Original Article

Evaluating the Results of Pterygium Excision with Cryotherapy

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ABSTRACT

Purpose: To evaluate the surgical outcomes, recurrence rates, and safety profile of pterygium excision combined with intraoperative cryotherapy.

Study Design: Quasi experimental study.

Place and Duration of Study: Layton Rahmatulla Benevolent Trust – LRBT, Karachi between October 2024 and December 2025.

Methods: This study included 56 eyes of 56 patients presenting with primary or recurrent pterygium. All participants underwent surgical excision followed by application of a double freeze-thaw cryotherapy cycle to the scleral bed and exposed sclera was left uncovered for secondary healing. Visual acuity (VA) was assessed pre and postoperatively using Snellen charts and converted to LogMAR for statistical analysis. Patients were followed for a minimum of 6 months to monitor for recurrence defined as fibrovascular regrowth >1 mm across the limbus, and other postoperative complications.

Results: The mean age of the study population was 50.27 ± 14.93 years, with a predominance of male patients (73.2%) and those residing in urban areas (80.4%). The procedure yielded a statistically significant improvement in mean LogMAR VA, improving from 0.47 preoperatively to 0.45 at the 6-month follow-up ($p < 0.001$). The recurrence rate was 1.8% (n=1). The safety profile was 91.1%. The most common adverse event was transient inflammation (7.1%), with no incidence of severe complications such as scleral necrosis or granuloma formation.

Conclusion: Pterygium excision with adjuvant cryotherapy significantly reduces recurrence rates while improving visual outcomes. Given its low complication rate and avoidance of long-term toxicity associated with chemical antimetabolites, cryotherapy represents a valuable adjunctive treatment for ensuring ocular surface stability.

Keywords: Pterygium, Cryotherapy, Adjuvant therapy.

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INTRODUCTION

Pterygium is a common ocular surface disorder characterized by the encroachment of a fibrovascular growth from the bulbar conjunctiva onto the cornea, often induced by chronic exposure to ultraviolet radiation, dust, and dry environments. While the exact pathogenesis remains multifactorial, involving genetic predisposition and anti-apoptotic mechanisms, the condition can lead to significant visual impairment through induced astigmatism or direct obscuration of the visual axis, necessitating surgical intervention.[1,2] Surgical excision is the primary management strategy; however, the high rate of recurrence remains the most challenging complication.[3] Consequently, various surgical modifications and adjuvant therapies have been introduced to improve long-term outcomes and reduce the proliferation of residual fibroblastic tissue.[4]

Limbal conjunctival autograft (LCAG) is currently considered the gold standard technique, significantly reducing recurrence rates compared to bare sclera excision by restoring the limbal barrier function.[5]

Despite its success, recurrence is still reported, particularly in high-risk populations or recurrent cases.[6] To further minimize these rates, pharmacological adjuvants such as Mitomycin C (MMC) and 5-Fluorouracil (5-FU) are frequently employed. While effective in inhibiting fibroblast proliferation, these antimetabolites are associated with potentially sight-threatening complications, including scleral necrosis, corneal melting, and secondary glaucoma, prompting the search for safer alternative adjuvants.[7,8]

Cryotherapy using liquid nitrogen or nitrous oxide cryotherapy to the scleral bed and conjunctival margins aims to destroy the subconjunctival microvasculature and resident fibroblasts through intracellular ice crystal formation and ischemic necrosis.[9] Unlike chemical antimetabolites, cryotherapy offers a more controlled depth of tissue destruction and lacks the long-term toxicity associated with alkylating agents.[10] Many grading systems have been described in literature.[11-13]

This study was done to determine surgical outcomes for pterygium by evaluating the effectiveness of cryotherapy as a safe and accessible adjuvant. While conjunctival autografting addresses the limbal deficiency, it may not fully neutralize the activated fibroblasts in the surrounding tissue. This study evaluates the results of pterygium excision combined with cryotherapy, specifically assessing recurrence rates, postoperative complications, and final visual outcomes.

METHODS

This quasi-experimental study was conducted at the Layton Rahmatulla Benevolent Trust – LRBT, Karachi between October 2024 and December 2025. The study protocol adhered to the tenets of the Declaration of Helsinki and received ethical approval from the Institutional Review Board **(Reference Number LRBT/TTEH/ERC/3910/36)** prior to the commencement of the study. Written informed consent was obtained from all participants after a detailed explanation of the surgical procedure and potential risks.

The study included 56 consecutive patients (56 eyes) diagnosed with primary or recurrent pterygium requiring surgical excision. Inclusion criteria were patients aged 18 years or older with clinically significant pterygium causing visual symptoms (irritation, redness, foreign body sensation), cosmetic deformity, or induced astigmatism. Patients with pseudopterygium, ocular surface infections, severe dry eye syndrome, history of glaucoma, or other co-existing ocular pathologies that could compromise visual potential (e.g., dense cataract, retinal disease) were excluded. All patients underwent a comprehensive preoperative ophthalmic examination. Data included patient demographics (age, gender, occupation, residential status) and detailed medical history regarding systemic diseases, smoking, and ultraviolet (UV) exposure. Visual acuity (VA) was recorded using a standard Snellen chart and converted to the Logarithm of the Minimum Angle of Resolution (LogMAR) scale for statistical analysis. Pterygium grading was performed based on the extent of corneal encroachment: Grade I (crossing the limbus but not reaching the pupil margin), Grade II (reaching the pupil margin), and Grade III (crossing the pupil margin).[11,12] The morphology was further classified as atrophic, intermediate, or fleshy based on the transparency of the pterygium body.[13]

All surgeries were performed by a single experienced surgeon under local anesthesia (topical 0.5% proparacaine hydrochloride and subconjunctival 2% lidocaine with adrenaline). The surgical site was prepared with 5% povidone-iodine solution. The pterygium was excised using a microscope-assisted dissection technique. The head of the pterygium was avulsed or dissected from the cornea using a crescent blade, and the body was excised from the scleral bed to remove the fibrovascular tissue and Tenon's capsule. Following excision, cryotherapy was applied to the bare scleral bed and the conjunctival margins using a cryoprobe (liquid nitrogen or nitrous oxide). A double freeze-thaw technique was employed, consisting of a rapid freeze cycle (approximately 3–5 seconds) followed by a slow thaw, repeated twice, to ensure destruction of residual fibroblasts and vascular endothelial cells while minimizing scleral damage.

Following cryotherapy, the defect was left bare sclera to heal through secondary intention.

Postoperatively, eyes were patched for 24 hours. Patients were prescribed a regimen of topical antibiotics (Moxifloxacin 0.5%) four times daily for one week and topical steroids (Prednisolone acetate 1%) four times daily, tapered over 4–6 weeks. Artificial tears were prescribed for 3 months.

Patients were evaluated at Day 1, 1 week, 1 month, 1 month, 3 months, and 6 months

postoperatively. The primary outcome measure was the recurrence of pterygium, defined as the regrowth of fibrovascular tissue crossing the corneoscleral limbus >1 mm.[3] Secondary outcome measures included best-corrected visual acuity (BCVA), cosmetic outcome, and postoperative complications such as granuloma formation, or persistent inflammation.

Data were entered into a standardized proforma and analyzed using SPSS software version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables, such as age and VA, were expressed as mean ± standard deviation (SD). Categorical variables, such as gender, pterygium grade, and complication rates, were presented as frequencies and percentages.

Pre and postoperative VA were compared using the paired t-test. A Pearson correlation coefficient (r) was calculated to assess the relationship between immediate postoperative VA and VA at 6 months. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 56 patients were included, with a mean age of 50.27 ± 14.93 years. Most were older than 45 years 33 (58.9%). Males predominated 41 (73.2%). The majority resided in urban areas 45 (80.4%)(Table 1).

Table 1: *Demographic & Baseline Characteristics of Patients (n=56)*

Demographic Characteristics	Frequency (%)
Age (years) Mean ±SD = 50.27 ±14.93	
Age Group	
18 – 45 years	23 (41.1)
>45 years	33 (58.9)
Gender	
Male	41 (73.2)
Female	15 (26.8)
Residential Status	
Urban	45 (80.4)
Rural	11 (19.6)
Ethnicity	
Urdu Speaking	19 (33.9)
Sindhi	16 (28.6)
Punjabi	8 (14.3)
Pathan	8 (14.3)
Balochi	5 (8.9)
Employment Status	
Housewife	15 (26.8)
Employed	7 (12.5)
Self-Employed	32 (57.1)
Student	2 (3.6)

All procedures were performed under subconjunctival anesthesia. The excision was conducted using the blunt dissection technique in all cases. Cryotherapy was applied as adjunctive therapy in every patient. The study population largely consisted of patients without prior ocular surgery or recurrent pterygium(Table 2).

Table 2: *Clinical Characteristics of Patients (n=56).*

Clinical Characteristics	Frequency (%)
Previous Ocular Surgery	
Yes	15 (26.8)
No	41 (73.2)
Prior Pterygium Surgery in Same Eye	
Yes	3 (5.4)
No	53 (94.6)
Systemic Disease	
Diabetic	7 (12.5)
Hypertension	6 (10.7)
Hypertension & Diabetes	1 (1.8)
Cardiac	2 (3.6)
None	40 (71.4)
History of Smoking	
Yes	18 (32.1)
No	38 (67.9)
History of Prolonged UV Exposure	
Yes	9 (16.1)
No	47 (83.9)
Laterality	
Right	29 (51.8)
Left	27 (48.2)
Grade of Pterygium	
Grade II	13 (23.2)
Grade III	43 (76.8)
Involving Site	
Nasal	46 (82.1)
Temporal	4 (7.1)
Both	6 (10.7)
Symptoms	
Cosmetic Concern	12 (21.4)
Irritation	17 (30.4)
Redness	14 (25.0)
Visual Disturbance	13 (23.2)
Number of Freez Thaw Cycles	
3 – 5 Cycles	54 (96.4)
>5 Cycles	2 (3.6)

A moderate positive correlation was observed between immediate post-operative VA and at 6 months ($r = 0.55$), which was statistically significant ($p < 0.001$). Comparison of post-operative VA at 6 months across different complication groups showed no statistically significant difference ($p = 0.308$). Patients without complications demonstrated a mean VA of 0.48 ± 0.20, which was comparable to those with persistent inflammation (0.48 ± 0.17). The single

patient with recurrence had a lower VA (0.17), but this did not influence overall statistical significance. Complications were at minimal, persistent inflammation occurred in 7.1% of patients, recurrence in 1.8%, and 91.1% experienced no complications.

DISCUSSION

This study evaluated the efficacy and safety of pterygium excision with adjuvant cryotherapy. Our findings demonstrate that this combined approach yields a low recurrence rate and significant improvement in visual acuity, with a manageable complication profile. These results support the use of cryotherapy as a viable alternative or adjunct to other antimetabolites like MMC, particularly in populations with high occupational UV exposure.

Demographically, our study population showed a male predominance (73.2%), consistent with global epidemiological patterns where men are more frequently exposed to outdoor environmental risk factors. This aligns with findings by Ang et al, who identified male gender and cumulative UV exposure as primary risk factors for pterygium development.[14] The mean age of 50.27 ± 14.93 years in our study is also typical for this condition, reflecting the chronic, cumulative nature of actinic damage required for pterygium pathogenesis.[15]

The recurrence rate is the most critical metric for success in pterygium surgery. We observed a recurrence rate of only 1.8% (1 eye) over a 6-month follow-up period. This is comparable to, and in some cases lower than, rates reported for LCAG alone or LCAG with MMC in similar demographics.[16] For instance, a study by Hirst et al, reported a recurrence rate of virtually zero with meticulous LCAG technique, emphasizing that the surgical removal of the fibrovascular tissue and reconstruction of the limbal barrier are paramount.[17] A study conducted by Dag U et al, used cryotherapy for pterygium removal in conjunction with LCAG showed no recurrence rate with this combined procedure validating our study.[18] Our low recurrence rate suggests that use of cryotherapy targets residual fibroblasts in the scleral bed and Tenon's capsule without compromising normal architecture of conjunctiva due to graft harvesting. This mechanism mirrors the effect of MMC but potentially offers a safer toxicity profile, avoiding the long-term risks of scleral melting associated with alkylating agents.[19]

Visual outcomes in our study were favorable, with a significant improvement in mean LogMAR VA from 0.47 preoperatively to 0.45 at 6 months ($p < 0.001$). This improvement is likely attributable to the reduction of induced astigmatism and the restoration of a regular ocular surface. Pterygium excision significantly reduces corneal higher-order aberrations and regularizes corneal topography, directly correlating with improved visual quality.[20] The strong positive correlation ($r = 0.55$) we observed between immediate postoperative vision and 6-month outcomes suggests that early visual recovery is a reliable predictor of long-term stability.

Regarding complications, our safety profile was acceptable. Persistent inflammation was the most common issue (7.1%), which is an expected transient response to cryotherapy-induced tissue injury. This rate is consistent with findings by Fraunfelder, who noted that while cryotherapy is effective, it can induce temporary post-operative inflammation and chemosis.[10] We did not observe severe vision-threatening complications such as scleral necrosis or diplopia, which are occasionally reported with the use of MMC or excessive cautery.[21] The single case of recurrence in our study did not significantly impact the overall visual statistics, reinforcing the procedure's general reliability.

Our study has several limitations. First, the sample size of 56 eyes is relatively small, which may limit the generalizability of the findings to larger populations. Second, the follow-up period of 6 months, while sufficient to detect early recurrences, may miss late recurrences that typically occur within the first 12 to 18 months. Third, the lack of a control group prevents a direct statistical comparison of efficacy between cryotherapy and other adjuvant modalities. Future randomized controlled trials with longer follow-up durations and comparative arms are needed to definitively establish the superiority or non-inferiority of cryotherapy in modern pterygium management.

CONCLUSION

Pterygium excision combined with adjuvant cryotherapy proves to be a safe and highly effective management strategy. Cryotherapy offers advantage of targeted tissue destruction without the long-term toxicity risks often associated with chemical antimetabolites like MMC. Consequently, it represents a valuable, accessible therapeutic option for

minimizing recurrence and optimizing surgical success in pterygium management, particularly in high-risk populations.

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Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board **(LRBT/TTEH/ERC/3910/36).**

REFERENCES

1. **Dushku N, John MK, Schultz GS, Reid TW.** Pterygia pathogenesis: corneal invasion by matrix metalloproteinase expressing altered limbal epithelial basal cells. Arch Ophthalmol. 2001;**119(5):**695-706. Doi: 10.1001/archopht.119.5.695. Erratum in: Arch Ophthalmol 2002;120(2):234-237.
2. **Shahraki T, Arabi A, Feizi S.** Pterygium: an update on pathophysiology, clinical features, and management. Ther Adv Ophthalmol. 2021;**13:**25158414211020152. Doi: 10.1177/25158414211020152.
3. **Sarkar P, Tripathy K.** Pterygium. [Updated 2023 Aug 25]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2026 Jan-.Available from: https://www.ncbi.nlm.nih.gov/books/NBK558907/.
4. **Chu WK, Choi HL, Bhat AK, Jhanji V.** Pterygium: new insights. Eye (Lond). 2020;**34(6):**1047-1050. Doi: 10.1038/s41433-020-0786-3.
5. **Shusko A, Schechter BA, Hovanesian JA.** Pterygium Surgery Utilizing Limbal Conjunctival Autograft and Subconjunctival Amniotic Membrane Graft in High-Risk Populations. Clin Ophthalmol. 2020;**14:**2087-2090. Doi: 10.2147/OPTH.S243584.
6. **Al-Fayez MF.** Limbal versus conjunctival autograft transplantation for advanced and recurrent pterygium. Ophthalmology. 2002;**109(9):**1752-1755. Doi: 10.1016/s0161-6420(02)01160-0.
7. **Martins TG, Costa AL, Alves MR, Chammas R, Schor P.** Mitomycin C in pterygium treatment. Int J Ophthalmol. 2016;**9(3):**465-468. Doi: 10.18240/ijo.2016.03.25.
8. **Gündüz K, Günalp I, Ozden RG.** Anterior segment ischemia following pterygium surgery. Jpn J Ophthalmol. 1997;**41(3):**192-195. Doi: 10.1016/s0021-5155(97)00028-2.
9. **Fraunfelder FW.** Liquid nitrogen cryotherapy for surface eye disease (an AOS thesis). Trans Am Ophthalmol Soc. 2008;**106:**301-324. PMID: 19277243
10. **Fraunfelder FW.** Cryotherapy for pterygia. Ophthalmology. 2008;**115(12):**2314-2314.e2. Doi: 10.1016/j.ophtha.2008.06.027.
11. **Shahraki T, Arabi A, Feizi S.** Pterygium: an update on pathophysiology, clinical features, and management. Ther Adv Ophthalmol. 2021;**13:**25158414211020152. Doi: 10.1177/25158414211020152.
12. **Liu J, Fu Y, Xu Y, Tseng SC.** New grading system to improve the surgical outcome of multirecurrent pterygia. Arch Ophthalmol. 2012;**130(1):**39-49. Doi: 10.1001/archophthalmol.2011.328.
13. **Tan DT, Chee SP, Dear KB, Lim AS.** Effect of pterygium morphology on pterygium recurrence in a controlled trial comparing conjunctival autografting with bare sclera excision. Arch Ophthalmol. 1997;**115(10):**1235-1240. Doi: 10.1001/archopht.1997.01100160405001. Erratum in: Arch Ophthalmol 1998;**116(4):**552. PMID: 9338666.
14. **Ang M, Li X, Wong W, Zheng Y, Chua D, Rahman A, et al.** Prevalence of and racial differences in pterygium: a multiethnic population study in Asians. Ophthalmology. 2012;**119(8):**1509-1515. Doi: 10.1016/j.ophtha.2012.02.009.
15. **Liu L, Wu J, Geng J, Yuan Z, Huang D.** Geographical prevalence and risk factors for pterygium: a systematic review and meta-analysis. BMJ Open. 2013;**3(11):**e003787. Doi: 10.1136/bmjopen-2013-003787. Erratum in: BMJ Open. 2017;**7(12)**:e003787corr1. Doi: 10.1136/bmjopen-2013-003787corr1.
16. **Shoaib KK.** Conjunctival autograft with mitomycin C (MMC) in primary pterygium excision. Pak J Ophthalmol. 2023;**39(4).**Doi:10.36351/pjo.v39i4.1731.
17. **Hirst LW.** Recurrence and complications after 1,000 surgeries using pterygium extended removal followed by extended conjunctival transplant. Ophthalmology. 2012;**119(11):**2205-2210. Doi: 10.1016/j.ophtha.2012.06.021.
18. **Dağ U, Çağlayan M, Vardar S, Al-Akuş F, Öncül H, Yıldırım Y.** Evaluation of the Effect of Cryotherapy in Limbal Conjunctival Autograft Technique in Pterygium Surgery. Acta Med. Alanya. 2021;**5(2):**126-131.
19. **Rubinfeld RS, Pfister RR, Stein RM, Foster CS, Martin NF, Stoleru S, et al.** Serious complications of topical mitomycin-C after pterygium surgery. Ophthalmology. 1992;**99(11):**1647-1654. Doi: 10.1016/s0161-6420(92)31749-x.
20. **Razmjoo H, Vaezi MH, Peyman A, Koosha N, Mohammadi Z, Al-Avirad M.** The effect of pterygium surgery on wavefront analysis. Adv Biomed Res. 2014;**3:**196. Doi: 10.4103/2277-9175.140677.
21. **Ti SE, Chee SP, Dear KB, Tan DT.** Analysis of variation in success rates in conjunctival autografting for primary and recurrent pterygium. Br J Ophthalmol. 2000;**84(4):**385-389. Doi: 10.1136/bjo.84.4.385.

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