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Relaxing descemetotomy: microscope-integrated OCT-guided technique for acute corneal hydrops

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Abstract

Introduction: 3 cases are used to illustrate the technique of Descemet membrane (DM) relaxing incisions followed by air descemetopexy for the management of patients with acute corneal hydrops.

Patients and Clinical Findings: In each case, anterior-segment optical coherence tomography (OCT) demonstrated taut DM detachments and hydrops was refractory to conservative medical management and intracameral air injection.

Diagnosis, Intervention, and Outcomes: To facilitate the reapproximation of DM and potentiate corneal deturgescence, intraoperative OCT-guided descemetotomy was performed with bent surgical scissors and a bent 30-gauge needle. Subsequent air descemetopexy was successful, and DM reattachment was maintained postoperatively. Corneal edema improved in all patients relatively rapidly postoperatively.

Conclusions: Relaxing descemetotomy with air descemetopexy may be useful in cases of acute corneal hydrops with taut DM detachments that are unresponsive to air tamponade alone.

Rupture or detachment of Descemet membrane (DM) is associated with corneal edema that can result in pain and decreased vision. Acute corneal hydrops is caused by spontaneous rupture and/or detachment of DM in the setting of corneal ectasia. The endothelium is rendered unable to maintain corneal deturgescence, and the affected area of the cornea remains edematous. Edema typically resolves over several months as endothelial cells migrate to cover the stroma overlying the DM detachment and regenerate a basement

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membrane, but prolonged edema may cause visually significant sequelae such as scarring and neovascularization.[1–4]

Surgical treatments that promote DM reapproximation include compression sutures, DM endothelial keratoplasty patch graft, full-thickness corneal incisions, and intracameral gas (eg, air or isoexpansile inert gas) tamponade.[5–13] Intracameral gas tamponade has the most reported evidence, and time to visual recovery may be reduced.[13] However, if the detached DM has a taut configuration, gas alone may not reapproximate the detachment.

In this case series, we describe 3 patients with hydrops who underwent a surgical technique that successfully restored corneal anatomy: intraoperative microscope-integrated optical coherence tomography (i-OCT)-guided DM relaxing incisions—that is, descemetotomy—with intracameral air tamponade.

Patient Consent

Each patient provided verbal informed consent for their deidentified information to be reported. All information was handled in a HIPAA-compliant manner.

SURGICAL TECHNIQUE

Preoperative miosis was achieved with topical 1% pilocarpine. Intraoperatively, i-OCT was used to identify the area of DM detachment. Air tamponade was unsuccessful, and the detached DM remained taut despite a large air bubble.

Intracameral trypan blue was used to visualize DM, followed by injection of a cohesive ophthalmic viscosurgical device (OVD). A bent 30-gauge needle was used to create an initial incision in the detached DM. 23-gauge MST bent surgical scissors (Microsurgical Technology) were then used to extend the incision radially in several directions. Approximately 4 relaxing incisions were created in a cruciate pattern. The remaining OVD was removed, and air was injected to a 60% chamber fill. i-OCT confirmed relaxation and gross reapproximation of DM.

Subconjunctival antibiotic and steroid were used at the end of the case, and topical antibiotics (for 1 week), steroids (for 1 month), and aqueous suppressants (for 1 week) were used postoperatively. Cycloplegia was used to prevent pupillary block in cases 2 and 3 while case 1 underwent preoperative YAG inferior iridotomy. Patients were instructed to lie supine for 4 postoperative days.

Case 1

A 46-year-old woman with a history of advanced keratoconus and Crouzon syndrome with secondary optic neuropathy presented with 1 day of blurred vision, photophobia, and pain in the left eye. A large area of central corneal edema was found on examination, and she was diagnosed with acute corneal hydrops (Figure 1, A and B). Corrected distance visual acuity (CDVA) was counting fingers (CF) at face. Her baseline CDVA is unknown but limited by her optic neuropathy, and her right eye has a baseline CDVA of 20/400. Her central corneal thickness (CCT) was 1387 mm. Initial treatment with topical hypertonic saline,

steroids, and antibiotics did not improve the edema after 6 weeks, and anterior-segment OCT (AS-OCT) revealed a persistent, taut DM detachment without breaks (Figure 1, C and D). A relaxing descemetotomy followed by air descemetopexy was successfully performed. Her DM remained attached throughout the postoperative period (Figure 1, E and F). Gradually, the edema cleared without substantial scarring and after 2 months her vision returned to a subjective baseline of 20/500 under a rigid gas-permeable lens. Her condition remained stable until she was lost to follow-up 5 months postoperatively.

Case 2

A 24-year-old man with a history of keratoconus presented to an outside institution for acute pain and blurriness in the right eye. His baseline CDVA was 20/40 because of corneal ectasia and preexisting corneal scarring. With a large area of inferior paracentral corneal edema, the patient was diagnosed with acute corneal hydrops and treated with topical hypertonic saline, a cycloplegic agent, and an aqueous suppressant (Figure 2, A and B). One week later, he presented for follow-up, with a CDVA of 20/100, CCT of 1275 mm, and a large inferior paracentral DM detachment without a break (Figure 2, C and D).

The patient's pain was refractory to initial medical management and underwent relaxing descemetotomy 2 weeks later. After 1 week, the DM remained attached, and his CDVA improved to his baseline of 20/40 (Figure 2, E and F). Throughout a 1-year postoperative period, his CDVA remained stable.

Case 3

A 39-year-old man with a history of stage IV keratoconus presented with several days of pain and blurriness in the left eye. Baseline tomography revealed a maximum anterior curvature of 96.4 D. At presentation, his CDVA was hand motion from a baseline of 20/40 in a scleral lens. Examination revealed a large area of inferior stromal edema, consistent with acute corneal hydrops, and treatment was initiated with topical hypertonic saline, antibiotics, steroids, and cycloplegia. Two weeks later, vision had marginally improved to counting fingers, but a large DM detachment was identified (Figure 3, A and B). A pneumatic descemetopexy was performed at the slitlamp microscope, but the DM remained detached (Figure 3, C and D).

Six weeks later, the patient underwent relaxing descemetotomy and pneumatic descemetopexy. The initial postoperative period was complicated by medication nonadherence and pupillary block, which resolved with restarting topical cycloplegia. DM appeared attached postoperatively (Figure 3, E and F). The patient's CDVA improved to 20/80 by the second postoperative week, but—despite anatomic reattachment—he developed significant corneal scarring. Ultimately, a penetrating keratoplasty was performed.

DISCUSSION

We have described 3 cases of acute corneal hydrops in keratoconus that were treated with i-OCT–guided relaxing descemetotomy with intracameral air tamponade. This technique likely promoted anatomic reattachment of DM to overlying stroma and potentiate corneal deturgescence.

Restoration of the DM and endothelial lining are critical to resolution of corneal edema. In cases of a taut DM detachment without a DM break, there is no gross exit pathway for the fluid within the detachment when a bubble is applied. Furthermore, even in cases with a DM break, the taut DM lacks the elasticity needed to reach the posterior surface of the ectatic cornea. Consequently, pneumatic descemetopexy may fail to reapproximate DM when the DM detachment is taut. The proposed mechanism of descemetotomy is to allow the taut region of DM detachment to reapproximate to the overlying corneal stroma, thus facilitating endothelial cell function and allowing for the migration of endothelial cells over the area devoid of DM. Relaxing descemetotomy incisions have been used successfully in cases of bullous DM detachments occurring after cataract extraction surgery.[14] To the author's knowledge, this is the first report on the use of this surgical technique to treat acute corneal hydrops.

In our cases, OCT imaging was vital to identifying candidates and performing the descemetotomy. AS-OCT allowed for the identification of a taut DM detachment through an edematous cornea. Furthermore, the use of i-OCT was vital to a successful procedure because of the poor view through an edematous cornea. i-OCT allows the surgeon to make precise incisions and make multiple intraoperative reassessments. In addition, i-OCT allows the surgeon to confirm a successful procedure at the end of the case.

While acute hydrops is usually caused by a break in DM, corneal hydrops may rarely occur without a DM break, as seen in 2 of our cases.[2,15] The pathogenesis in these cases is unclear. In our patients, there was a substantial difference in corneal stromal thickness between the area overlying the detachment and the surrounding tissue. Despite being grossly edematous with prominent stromal and epithelial edema on AS-OCT, the area overlying the DM detachment was thinner and more ectatic than the surrounding tissue. Our patients did not have baseline tomography available before the onset of acute corneal hydrops, but we hypothesize that the location of the DM detachment in these cases corresponded to an area of especially high gradient of posterior float.

Without a comparative study, we cannot conclude whether outcomes were influenced by descemetotomy. Optimal timing of this procedure is also beyond the scope of this report. However, the lack of improvement in vision with conservative therapy that was followed by a rapid postoperative improvement of vision is convincing. While we used a cruciate incision in this study to give the DM the freedom to reapproximate, we cannot determine the optimal descemetotomy technique. Finally, as our third case demonstrated, the risk of pupillary block is a potentially vision-threatening complication with any bubble tamponade (with or without descemetotomy) and must be assessed when considering this procedure.

In summary, we have presented a potentially useful surgical approach for acute corneal hydrops. AS-OCT can be used to identify those with a taut DM detachment, and i-OCT may be used to perform relaxing descemetotomy and air tamponade to achieve DM reattachment.

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WHAT WAS KNOWN

- When acute corneal hydrops occurs with a taut Descemet membrane detachment, conservative medical therapy and pneumatic descemetopexy may fail.

WHAT THIS PAPER ADDS

- The first report, to the authors' knowledge, of successful relaxing descemetotomy in acute corneal hydrops.
- An additional use case for intraoperative ocular coherence tomography, which proved invaluable in assuring Descemet membrane reattachment during each of the reported cases.

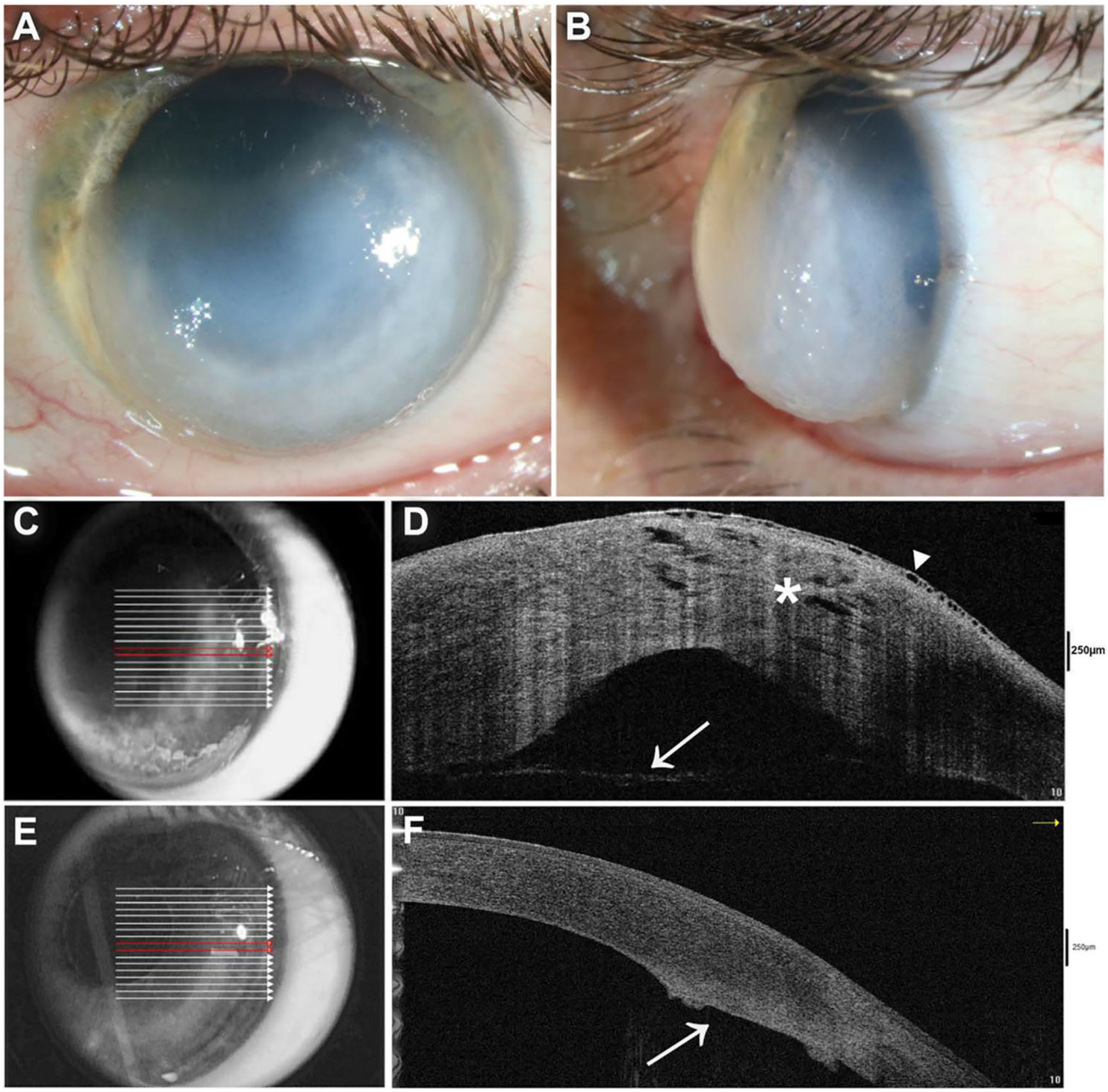

Figure 1.

Case 1. Initial presentation (*A*-*D*). CDVA of counting fingers at face. Slitlamp photographs from initial presentation with corneal hydrops demonstrating a large inferior paracentral area of severe ectasia, stromal edema, and epithelial bullae (*A*, *B*). En face (*C*) and B-scan (*D*) AS-OCT images demonstrating a localized, taut DM detachment (*arrow*), with overlying intrastromal fluid clefts (*star*) and epithelial cysts (*triangle*). Two months postoperatively (*E*, *F*). CDVA had improved to baseline of 20/500. Representative en face (*E*) and B-scan (*F*) AS-OCT images demonstrating resolution of corneal edema and fibrosed but reapproximated DM (*arrow*). DM = Descemet membrane

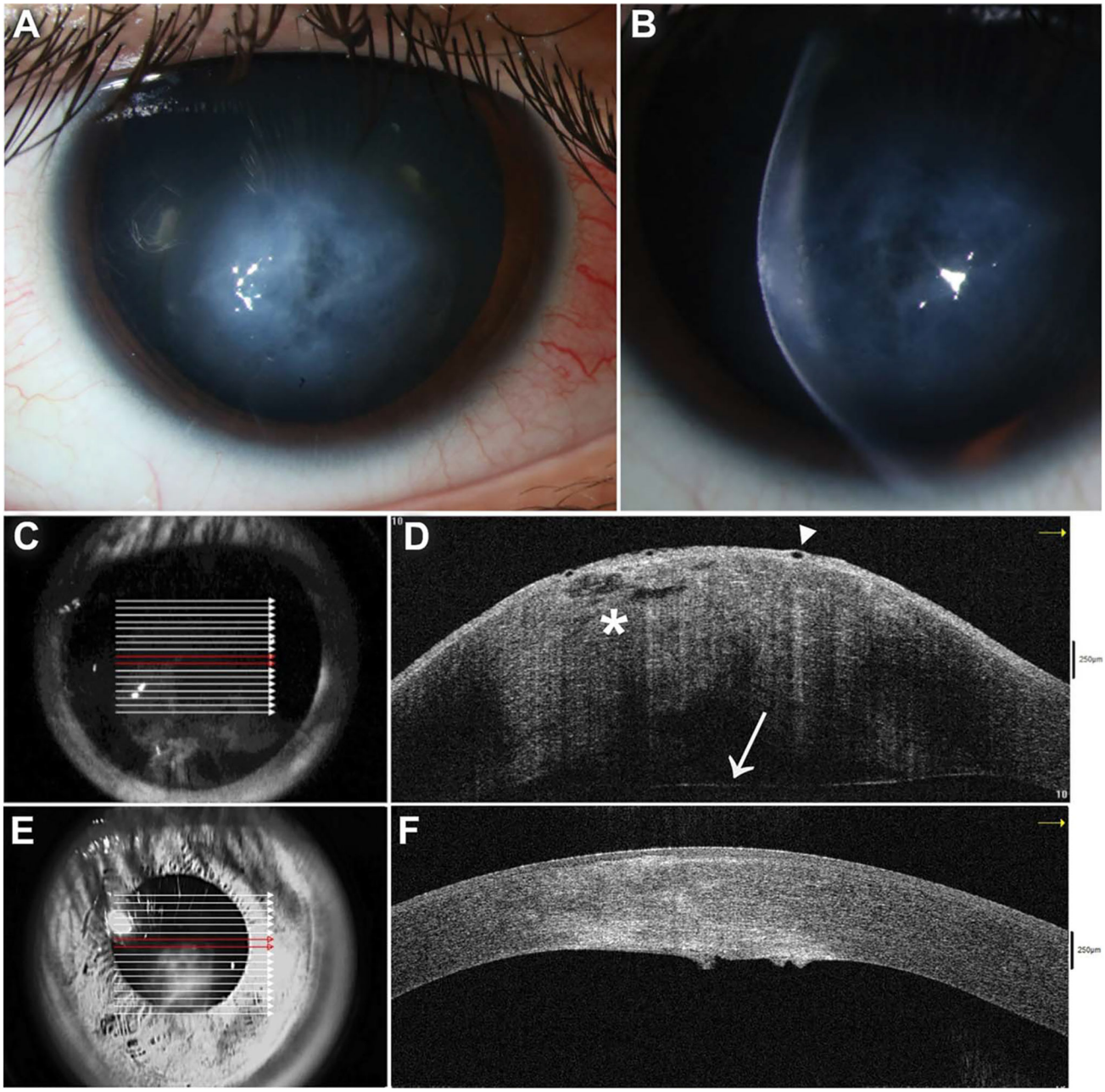

Figure 2.

Case 2. Initial presentation (*A*-*D*) with a CDVA of 20/100. Slitlamp photographs from initial presentation showing inferior paracentral area of severe stromal and epithelial edema (*A*, *B*). En face (*C*) and B-scan (*D*) AS-OCT images demonstrating a localized, taut DM detachment (*arrow*), with overlying intrastromal fluid clefts (*star*) and epithelial cysts (*triangle*). One week postoperatively (*E*, *F*). CDVA returned to a baseline of 20/40. Representative en face (*E*) and B-scan (*F*) AS-OCT images demonstrating resolution of corneal edema and reapproximation of DM. Stromal scarring and fibrosis of DM are also visualized. DM = Descemet membrane

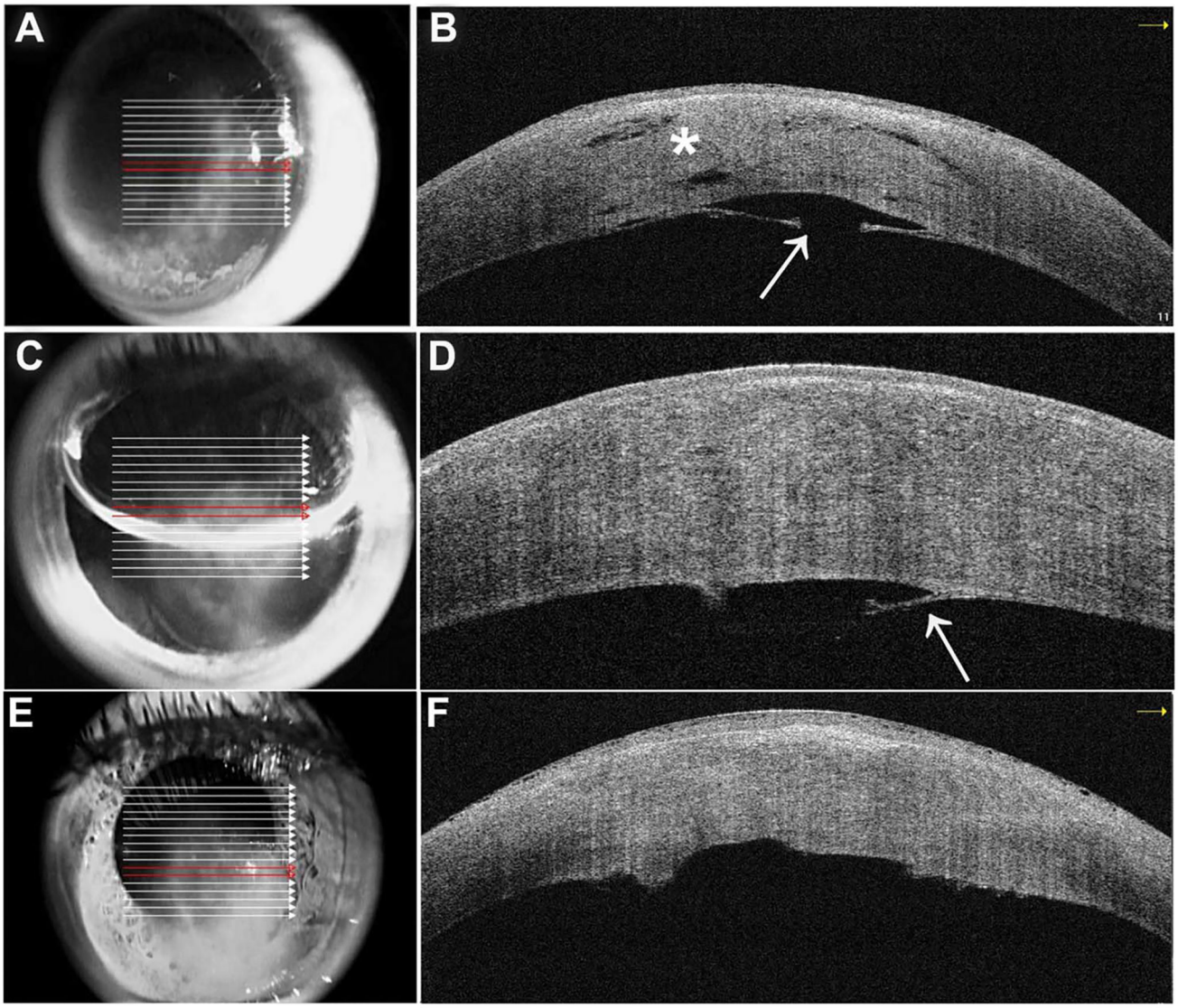

Figure 3.

Case 3. Initial presentation (*A*-*D*) with a CDVA of hand motion. En face (*A*) and B-scan (*B*) AS-OCT images demonstrating a localized, taut DM detachment with a large break (*arrow*), with overlying intrastromal fluid clefts (*star*). After administration of an intracameral air bubble (*C*), the DM detachment remained (*D*, *arrow*). One week postoperatively (*E*, *F*). CDVA improved to 20/80. Representative en face (*E*) and B-scan (*F*) AS-OCT images demonstrating improvement in corneal edema and reapproximation of DM but also fibrosis of the corneal stroma and DM. DM = Descemet membrane