Customized Cryotherapy for Ocular Salvage in Descemetocele and Iris Prolapse: A 17-Year Retrospective Study

Pardianto Gede[1,2], Metta Cindy Prajna[1], Sugiaman Kristo Hadi Audric[1], Lister Clarissa[1], Purworini Diyah[3]

[1]Department of Ophthalmology and Vision Sciences, Universitas Prima Indonesia, Medan, Indonesia
[2]SMEC Eye Hospital, Medan, Indonesia
[3]Department of Biomedical Sciences, Universitas Prima Indonesia, Medan, Indonesia

First author:
Gede Pardianto, MD, PhD

Corresponding author:
Cindy Prajna Metta, MD
51 Pabrik Tenun
Medan
Indonesia
E-mail: cindyprajna@gmail.com

Submitted to the editorial board: September 16, 2025
Accepted for publication: December 2, 2025
Available on-line: January 29, 2026

The authors of the study declare that no conflict of interests exists in the compilation, theme and subsequent publication of this professional communication, and that it is not supported by any pharmaceuticals company. The study has not been submitted to any other journal or printed elsewhere, with the exception of congress abstracts and recommended procedures.

SUMMARY

Aim: To evaluate the efficacy of a customized cryotherapy technique in enhancing ocular salvage and reducing evisceration rates in patients with descemetocele and iris prolapse.

Material and Methods: A retrospective, observational study was conducted at SMEC Eye Hospital, Medan, including 467 eyes from 467 patients treated with customized cryotherapy between January 2008 and July 2025. The procedure integrated standardized cryotherapy with adjunctive perioperative protocols, including antiseptic preparation, postoperative antibiotic, anti-inflammatory, and beta-blocker eyedrops, as well as strict environmental precautions and protective eyewear. Outcomes assessed were the need for repeated cryotherapy and evisceration.

Results: Of the 467 treated eyes, 454 (97.2%) were successfully preserved without requiring evisceration. Repeated cryotherapy was required in 11 eyes (2.2%), of which 10 achieved ocular preservation. Evisceration was ultimately required in 13 eyes (2.8%), primarily due to spontaneous ocular content prolapse. Most treated eyes demonstrated corneal wall thickening and scarring, with regression of iris prolapse, thereby restoring ocular contour.

Conclusion: Customized cryotherapy is a highly effective intervention for preventing evisceration in eyes with descemetocele and iris prolapse. By stabilizing the corneal wall and mitigating the risk of spontaneous ocular prolapse, this technique represents a valuable strategy for ocular salvage. Further prospective and controlled studies are warranted to validate long-term outcomes and to optimize treatment protocols.

Key words: cryotherapy, ocular salvage, evisceration, descemetocele, iris prolapse

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INTRODUCTION

Ocular trauma and corneal ulcers complicated by descemetocele and iris prolapse can result in the spontaneous prolapse of intraocular contents, often necessitating evisceration. Evisceration, while sometimes unavoidable, results in the loss of the globe and significantly impacts patients' psychological well-being and quality of life. In many cases, especially when the extent of damage is not severe, preservation of the eye – even if vision cannot be restored – remains a priority for patients and surgeons alike [1–4].

Cryotherapy has been explored as a therapeutic option for corneal pathology, with reported benefits in preserving ocular integrity [5–8]. However, its specific role in preventing spontaneous prolapse and subsequent evisceration in cases of descemetocele and iris prolapse has not been fully elucidated.

This study investigates a comprehensive technique termed "Customized Cryotherapy", which integrates cryotherapy with strict perioperative protocols. We aim to evaluate its effectiveness in enhancing ocular salvage and reducing evisceration rates in a large cohort of patients treated over 17 years.

MATERIALS AND METHODS

Study Design and Setting

This retrospective, observational study was conducted at SMEC Eye Hospital, Medan. Medical records of patients treated with customized cryotherapy between January 2008

and July 2025 were reviewed. All procedures were performed by a single experienced surgeon (GP). The study adhered to the Declaration of Helsinki and received approval from the SMEC Hospital Research Ethical Review Committee (Approval Number: EA00000684, August 28, 2025).

Participants

A total of 467 eyes from 467 patients with descemetocele and iris prolapse were included. Demographic data such as age, sex, and ethnicity were recorded.

Patient Characteristics

The study included 467 patients – 282 males (60.4%), 185 females (39.6%) with a mean age of 48.9 years (range 23–69). Ethnic distribution was as follows: Malay Indonesian 310 (66.4%), Chinese Indonesian 114 (24.4%), and Indian Indonesian 43 (9.2%) (Table 1).

Surgical Technique: Customized Cryotherapy

- **Anesthesia and Preparation:** All procedures were performed under general anesthesia. Topical anesthesia was administered using 0.5% tetracaine hydrochloride (Pantocain, PT Cendo, Indonesia). The eyelids and surrounding skin were disinfected with 10% povidone-iodine, and the conjunctival surface with 5% povidone-iodine. Sterile draping and an eye speculum were applied, with all instruments sterilized appropriately and speculums immersed in 5% povidone-iodine solution prior to use.
- **Cryotherapy Equipment:** Cryotherapy was performed using the Appasamy Cryo System (Appasamy Associates, Chennai, India), equipped with a 3 mm round cryoprobe and an approximate 20 cm shaft length. The probe tip temperature was maintained between -80 °C and -90 °C, utilizing liquid nitrogen as the cryogen.
- **Cryotherapy Procedure:** The cryoprobe was first applied to the peripheral margin of the descemetocele and then gradually advanced toward the center. Each freeze cycle lasted 6-8 seconds, and the probe was kept stationary until complete thawing occurred, before being repositioned. The number of cryo applications varied according to lesion size and severity – one to three applications for small lesions, and up to twelve overlapping applications for larger or irregular defects. Freeze spots were placed approximately 1 mm apart to ensure uniform coverage while minimizing the risk of excessive stromal freezing. Formation of a distinct ice halo around the lesion marked adequate freezing.
- **Postoperative Care:** All patients received 0.5% levofloxacin (LFX, PT Cendo), 0.5% betaxolol (Tonor, PT Cendo), and 0.1% sodium diclofenac (Noncort, PT Cendo) eyedrops six times daily, in addition to oral sodium diclofenac 50 mg twice daily. Patients were advised to avoid exposure to water, wind, dust, smoke, and other ocular irritants, and were strictly instructed not to rub their eyes to prevent disruption of the healing corneal surface. Protective eyewear and eye shields were provided postoperatively. Follow-up evaluations were conducted on postoperative day 1 and day 7.

The combination of precise cryo application parameters and structured perioperative management collectively defines the "Customized Cryotherapy" technique.

Table 1. Baseline characteristics of study participants. Sex and ethnicity are presented as number (%)

Characteristics	Numbers (%)
Age	
Age (years)	48.9 (23–69)
Sex, number of eye (%)	
Male (%)	282 (60.4%)
Female (%)	185 (39.6%)
Race, number of eye (%)	
Malay Indonesian (%)	310 (66.4%)
Chinese Indonesian (%)	114 (24.4%)
Indian Indonesian (%)	43 (9.2%)

Outcome Measures

The primary outcome was the rate of ocular salvage (avoidance of evisceration). Secondary outcomes included the need for repeated cryotherapy and postoperative morphological changes in the cornea and iris.

RESULTS

Surgical Outcomes

- Ocular salvage was achieved in 454 eyes (97.2%).
- Repeated cryotherapy was required in 11 eyes (2.2%), of which 10 eyes (2.2%) avoided evisceration.
- Evisceration was necessary in 13 eyes (2.8%), 12 due to spontaneous ocular prolapse and 1 after failed repeated cryotherapy (Table 2).

Visual Acuity

Preoperative VA varied widely from no light perception (NLP) to 20/20, depending on the lesion's location. Central descemetoceles were associated with markedly reduced VA (NLP to 1/300), while peripheral lesions preserved better acuity (up to 20/20).

Table 2. Clinical outcomes following customized cryotherapy. Data are presented as number (%)

Characteristics	Number of eyes (%)
Total sample	467 (100%)
Ocular salvage (evisceration not required)	454 (97.2%)
Post-cryotherapy evisceration	12 (2.6%)
Repeated cryotherapy	11 (2.2%)
Post-repeated cryotherapy evisceration	1 (0.2%)
Total evisceration	13 (2.8%)

Postoperatively, anatomical restoration of the globe was prioritized. For this reason, visual improvement was limited and depended primarily on the location and density of corneal scarring. Nonetheless, all preserved eyes retained at least light perception, and several achieved counting fingers or better vision at final follow-up.

Intraocular Pressure Management

Quantitative assessment of intraocular pressure (IOP) was not feasible preoperatively, due to extreme corneal thinning and the risk of perforation with tonometric contact. Therefore, IOP was assessed qualitatively by digital palpation. Following cryotherapy, an optimally controlled IOP was characterized by a "soft but well-formed" globe upon palpation.

A markedly soft globe suggested ocular hypotony or evolving phthisis bulbi, whereas excessive firmness indicated IOP elevation. IOP was monitored regularly, until the development of a stable corneal cicatrix and confirmation that there was no residual risk of spontaneous ocular content prolapse.

Morphological Changes

Most eyes demonstrated corneal wall thickening and scarring at the site of the descemetocele. Iris prolapse regressed post-cryotherapy, restoring a flat corneal contour (Figures 1–2).

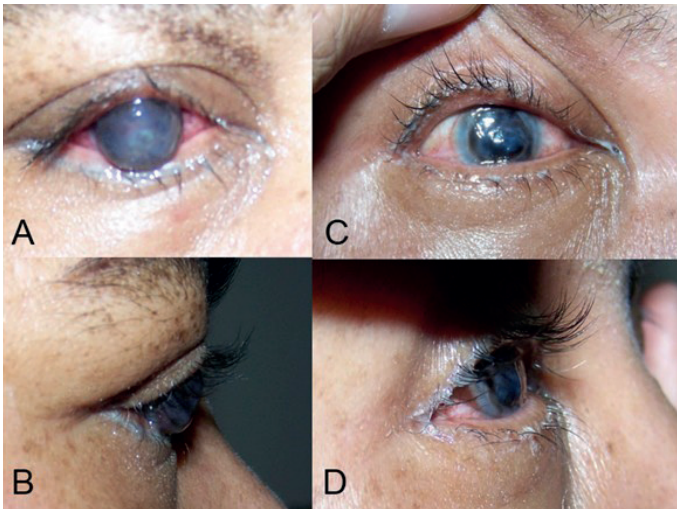

Figure 1. Severe descemetocele with iris prolapse. (**A**) Frontal view before cryotherapy. (**B**) Lateral view before cryotherapy. (**C**) Frontal view after cryotherapy. (**D**) Lateral view after cryotherapy. Following cryotherapy, the corneal wall at the site of the descemetocele demonstrated thickening and scarring, while the prolapsed iris regressed, resulting in restoration of a smooth corneal surface without anterior bulging

Figure 2. Severe descemetocele. (**A**) Frontal view before cryotherapy. (**B**) Lateral view before cryotherapy. (**C**) Frontal view after cryotherapy. (**D**) Lateral view after cryotherapy. Post-cryotherapy, the corneal wall at the site of the descemetocele exhibited thickening and scarring, resulting in flattening of the previously bulging corneal surface

DISCUSSION

This study demonstrates that a customized cryotherapy technique can achieve a high rate of ocular preservation in patients presenting with advanced corneal compromise characterized by descemetocele and iris prolapse. With 97.2% of eyes avoiding evisceration, these findings suggest that cryotherapy, when applied in a targeted and standardized manner, offers a viable alternative to globe-sacrificing procedures in severe cases where conventional therapeutic options are often exhausted [5–10].

The observed efficacy is supported by the underlying biological mechanism of cryotherapy. Controlled freezing induces keratocyte necrosis, which subsequently activates fibroblastic proliferation and collagen deposition. This cascade results in localized scar formation and thickening of the residual stromal tissue, thereby reinforcing the corneal wall [5–10]. In parallel, cryotherapy appears to facilitate regression of iris prolapse, restoring anterior segment integrity and reducing the likelihood of the spontaneous extrusion of intraocular contents. These effects, taken together, provide a biomechanical rationale for the improved structural stability observed in this cohort.

Although outcomes were favorable, 13 cases required evisceration, largely attributed to delayed presentation, poor compliance with postoperative care, and environmental challenges typical of tropical climates. These findings emphasize the importance of comprehensive perioperative management, patient education, and long-term follow-up to optimize results [11–13].

Despite its success, the technique has intrinsic limitations. Visual rehabilitation was generally restricted by dense corneal scarring. Transient IOP elevation or mild inflammation occasionally occurred, but resolved with topical beta-blockers and corticosteroids within a few weeks. The procedure is contraindicated in eyes with stromal thickness < 0.1 mm or in active endophthalmitis, and its success depends on strict postoperative adherence, particularly in environments with high humidity and infection risk.

The strengths of this study include the large sample size and the consistency afforded by a single surgeon performing all procedures, which reduces variability in technique and outcomes. However, several limitations should be acknowledged. The retrospective design introduces inherent biases, and the absence of a comparative control group limits the ability to establish causal relationships.

Future directions should include prospective, multicenter trials with standardized outcome measures to validate the reproducibility of this approach. Comparative studies against alternative globe-preserving strategies, such as tissue adhesives, amniotic membrane transplantation, or keratoplasty, would further clarify the relative efficacy of cryotherapy. Moreover, refinement of patient selection criteria and the development of tailored postoperative care protocols may enhance the safety and effectiveness of the procedure.

Overall, this study provides evidence that customized cryotherapy offers a practical, low-cost, and effective strategy for globe preservation in severe descemetocele with iris prolapse, particularly in regions where access to corneal transplantation or advanced surgical resources may be limited.

CONCLUSION

Customized cryotherapy is a highly effective technique for ocular salvage in cases of descemetocele and iris prolapse, significantly reducing the need for evisceration. Its integration into clinical practice may improve patient outcomes, particularly in resource-limited settings. Future research should focus on long-term outcomes and comparative effectiveness against alternative therapies.

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