect of year of resident on UCVA at 1 month and 3 months of surgery was not statistically significant, P-0.33, p-0.3 respectively) (Table 7 and 8).

Table 7: ANOVA Analysis of the Effect of Year of Residency on Postoperative Uncorrected Visual Acuity (UCVA) at 1 Month

Model	Sum of squares	Df	Mean square	F	Sig
Regression	.250	1	.250	.969	.333 ^b
Residual	7.750	30	.258		
Total	8.000	31			
a. Dependent Variable: year of resident					
b. Predictors: (Constant), UCVA at 1 month of surgery					

Table 8: ANOVA Analysis of the Effect of Year of Residency on Postoperative Uncorrected Visual Acuity (UCVA) At 3 Months.

Model	Sum of squares	Df	Mean square	F	Sig
Regression	.061	1	.061	1.095	.304 ^b
Residual	1.678	30	.056		
Total	1.739	31			
a. Dependent Variable: UCVA at 3months of surgery					
b. Predictors: (Constant), year of residents					

The multiple linear regression analysis shows several predictors significantly associated with preoperative corneal astigmatism.

The R-squared value ($R^2 = 0.286$) indicated that approximately 28.6% of the variance in the preoperative amount of corneal astigmatism could be explained by the independent variables. Age was significant predictor (OR=0.255, 95% CI: 0.001–0.029, $p=0.043$), indicating older individuals were high likely to have higher astigmatism. Outdoor activity was significantly associated with preoperative corneal astigmatism (OR=0.169, 95% CI: 0.115–0.380, $p=0.009$). Educational status showed mixed results: primary school education was significantly associated with preoperative corneal astigmatism (OR=0.342, 95% CI: 0.003–0.913, $p=0.048$), while other levels were not statistically significant. Sun exposure was highly significant (OR=0.480, 95% CI: 0.022–0.168, $p=0.003$), indicating increased risk of astigmatism with exposure.

Occupation also mattered: industry workers (OR=0.155, 95% CI: 0.259–0.491, $p=0.035$), daily laborers (OR=0.631, 95% CI: 0.093–0.286, $p=0.001$), and farmers (OR=0.645, 95% CI: 0.215–0.329, $p=0.004$) had significant associations, while housewives had a negative association (OR=-0.686, 95% CI: -1.687 to -0.381, $p=0.032$). Finally, pterygium size showed borderline significance, (OR=0.130, 95% CI: 0.231–0.453, $p=0.046$). Overall, the results suggest that environmental exposure (sunlight, outdoor work), occupation, and education are important predictors of preoperative corneal astigmatism, with protective and risk factors varying across categories. (Table 9).

Table 9: Multiple regression analysis of factors associated with corneal astigmatism before surgery.

Predictors	Categories	Odds ratio	P - value	95% Confidence interval	
				Lower bound	Upper bound
Residency	Rural	.318	.032	.037	.767
Age	Age	.255	.043	.001	.029
Working area	Outdoor activity	.169	.009	.115	.380
Educational status	Illiterate	-.039	.767	-.638	.473
	Can read	.118	.444	-.400	.900
	Primary school	.342	.048	.003	.913
	Secondary school	.353	.097	-.082	.960
Sun exposure	Yes	.480	.003	.022	.168
Occupation	Works in industry	.155	.035	.259	.491
	Merchant	-.389	.100	-1.101	.100
	Daily laborer	.631	.001	.093	0.286
	Housewife	-.686	.032	-1.687	-.381
	Farmer	.645	.004	.215	.329
Size of pterygium	Grade3	.310	.151	.045	.123
	Grade4	.130	0.046	.231	.453

Comparison of mean change in corneal astigmatism before and after pterygium surgery.

A paired samples t-test was conducted to assess the mean change in corneal astigmatism before and after pterygium surgery. The preoperative mean corneal astigmatism of patients who underwent pterygium excision with conjunctival autograft (CAG) decreased from 0.83 ± 0.57 D to 0.59 ± 0.36 D one month after surgery and to 0.265 ± 0.28 D three months after surgery (see Figure 4).

The mean change in corneal astigmatism between preoperative and postoperative measurements at one month after pterygium surgery was 0.24 ± 0.45 diopters, which was statistically significant ($p = 0.000$) (see Table 10). Similarly, the mean change in corneal astigmatism between preoperative and postoperative measurements at three months after surgery was 0.56 ± 0.45 diopters, also statistically significant ($p = 0.000$) (see Table 10).

Table 10: Paired t-test to compare the mean change in corneal astigmatism before surgery, one month after surgery, and three months after surgery.

Comparison	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Corneal astigmatism before and after 1month of surgery	.23846	.45593	.05655	4.217	64	.000
Corneal astigmatism before and after 3months of surgery	.56154	.45507	.05644	9.948	64	.000
Corneal astigmatism after 1month of surgery and after 3months of surgery	.32308	.21067	.02613	12.364	64	.000

The paired differences analysis showed that a mean difference between the astigmatism measurements at one month and three months of pterygium surgery was 0.323 ± 0.215 diopter, and the result was statistically significant with a p-value of 0.000. The results indicate that there is a statistically significant reduction in corneal astigmatism from one month to three months post-surgery ($p = 0.000$) (Table 10). The mean decrease of approximately 0.323 suggests that the surgical intervention has a substantial positive effect on reducing corneal astigmatism over time.

Comparison of mean change in UCVA before and after pterygium surgery.

The pre-operative mean uncorrected visual acuity (UCVA) in log MAR improved from 0.21 ± 0.19 to 0.14 ± 0.19 one month after surgery and to 0.12 ± 0.18 three months after surgery (Figure 5). The mean difference between the UCVA in log MAR measurements before surgery and one month after surgery was 0.07 ± 0.07 , and the result was statistically significant with a p-value of 0.000 (Table 11). The mean difference between the UCVA in log MAR measurements before surgery and three months after surgery was 0.09 ± 0.08 , and the result was statistically significant with a p-value of 0.000 (Table 11). The mean difference in UCVA in log MAR between one month and three months post-surgery was 0.02 ± 0.05 (Table 11). This indicates a slight improvement in visual acuity from the one-month to the three-month after surgery.

In conclusion, these results support the efficacy of the surgical procedure in improving uncorrected visual acuity over a three-month period.

Table 11: Paired t-test to compare of mean change in UCVA before surgery, one month after surgery, and three months after surgery.

Comparison	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
UCVA before and after 1 month of surgery	.06708	.07119	.00883	7.597	64	.000
UCVA before and after 3 months of surgery	.09169	.08139	.01009	9.083	64	.000
UCVA after 1 month and 3 months of surgery	.02462	.05034	.00624	3.942	64	.000

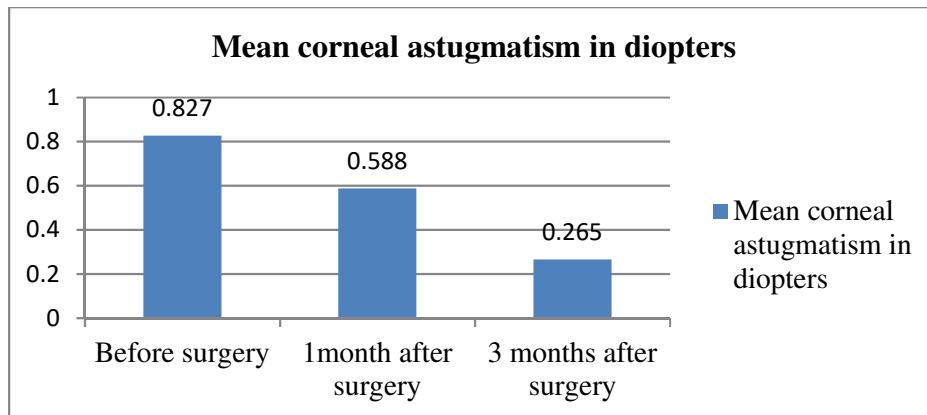


Figure 4: Bar chart comparing the mean of corneal astigmatism before surgery, one month after surgery, and three months after surgery.

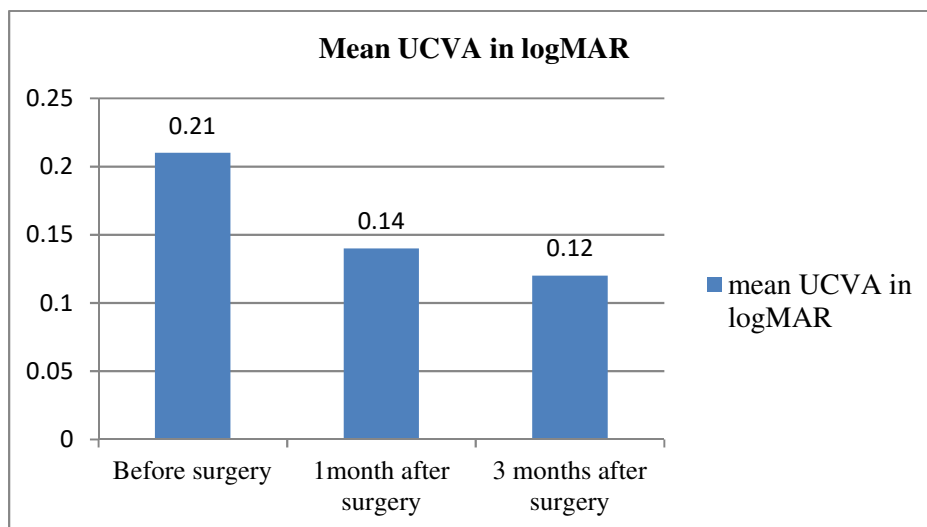


Figure 5: Bar chart comparing the mean of uncorrected visual acuity (UCVA) before surgery, one month after surgery, and three months after surgery.

6: DISCUSSION.

The study involved 65 patients (65 eyes) with pterygium, predominantly females (61.5%) with a mean age of 37.8 years. Most participants lived in urban areas (72.3%), and merchants formed the largest occupational group (26.2%). Educationally, the majority had college-level education or above (32.3%). Clinically, nasal pterygium was overwhelmingly common (90.8%), and 55.4% of surgeries were performed on the left eye. Morphologically, grade 2 pterygium was most frequent (40%). A large proportion of participants engaged in outdoor activities (73.8%) and had

sun exposure (66.2%). Correlation analyses showed that larger pterygium size was strongly linked to higher corneal astigmatism and moderately associated with reduced visual acuity. Regression analyses highlighted age, outdoor work, sun exposure, occupation, and education as predictors of astigmatism. Mean corneal astigmatism decreased from 0.83 D preoperatively to 0.59 D at one month and 0.27 D at three months, with statistically significant reductions at both intervals. UCVA also improved significantly, from 0.21 logs MAR preoperatively to 0.14 at one month and 0.12 at three months.

The predominance of females in our study contrasts with several epidemiological studies that reported higher prevalence among males, often attributed to greater outdoor exposure. For example, Viso et al. in Spain found pterygium more common in men, linking this to occupational sun exposure (6). Similarly, Pyo et al. in South Korea reported male predominance (8). However, Addis et al. in Ethiopia observed no significant gender difference (19). The relatively younger mean age in our study (37.8 years) is consistent with findings from Ethiopia and Uganda, where pterygium was frequently diagnosed in adults less than 40 years (18, 19, 20). This suggests regional variations in age and gender distribution, possibly influenced by lifestyle and occupational factors. The possible justification for the predominance of females in our study, they are more likely to seek medical attention for cosmetic issue.

Most participants in our study lived in urban areas, which differ from studies in rural China and Ethiopia that identified rural residency as a major risk factor due to higher UV exposure (14, 16, and 27). The urban predominance in our study may reflect hospital-based recruitment rather than true population prevalence. Nonetheless, outdoor activity was reported by 73.8% of participants, supporting the established role of UV exposure in pterygium pathogenesis (7, 29).

A relatively high proportion of participants had college-level education, which contrasts with studies in rural Ethiopia and South Korea where lower educational attainment was common among pterygium patients (8, 19). Higher education may correlate with increased health-seeking behavior and earlier hospital presentation, rather than reduced disease risk. This aligns with findings from Tan & Chan, who noted that awareness and access to care influence disease detection and management (7).

The predominance of grade II and III pterygium in our study is comparable to findings from Nepal and Pakistan, where intermediate grades were most frequently observed (17, 23). Higher grades were associated with greater astigmatism in these studies, consistent with our correlation analysis showing larger pterygium size linked to higher astigmatism and poorer UCVA. Nejima (2014) similarly demonstrated that pterygium size significantly affects corneal topography and visual outcomes (13).

Our study identified several socio-demographic and environmental factors significantly associated with preoperative corneal astigmatism in patients with pterygium. Age was a strong predictor, with older individuals more likely to develop higher astigmatism, which is consistent with population-based studies in Spain and China that reported increasing prevalence and severity of pterygium with advancing age (6,14). Similarly, environmental exposures such as outdoor working areas and sun exposure were significant risk factors, reinforcing the established role of ultraviolet radiation in pterygium pathogenesis (3). Educational status showed mixed associations; with primary school education was significantly associated with corneal astigmatism. Comparable results were reported in Ethiopia and Asia, where lower education levels were linked to higher prevalence, likely due to occupational exposure and limited awareness of ocular health (19, 8, and 12).

Occupation was another determinant: daily laborers and farmers had a significant risk factor, consistent with studies from Uganda and Indonesia that found outdoor workers at greater risk compared to indoor occupations (18, 28). Finally, pterygium size influenced astigmatism, with Grade 4 lesions significantly associated with higher astigmatism. This corroborates findings by Maheshwari (1), Nejima (13), and Zheleva & Voynov (9), who demonstrated that larger pterygia induce greater corneal distortion and refractive changes.

The moderate positive correlation between preoperative astigmatism and UCVA in our study aligns with reports from Parajuli & Bajracharya (2019), who found that higher astigmatism was associated with poorer vision, and excision significantly improved both parameters (17). Ali et al. (2022) also demonstrated that reduction in astigmatism after conjunctival autograft correlated with improved UCVA (23). Similarly, Amoah et al. (2022) in Ghana confirmed that excision led to significant improvement in both astigmatism and visual acuity (26).

The strong correlation between astigmatism at one and three months ($r = 0.811$) reflects progressive improvement, consistent with longitudinal studies. Zheleva & Voynov (2018) reported sustained reduction in astigmatism three months after excision (9). Similar trends were observed in Egypt (25) and Nepal (17), where astigmatism decreased steadily over follow-up. Our results therefore align with global evidence that pterygium excision provides stable refractive benefits.

The negative correlation between postoperative astigmatism and year of residency suggests that surgical experience improves outcomes. This finding complements Kulthe (2013), who emphasized that proper surgical technique and early excision prevent visual impairment and recurrence (2). Anwar et al. (2022) also demonstrated that meticulous technique reduces postoperative refractive error (25).

Our findings that shows mean corneal astigmatism decreased from 0.83 D preoperatively to 0.59 D at one month and 0.27 D at three months are consistent with previous study in India ,who reported significant reduction in pterygium-induced astigmatism after one month of excision (1). Khan et al. (2014) also found that excision reduced corneal astigmatism, particularly in larger lesions (10). Another study done in Bulgaria, demonstrated similar improvements, with mean astigmatism decreasing from 1.26D to 0.84D three months postoperatively (9). Our findings are also consistent with study done in Nepal, who reported reductions from 2.8D to 0.8D at three month) reported reductions from 2.8D to 0.8D at three months (17). The mean change in our study from preoperative to 3 months of surgery was 0.56 D, which was similar with the study done in Pakistan, who found mean changes of 1.79D after 3 months CAG (23). Our results shows smaller baseline astigmatism, because majority of study participants had college and above education, which leads early health seeking behavior.

The improvement in UCVA in our study parallels findings from Kulthe (2013), who emphasized that early excision with autograft improves vision and prevents impairment (2). Anwar et al. (2022) in Egypt reported UCVA improvement from 0.75 to 0.33 logMAR at three months (25), while Amoah et al. (2022) in Ghana found significant improvement in both UCVA and BCVA after surgery (26). These consistent findings across diverse populations reinforce the reproducibility of visual benefits following pterygium excision.

7. LIMITATIONS OF THE STUDY.

- **Hospital-based design:** Since the study was conducted only at SPHMMC, the findings may not be generalizable to the wider Ethiopian population, particularly rural communities where pterygium prevalence and risk factors may differ.
- **Short follow-up period:** Postoperative outcomes were assessed only at 1 and 3 months. Longer-term follow-up is required to evaluate recurrence rates and sustained improvements in astigmatism and visual acuity.
- **Small sample size:** The relatively limited number of participants reduces the statistical power of the study and may affect the robustness of associations identified.
- **Measurement tools:** Corneal astigmatism was assessed using automated keratometry, which may not capture subtle corneal irregularities as precisely as advanced diagnostic modalities such as corneal topography or wavefront aberrometry

8. STRENGTH OF THE STUDY.

- **Relevant research focus** – addresses the debated effect of pterygium excision on corneal astigmatism and visual acuity.
- **Well-defined methodology** – clear inclusion/exclusion criteria, standardized surgical technique (CAG with sutures), and structured data collection tools.
- **Comprehensive data collection** – demographic, occupational, environmental, and clinical factors included.
- **Robust statistical analysis** – paired t-test for outcome comparison and multiple regression for associated factors
- **Clinical and practical significance** – findings can guide surgical planning, patient counseling, and preventive strategies.
- **Quality control measures** – training of data collectors and calibration of instruments
- **Contribution to future research** – provides baseline data for Ethiopia and supports comparative international studies.

9. CONCLUSION

The study demonstrated that pterygium excision with conjunctival autograft significantly reduced corneal astigmatism and improved uncorrected visual acuity (UCVA) over a three-month follow-up period. Preoperatively, larger pterygium size was strongly correlated with higher astigmatism and moderately associated with poorer UCVA, while environmental and occupational factors such as outdoor work, sun exposure, and farming or daily labor were significant predictors of astigmatism. Postoperatively, mean corneal astigmatism decreased from 0.83 D to 0.59 D at one month and 0.27 D at three months, with statistically significant improvements at both intervals, while UCVA improved from 0.21 logMAR preoperatively to 0.14 at one month and 0.12 at three months. These findings confirm that surgical intervention not only alleviates ocular discomfort but also provides measurable refractive and visual benefits, highlighting the importance of timely excision and preventive strategies in populations at risk.

10. RECOMMENDATION.

Based on the findings of our study, we recommend that:

❖ For Ministry of Health (MOH)

- Develop national preventive guidelines targeting outdoor workers, emphasizing protective measures (UV-blocking sunglasses, hats) to reduce pterygium-related astigmatism.
- Integrate occupational health policies that include mandatory ocular health assessments for high-risk professions, given occupation's significant impact on astigmatism.

❖ For Hospitals

- Strengthen screening services for patients with large pterygium size
- Implement UV-protection counseling in ophthalmology clinics, particularly for patients reporting outdoor work and sun exposure.
- Ensure early surgical intervention for large pterygium sizes as regression analysis confirmed larger lesions are associated with higher astigmatism.

❖ For Health Professionals

- Pay close attention to pterygium size during preoperative evaluation, as it significantly predicts corneal astigmatism. Accurate measurement and grading should guide surgical timing.
- Counsel patients from high-risk occupations about their increased likelihood of astigmatism and emphasize preventive strategies.
- Encourage continuous surgical training and mentorship for residents, as higher training levels were associated with better postoperative astigmatism outcomes.

❖ **For Patients**

- Patients with larger pterygium size should be advised to seek surgical intervention early, since size significantly increases astigmatism and reduces vision.
- Outdoor workers (farmers, laborers, industry workers) should adopt consistent protective measures (sunglasses, hats) to minimize UV exposure and reduce risk of pterygium-related astigmatism.

11: REFERENCES.

1. Maheshwari S. Effect of pterygium excision on pterygium induced astigmatism. Indian J Ophthalmol. 2003;51(2):187–8.
2. Kulthe SB. Pterygium – Early Excision with Conjunctival Auto-graft , Improves Vision and Prevents Visual Impairment. 2013;18(May):495–6.
3. Hill JC. Pathogenesis of pterygium. Eye. 1989;3(2):218–26.
4. Maros H, Juniar S. Basic and Clinical Science Course, Section 8 : External Disease and Cornea. Am Acad Ophthalmol. 2021;3–9.
5. Razmjoo H, Vaezi MH, Peyman A, Koosha N, Mohammadi Z, Alavirad M. The effect of

- pterygium surgery on wavefront analysis. *Adv Biomed Res.* 2014;3(1):196–196.
6. Viso E, Gude F, Rodríguez-Ares MT. Prevalence of pinguecula and pterygium in a general population in Spain. *Eye.* 2011;25(3):350–7.
 7. Tan D, Chan C. Management of Pterygium. *Cornea.* 2011;1625–37.
 8. Pyo EY, Mun GH, Yoon KC. The prevalence and risk factors for pterygium in South Korea: the Korea National Health and Nutrition Examination Survey (KNHANES) 2009-2010. *Epidemiol Health.* 2016;38:e2016015.
 9. Zheleva V, Voynov L. Comparative study of astigmatic changes following pterygium excision with conjunctival autograft transplantation. *Biotechnol Biotechnol Equip* [Internet]. 2018;32(2):433–6. Available from: <https://doi.org/10.1080/13102818.2017.1423516>
 10. Khan FA, Niazi SPK, Khan DA. The impact of pterygium excision on corneal astigmatism. *J Coll Physicians Surg Pakistan.* 2014;24(6):404–7.
 11. Wong NA, Bahmani H. Heliyon Review article A review of the current state of research on arti fi cial blue light safety as it applies to digital devices. *Heliyon* [Internet]. 2022;8(January):e10282. Available from: <https://doi.org/10.1016/j.heliyon.2022.e10282>
 12. Tong L, Wong TY, Tay WT, Saw SM, Mei SS. The prevalence of and risk factors for pterygium in an urban Malay population : The Singapore Malay Eye Study (SiMES). 2010;977–81.
 13. Nejima R. Topographic Changes After Excision Surgery of Primary Pterygia and the Effect of Pterygium Size on Topograpic Restoration. 2014;
 14. Zhong H, Cha X, Wei T, Lin X, Li X, Li J, et al. Prevalence of and Risk Factors for Pterygium in Rural Adult Chinese Populations of the Bai Nationality in Dali : The Yunnan Minority Eye Study. 2012;000:6617–21.
 15. Chua JLL, Tan DTH. Current concepts and techniques in pterygium treatment Leonard P. 2007;308–13.
 16. Hashemi H, Khabazkhoob M, Yekta A, Jafarzadehpour E, Ostadimoghaddam H, Kangari

- H. The prevalence and determinants of pterygium in rural areas. *J Curr Ophthalmol* [Internet]. 2017;29(3):194–8. Available from: <http://dx.doi.org/10.1016/j.joco.2016.09.002>
17. Parajuli R, Bajracharya L. CHANGES IN ASTIGMATISM BEFORE AND AFTER. 2019;4(1):596–601.
 18. Denis E, Pauline A, Charity Z, Pius M, Jacob N, Agaba CA. Pterygium in Uganda: A hospital-based study. *Cogent Med* [Internet]. 2020;7(1). Available from: <https://doi.org/10.1080/2331205X.2020.1724602>
 19. Addis S, Id F, Assem AS, Adimassu NF. Prevalence of pterygium and its associated factors among adults aged 18 years and above in Gambella town , Southwest Ethiopia ,. 2020;127:1–12. Available from: <http://dx.doi.org/10.1371/journal.pone.0237891>
 20. Anbesse DH, Kassa T, Kefyalew B, Tasew A, Atnie A, Desta B. Prevalence and associated factors of pterygium among adults living in Gondar city, Northwest Ethiopia. *PLoS One*. 2017;12(3):1–9.
 21. U P D, Jain B. Effect of Pterygium Excision on Pterygium Induced Refractive Changes. *J Evol Med Dent Sci*. 2016;5(26):1376–8.
 22. Article O. Section : Ophthalmology Assessment of Preoperative and Postoperative Changes in Corneal Astigmatism after Pterygium Excision by Different Techniques. 2018;(May):2018–21.
 23. Ali A, Adnan M, Shaikh SP, Sami A, Riffat H. Mean Change in Pterygium Induced Astigmatism in Patients Undergoing Pterygium Excision with Conjunctival Autograft. *Pakistan J Ophthalmol*. 2022;38(4):245–9.
 24. S K, Kannan V, Ghouse NF. a Study on Corneal Astigmatism in Pterygium Cases Before and After Surgery. *J Evid Based Med Healthc*. 2018;5(9):830–5.
 25. Anwar A, Awad E, Elkhoully S, El-Fallal HM. Visual and refractive Outcome After Pterygium Excision by Different Techniques. *Egypt J Ophthalmol (Mansoura Ophthalmic Center)*. 2022;2(3):154–68.

26. Amoah K, Mohammed A kabir, Ahmed A sadik. Changes in Astigmatism and Visual Acuity after Pterygium Excision in the Ashanti Region of Ghana. 2022;19(2):86–93.
27. Alemayehu TK, Addis Y, Bizuneh ZY, Tegegne MM, Alemayehu AM. Prevalence and associated factors of pterygium among adults living in Kolla Diba Town, Northwest Ethiopia. Clin Ophthalmol. 2020;14:245–55.
28. Gazzard G, Saw SM, Farook M, Koh D, Widjaja D, Chia SE, et al. Pterygium in Indonesia: Prevalence, severity and risk factors. Br J Ophthalmol. 2002;86(12):1341–6.
29. Backes C, Religi A, Mocozet L, Behar-Cohen F, Vuilleumier L, Bulliard JL, et al. Sun exposure to the eyes: predicted UV protection effectiveness of various sunglasses. J Expo Sci Environ Epidemiol [Internet]. 2019;29(6):753–64. Available from: <http://dx.doi.org/10.1038/s41370-018-0087-0>
30. Benjamin WJ. Borish's Clinical Refraction. Borish's Clinical Refraction. 2006.

12: Assurance of Principal Investigator.

I the undersigned agree to accept all responsibilities for the scientific and ethical conduct of the research project. I have provided timely progress report to my advisor and seek the necessary advice and approval from my primary advisors in the course of the research. I have communicated timely to my advisors all stakeholders involved in the study including any source of funding for this research.

Name of the student: Dr. Tadesse Edessa

Signature: _____

Date: _____

Approval of the Clinical Advisor

Name of the primary advisor Dr.Dawit (Corneal Sub-Specialist)

Signature: _____

Date: _____

Approval of the Clinical Advisor

Name of the primary advisor: Dr.Tewudros (Corneal sub specialist)

Signature: _____

Date: _____

Approval of the Clinical Advisor

Name of the primary advisor: Mr.Zewudu (MSC in Optometry)

Signature: _____

Date: _____

Approval of the Public Health Advisor

Name of the primary advisor: Mr. Teasfalem Teshome (MPH consultant)

Signature: _____

Date: _____

13. Annexes.

13.1: Annex 1: English version study Information Sheet and Consent Form.

Name of the principal investigator: DR.TADESSE EDESSA.

Name of the Organization: St. Paul's Hospital Millennium Medical College.

Introduction: This information sheet and consent form is prepared by the investigator whose main aim is to study the mean change in corneal astigmatism before and after pterygium excision at the ophthalmology department of Paul's Hospital Millennium Medical College.

The principal investigator is a resident doctor in Ophthalmology department.

Purpose of study: To assess the mean change in corneal astigmatism before and after pterygium excision and associated factors among patients attending the ophthalmology department of Paul's Hospital Millennium Medical College.

The procedure of the study: To assess the mean change in corneal astigmatism before and after pterygium excision, we invite you to take part in our study. If you are willing to participate, you need to understand and give oral consent. Then, you will be asked to give your response for the questionnaire and clinical examination will be done by the data collectors. All responses given by the participants and the results obtained will be kept anonymous and confidential using a coding system whereby no one will have access to your responses.

Risk and/ or Discomfort: By participating in this research project you may feel that it has some discomfort especially on wasting your time but this may not be too much at your health care and it contributes to the overall improvement of the health status of the community. There is no risk during this research

Benefits: If you participate in this research project, you may not get the direct benefit but your participation is likely to help us in assessing effect of pterygium excision on corneal astigmatism.

Incentives: You will not be provided any incentives to take part in this research project.

Confidentiality and Anonymity: The information that will collect from this research project will be kept confidential. Information about you that will be collected from the study will be stored in a file, which will not have your name on it but a code number assigned to it. The number belongs to which name will be kept under lock and key, and it will not be revealed to anyone except the principal investigator.

Right to Refuse or withdrawal: You have the full right to refuse from participating in this research (You can choose not to respond some or all of the questions) if you do not wish to participate and this will not affect the health services you get from any health facilities. You have also the full right to withdraw from this study at any time you wish to without losing any of your rights as a resident of this site.

Person to contact: If you have any question you can contact any of the following individuals and you may ask at any time you want.

Dr. Tadesse Edessa: St. Paul's Hospital Millennium Medical College

Tel: +251922965851

E-mail: tadeseedesaa580@gmail.com

If you have well read this information sheet and you have given a chance to ask any question and clear with it or read to you and understood and finally you have agreed to participate on this research; please you need to give an oral agreement by saying “Yes” or if you refuse to participate by saying “No”.

13.2: Annex 2: English version of oral consent form.

Hello, how are you? My name is _____. This is an interview to be done with you for a study that is being conducted at St. Paul's Hospital Millennium Medical College, Department of Ophthalmology. the aim is to assess the mean change in corneal astigmatism before and after pterygium excision and associated factors among patients attending the ophthalmology department of Paul's Hospital Millennium Medical College. I would like to ask you some questions that are related to the above topic. I believe that the results of this study will assist policy makers, planners and health service providers for making considerations regarding pterygium induced corneal astigmatism and management. Your contribution has a great input for the study and I would greatly appreciate your participation.

Therefore, you will not be obliged to answer any question that you do not want to and you may end this interview at any time you want to. There are also no obligations for not participating in the interview. The interview along with the clinical examination will take about 20-30 minutes.

May I continue the interview?

Response

Yes ☐

No ☐ Stop the interview and thank the respondent.

Interviewer signature certifying that the consent has been given verbally.

Interviewer's name _____ signature _____ Date _____

Result: (to confirm for completeness)

A. Questionnaire completed _____

B. Questionnaire partially completed _____

C. Participant refused _____

Checked by Supervisor:

Supervisor's Name _____ Signature _____ Date _____

10.3: Annex 3 Questionnaires.

Instructions: I'm going to read you some statements about problems which involve your vision or feelings that you have about your vision condition. After each question I will read you a list of possible answers. Please choose the response that best describes your situation. Please take as much time as you need to answer each question. All your answers are confidential. In order for this survey to improve our knowledge about pterygium induced astigmatism and how they affect your vision, your answers must be as accurate as possible.

PATIENTS INTERVIEW CODE.....

DATE OF THE INTERVIEW/....../.....

Part I: Socio demographic characteristics of participants

S.no.	Variable	Coding category	Remarks
1.	Sex	A. Male B. Female	
2.	Age	----- Years	
3.	Place of residency	A. Urban B. Rural	
4.	Educational level	A. Illiterate B. Can read and write C. Primary D. Secondary E. College and above	
5.	Occupation	A. Farmer B. civil servant C. Daily laborer D. Housewife E. Merchant	

		F. Works in industry G. Un employed H. Retired I. Other -----	
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Part II. Associated factors assessment

S.no	Variable	Category	Remarks
1	Working area	A. Outdoor activities B. Indoor activities	
2	Sun exposure	A. Yes B. No	
3	If Q no2 is yes, what is the average time spent outdoors every day?	-----in hours	
4	Previous ocular surgery	A. Yes B. No	
5	If Q no 4 is yes ,please specify		
6	Ocular comorbid illness	A. Yes B. No	
7	If Q no 8 is yes ,please specify		
8	Presenting symptoms		

Part IV: Clinical Measurements

A. Preoperative assessment					
S/ N	Clinical Features	Variables	OD	OS	OU
1	Uncorrected visual Acuity	In Log MAR			
2	Best corrected Visual acuity	In Log MAR			

3	K readings on automated keratometry	In diopter	K1----- K2----- Axis-----	K1----- K2----- Axis ----	
4	Amount of astigmatism	In diopter			
5	Type of corneal astigmatism	A. With the –rule astigmatism B. Against the –rule astigmatism C. Oblique astigmatism			
6	Subjective refractive error	In diopter			
7	Grade of pterygium	A. Grade I B. Grade II C. Grade III D. Grade IV			
9	Location of pterygium	A. Nasal B. Temporal C. Both			

10	Indication for pterygium excision	A. Ocular discomfort, B. Induced astigmatism, C. Progression of the pterygium toward visual axis . D. Restricted ocular motility, E. Cosmetics			
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B postoperative assessment

S/N	Clinical features	Variables	OD	OS	OU
1	Uncorrected visual Acuity	At 1month of surgery			
		At 3 month of surgery			
2	Best corrected visual acuity	At 1 month of surgery			

		At 3 month of surgery			
3	K readings on automated keratometry (in diopter)	At 1 month of surgery	K1 K2 Axis ---	K1 K2 Axis ---	
		At 3 month of surgery	K1 K2 Axis ---	K1 K2 Axis --	
4	Amount of astigmatism	At 1 month of surgery			
		At 3 month of surgery			
5	Subjective refractive error	At 1 month of surgery			
		At 3 month of surgery			
6	Surgery was done by	A. Resident B. Senior			
7	If Q no 4 is Resident ,please specify				

Thank you for participating in this questionnaire. Your input is important for our study on the impact of pterygium excision surgery.

