

# Spontaneous Descemet Layer Dissection Without Pneumodissection in Femtosecond Laser-Assisted Mushroom-Type Deep Anterior Lamellar Keratoplasty

Elena Montolio-Marzo, MD, David Díaz-Valle, PhD, Barbara Burgos-Blasco, PhD, Haizea Etxabe, MD, and José Antonio Gegúndez-Fernández, PhD

**Purpose:** The aim of this study was to describe a case of spontaneous Descemet layer dissection without pneumodissection in femtosecond laser-assisted mushroom-type deep anterior lamellar keratoplasty.

**Methods:** This study is a case report.

**Results:** A 46-year-old woman diagnosed with reticular dystrophy underwent, in her left eye, mushroom configuration femtosecond laser-assisted DALK (F-DALK). After laser trephination and removal of the superficial stroma using manual dissection, a type 2 BB formation was observed intraoperatively in the AS-OCT without signs of an associated microperforation. A deeper stromal removal was accomplished by layer-by-layer manual dissection, while the BB persisted. After stromal dissection, the donor cornea was secured with 8 interrupted 10-0 nylon sutures. The next day AS-OCT showed a detachment of DM. After 1 week, a spontaneous resolution of the DM detachment was observed.

**Conclusions:** This unknown F-DALK intraoperative complication has been detected through intraoperative AS-OCT images which may improve our understanding of F-DALK surgery and possible complications associated with femtolaser-assisted procedures.

**Key Words:** F-DALK, femtosecond laser, Descemet layer dissection, mushroom-type

(*Cornea* 2023;42:1045–1048)

Deep anterior lamellar keratoplasty (DALK) is indicated for corneal diseases without endothelial involvement, owing to decreases in intraoperative and postoperative complications, minimization of endothelial rejection risk, and similar visual outcomes.<sup>1</sup> Several techniques have been proposed to successfully separate Descemet membrane (DM)

or pre-Descemet layer (Dua layer, DL) from the stroma, including manual dissection, viscoelastic dissection, or the big-bubble (BB) technique. The BB technique involves a forceful injection of air into the deep stroma to cleave DM or DL from the overlying stroma. When air is injected, 3 types of BB can be obtained: type 1 BB, where the air separates the DL from the deep stroma creating a large central bubble; type 2 BB, where DM is separated from the posterior surface of the DL by the air bubble; and a mixed type of bubble.<sup>2</sup>

The use of femtosecond lasers for corneal trephination instead of mechanical trephines allows precise and controlled corneal trephination with customized graft edges and lamellar planes. Different dissection patterns, such as mushroom configurations, can be performed, allowing excellent apposition of the tissue with less sutures that results in rapid wound healing and earlier suture removal.<sup>3,4</sup> In addition, intraoperative anterior segment optical coherence tomography (AS-OCT) enables corneal visualization during DALK, offering real-time information for surgical planning and optical instrument localization which helps in reducing surgical complications and obtaining a more precise stromal dissection.<sup>5</sup>

## CASE REPORT

We present the case of a 46-year-old woman diagnosed with reticular dystrophy who had undergone DALK surgery in her right eye. In her left eye, mushroom-configuration femtosecond laser-assisted DALK (F-DALK) (VICTUS, Bausch & Lomb) was performed (Fig. 1A). After removal of the donor cornea's Descemet membrane and endothelium, a penetrating cut with peripheral mushroom configuration was performed with an anterior diameter of 8.6 mm, a posterior diameter of 6.0 mm, and a midplane depth of 250  $\mu$ m. A lamellar cut was performed in the receptor cornea with peripheral mushroom configuration (Fig. 1A); the anterior diameter was 8.4 mm, posterior diameter was 6.1 mm, midplane depth was 225  $\mu$ m, and total depth was 444  $\mu$ m. After laser trephination and removal of the superficial stroma using manual dissection (Fig. 1B), a type 2 BB was observed intraoperatively in the AS-OCT (Zeiss OPTI LUMERA 700) without signs of an associated microperforation. A deeper stromal removal was accomplished by layer-by-layer manual dissection, while the BB persisted (Fig. 1C). After stromal dissection, the donor cornea was secured with 8 interrupted 10-0 nylon sutures. On the next day, BCVA was counting fingers at 1 ft and IOP was 18 mm Hg. Slit-lamp examination revealed an epithelial defect of 6x6mm in the donor cornea, flare 1+, moderate to severe stromal edema, no air bubble in anterior chamber, and a partial detachment of Descemet membrane (DMD). An AS-OCT

Received for publication November 10, 2022; revision received December 3, 2022; accepted December 5, 2022. Published online ahead of print January 27, 2023.

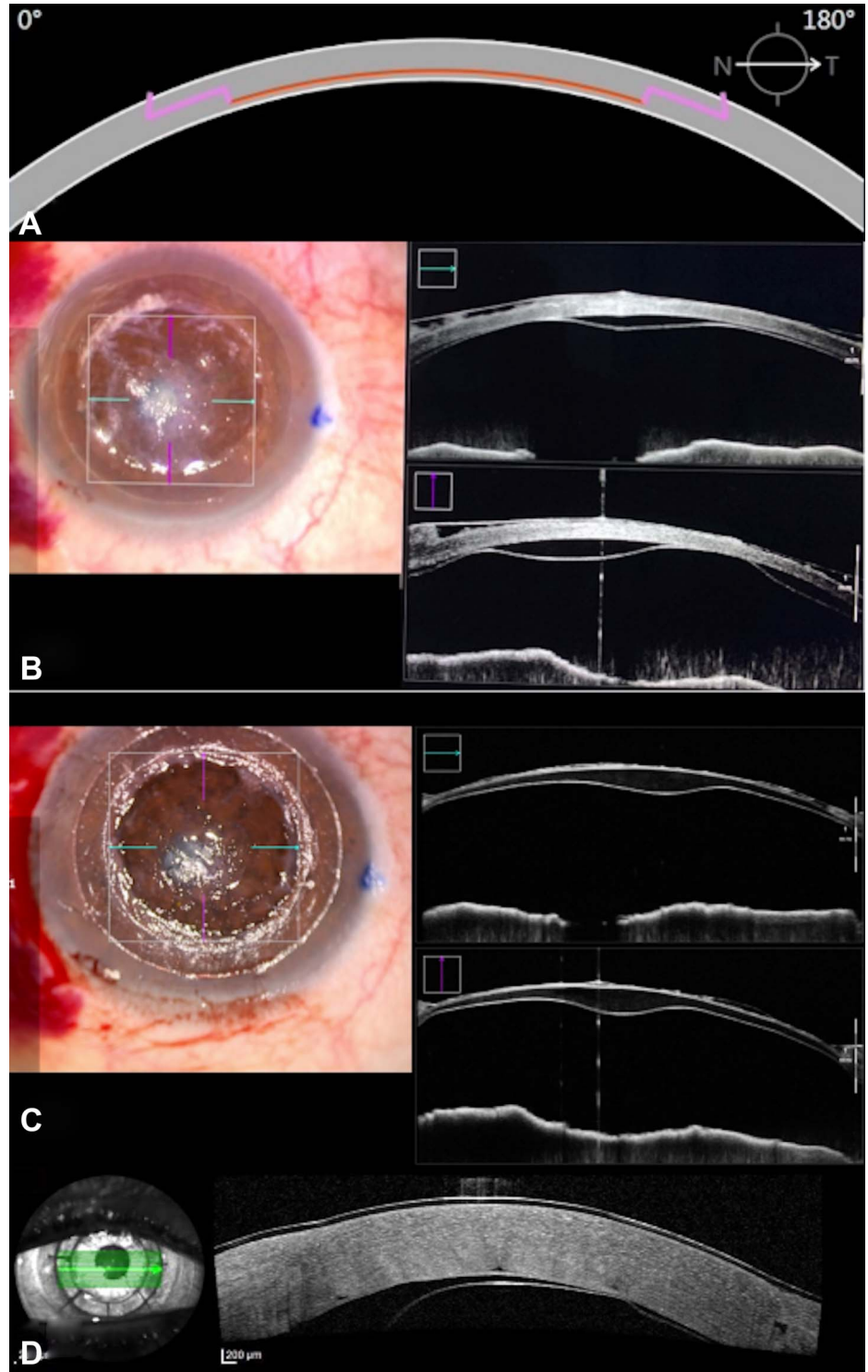
From the Ophthalmology Unit, Department of Ophthalmology and ORL, Faculty of Medicine, Hospital Clínico San-Carlos, Universidad Complutense de Madrid, Instituto de Investigación Sanitaria del Hospital Clínico San-Carlos (IdISSC), Madrid, Spain.

The authors have no funding or conflicts of interest to disclose.

E. Montolio-Marzo and D. Díaz-Valle contributed equally to the paper.

Correspondence: Elena Montolio Marzo, MD, Calle del Prof Martín Lagos, s/n, 28040 Madrid, Spain (e-mail: elenamontimar@gmail.com).

Copyright © 2023 Wolters Kluwer Health, Inc. All rights reserved.



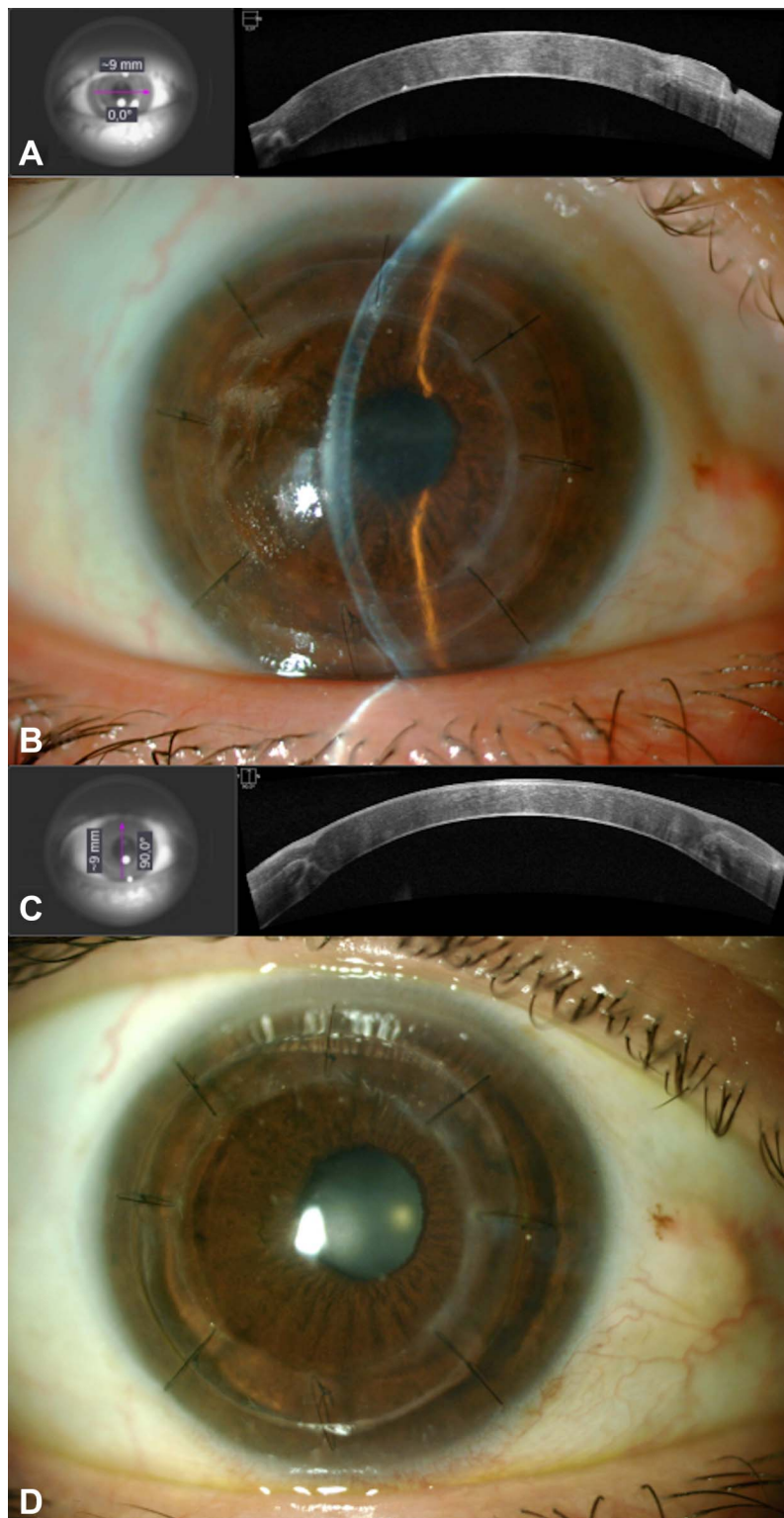
**FIGURE 1.** A, Scheme of mushroom-configuration F-DALK. (B) Intraoperative OCT scan after removal of superficial stroma with type 2 BB formation. C, Intraoperative OCT scan after deep stromal removal with type 2 BB presence. D, Spectralis OCT scan showing a detachment of Descemet membrane on next day's examination. (The full color version of this figure is available at [www.corneajrnl.com](http://www.corneajrnl.com).)

(Heidelberg Engineering Inc, Heidelberg, Germany) confirmed a DMD (Fig. 1D). After 1 week, BCVA had improved to 20/80, mild edema and progressive epithelization were observed in slit-lamp examination and spontaneous resolution of the DM detachment (Fig. 2A and B). After 2 months, BCVA had improved to 20/32 and slit-lamp examination showed a transparent graft with no inflammation, epithelial defect, or edema. AS-OCT showed a persistent

resolution of the DM detachment and a central pachymetry of 585 μm (Fig. 2C and D).

## DISCUSSION

To the best of our knowledge, this is the first report of a spontaneous intraoperative BB type 2 formation during



**FIGURE 2.** A, Spontaneous resolution of DM detachment in Cirrus OCT 1 week after surgery. B, Spontaneous resolution of DM detachment in slit-lamp examination. C, Persistent resolution of DM detachment 2 months after surgery in Cirrus OCT. (D) Persistent resolution of DM detachment 2 months after surgery in slit-lamp examination. (The full color version of this figure is available at [www.corneajrnl.com](http://www.corneajrnl.com).)

F-DALK surgery without perforation or previous pneumodissection. Bubble formation has been previously described in femtosecond LASIK (laser-assisted in situ keratomileusis) surgery as a complication during flap formation. In previous

reports describing bubble formation in the stroma and anterior chamber in LASIK procedures, Rush et al<sup>6</sup> described an incidence of anterior chamber gas bubble formation of 0.14% in a population of 2886 eyes. The authors theorized that the

dissecting bubbles created by femtolasers may migrate posteriorly through the cornea or pass in a retrograde fashion from the perilimbal area to the trabecular meshwork and into the anterior chamber.<sup>6,7</sup> A similar mechanism could explain its formation during F-DALK and result in a spontaneous DM dissection. DMD due to retrograde migration of air through the trabecular meshwork has also been described after pneumodissection in DALK.<sup>8</sup> In addition, mushroom patterns require higher energy values which could contribute to the increasing risk of bubble formation. A great number of intrastromal bubbles were present in our case after femtolasers dissection which may support this theory.

DMD has been described in numerous surgeries; the most common ones being microincision cataract surgery and extracapsular cataract extraction. This complication has been related to endothelial dysfunction, which was described as the only significant preoperative risk factor.<sup>9</sup> In our patient, the corneal dystrophy only affected the stroma with a healthy endothelium which does not support its spontaneous formation. There is a controversy in DMD management because of the lack of large prospective studies. Conservative treatment case reports leading to spontaneous resolution of DMD are plentiful, and many cases of pneumodescemetopathy with air or gas have been described. Passani et al<sup>8</sup> described a late spontaneous resolution of DMD after DALK surgery. In this case, the DMD started 1 week after DALK surgery and pneumodescemetopathy was initially performed with no results. After that, a conservative management was decided, obtaining a spontaneous resolution of the DMD after 3 months. They theorized of a false trabecular pathway after the surgery which led to air accumulation and DMD. In our case, the DMD was found in the first visit as it appeared intraoperatively. After 1 week, our DMD detachment was solved which may support a mechanism of double chamber formation because of posterior migration of femtolasers-induced

air bubbles, which dissected the posterior stroma intraoperatively and manual layer-by-layer dissection maneuvers could have contributed to DMD. A fast resolution was observed when the bubbles were reabsorbed.

In summary, a spontaneous DM dissection without pneumodissection in mushroom-type F-DALK is reported. This unknown F-DALK intraoperative complication has been detected through intraoperative AS-OCT images which may improve our understanding of F-DALK surgery and possible complications associated with femtolasers-assisted procedures.

## REFERENCES

1. Reinhart WJ, Musch DC, Jacobs DS, et al. Deep anterior lamellar keratoplasty as an alternative to penetrating keratoplasty: a report by the American Academy of Ophthalmology. *Ophthalmology*. 2011;118:209–218.
2. Dua HS, Katamish T, Said DG, et al. Differentiating type 1 from type 2 big bubbles in deep anterior lamellar keratoplasty. *Clin Ophthalmol*. 2015;9:1155–1157.
3. Chan CC, Ritenour RJ, Kumar NL, et al. Femtosecond laser-assisted mushroom configuration deep anterior lamellar keratoplasty. *Cornea*. 2010;29:290–295.
4. Slade SG. Applications for the femtosecond laser in corneal surgery. *Curr Opin Ophthalmol*. 2007;18:338–341.
5. Carlà MM, Boselli F, Giannuzzi F, et al. An overview of intraoperative OCT-assisted lamellar corneal transplants: a game changer? *Diagnostics*. 2022;12:727.
6. Rush SW, Cofoid P, Rush RB. Incidence and outcomes of anterior chamber gas bubble during femtosecond flap creation for laser-assisted in situ keratomileusis. *J Ophthalmol*. 2015;2015:542127.
7. Lifshitz T, Levy J, Klemperer I, et al. Anterior chamber gas bubbles after corneal flap creation with a femtosecond laser. *J Cataract Refract Surg*. 2005;31:2227–2229.
8. Passani A, Sframeli AT, Loiudice P, et al. Late spontaneous resolution of a double anterior chamber post deep anterior lamellar keratoplasty. *Saudi J Ophthalmol*. 2017;31:58–60.
9. Chow VWS, Agarwal T, Vajpayee RB, et al. Update on diagnosis and management of Descemet's membrane detachment. *Curr Opin Ophthalmol*. 2013;24:356–361.