

Case Report

Interface Fluid Syndrome (IFS) following Toxic Anterior Segment Syndrome (TASS): not related to high intraocular pressure but to endothelial failure



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Abstract

We describe the case of a 52-year-old female with past history of LASIK, 21 years earlier, without Fuchs' endothelial dystrophy, who underwent phacoemulsification and intraocular lens (IOL) implantation. During the early postoperative period severe corneal edema, anterior chamber cellularity and iris inflammation presented, accompanied by a clear space along the LASIK interface. Those findings were interpreted as part of a Toxic Anterior Segment Syndrome (TASS) and secondary interface fluid syndrome (IFS). When interface fluid was present, intraocular pressure (IOP) measured in the center of the cornea yielded very low values. In addition, applanation tonometry performed in the corneal periphery, as well as Schiötz tonometry and digital tonometry also indicated that the IOP was not high. Fluid in the interface persisted until a DMEK was carried out 11 months after the phacoemulsification surgery. Five days postoperatively the IFS resolved, confirmed by OCT imaging. The origin of IFS in this case was corneal edema secondary to endothelial cell dysfunction and it was not related to high IOP. This is the first reported case of IFS following TASS, the third case published of DMEK procedure used to solve endothelial failure-related IFS, and the case with the longest time of presentation after LASIK.

Keywords: TASS, LASIK, Pressure-induced keratopathy (PISK), Interface fluid syndrome (IFS), Descemet Membrane Endothelial Keratoplasty (DMEK)

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Introduction

Because of the increasing number of patients with prior LASIK surgery who are undergoing phacoemulsification in the present or will require it in the near future, some new complications involving the coexistence of both procedures will arise more frequently. Interface Fluid Syndrome (IFS) is an uncommon LASIK complication originally described in

1999,¹ as the presence of liquid in the LASIK interface secondary to increase in intraocular pressure (IOP) in steroid responders after topically receiving those substances in the early postoperative period. Dawson et al performed an elegant experimental study on the pathogenesis of the condition, and found that it could be consequence of any disorder resulting in corneal edema, including among other causes, both IOP increase and endothelial failure.² They

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confirmed that the condition had a spectrum of manifestations classified in 3 stages which include interface swelling, stromal haze [condition also known as Pressure Induced Interlamellar Stromal Keratitis (PISK)] and finally interface fluid

deposition.^{2,3} Based on the experimental study of Dawson et al, and since some cases of both IFS and PISK had been reported without the presence of high IOP in 2012 Galvis et al. proposed the name Post LASIK edema-induced

Table 1. Published ifs cases related to endothelial failure or other cause of corneal edema, without high IOP.

Author/Country/Year	Case characteristics	Latency between LASIK and presentation	Corneal transplant procedure performed	Postoperative course/final result
Vroman et al./USA/2002 ⁶	A 58-year-old woman with Fuchs' dystrophy underwent LASIK in the left eye developed corneal edema and IFS apparently without IOP increase	7 months	Penetrating keratoplasty (PK)	10 months after (PK). Refraction: +1,25–2,75 × 165. CDVA: 20/40
Dawson et al./USA/2003 ⁹ and Hardten/USA/2003 ^{10,11}	Case 1: A 71-year-old man with a history of penetrating keratoplasty underwent LASIK and astigmatic keratotomy. Previous to LASIK the eye had "extremely low endothelial cell density". IFS occurred in the eye. IOP in the periphery (applanation tonometer) was 15 mmHg Case 2: Patient with a history of penetrating keratoplasty underwent LASIK. Endothelial cells density 678 cells/mm ² . No additional information. In both patients the peripheral intraocular pressure readings were normal ^a	Case 1: 3 months Case 2: 1 month	Case 1: Corneal re-graft: penetrating keratoplasty. Case 2: Flap amputation. ^a	N/A
Wirbelauer & Pham/Germany/2005 ¹²	A 41-year-old man with a history of LASIK underwent encircling band, pars plana vitrectomy, and silicone oil filling and developed corneal edema and IFS, without IOP increase	6 months	None	N/A
Bushley et al./USA/2005 ¹³	A 41-year-old man with a history of LASIK suffered a penetrating injury and developed IFS	10 months	None (only corneal suture)	One year after corneal suture. Refraction: +1,00–0,50 × 8. DCVA: 20/20
Hoffman et al./USA/2008 ¹⁴	A 65-year-old woman with a history of penetrating keratoplasty and LASIK presented IFS. Endothelial cells' density was too low to count. IOP in the periphery (Tono-Pen XL) was 21 mmHg	2 years	Descemet-stripping endothelial keratoplasty (DSEK)	In the early postoperative period 2 pockets of fluid were evident: in the LASIK interface and anterior to endothelial graft. Later the graft fully adhered but the pocket of fluid in the interface persisted. Eventually it resolved after lifting and repositioning the flap. Eight months after DSEK CDVA with contact lens was 20/20
Bardet et al./France/2010 ¹⁵	A 37-year-old man underwent phakic IOL implantation and corneal flap creation and developed diffuse corneal edema and IFS due to endothelial dysfunction	11 months	Penetrating keratoplasty	N/A
Luceri et al./The Netherlands/2016 ¹⁶	A 58-year-old man with a history of LASIK and Fuchs' dystrophy presented with corneal edema, haze in LASIK interface and endothelial cells' density too low to count. After undergoing phacoemulsification corneal edema worsened and developed IFS. IOP was reported as normal (no details)	10 years	Descemet Membrane Endothelial Keratoplasty (DMEK)	One month after DMEK, the interface cleft completely disappeared. 6 months after DMEK refraction was: +0,50–0,75 × 95. CDVA: 20/25
Shajari et al./Germany/2017 ¹⁷	A 74-year-old woman with a history of LASIK, Fuchs' dystrophy and phacoemulsification presented with corneal edema and IFS. It was not possible to measure endothelial cells density	15 years	Descemet Membrane Endothelial Keratoplasty (DMEK)	Partial graft detachment at the inferotemporal quadrant. Gas reinjection in the anterior chamber (re-bubbling) was required. 6 months after DMEK refraction was: –1,00–2,50 × 36. CDVA: 20/25

N/A: Not available.

^a Hardten DR. Personal communication. 29 May 2017.

keratopathy (PLEK) to the condition, in order to exclude the words “pressure induced”, as evidently this is not the etiology in all cases.^{4–17} Recently Luceri et al. and Shajari et al reported the first two cases of Descemet Membrane Endothelial Keratoplasty (DMEK) performed to solve and IFS secondary to corneal edema in two patients with Fuchs endothelial dystrophy who developed corneal edema after phacoemulsification without an increase in IOP.^{16,17}

We present a new case in which, similarly, the condition was not associated with ocular hypertension, but with endothelial dysfunction. However, unlike previous reports, our patient did not have Fuchs’ endothelial dystrophy. She presented endothelial failure secondary to Toxic Anterior Segment Syndrome (TASS). Corneal edema and IFS resolved after a DMEK. According to our knowledge this is the third case of DMEK performed to solve an IFS, and the case with the longest period of time reported between LASIK and the presentation of the IFS (see Table 1).

Case report

A 52-year-old female with past history of LASIK, 21 years earlier, underwent phacoemulsification and intraocular lens (IOL) implantation in her left eye. Monovision was planned, and the IOL’s power was calculated for a target refraction of -2.50 D. Preoperatively there were not corneal guttae, and endothelial cells density was 1956 cells/mm². The procedure was carried out uneventfully.

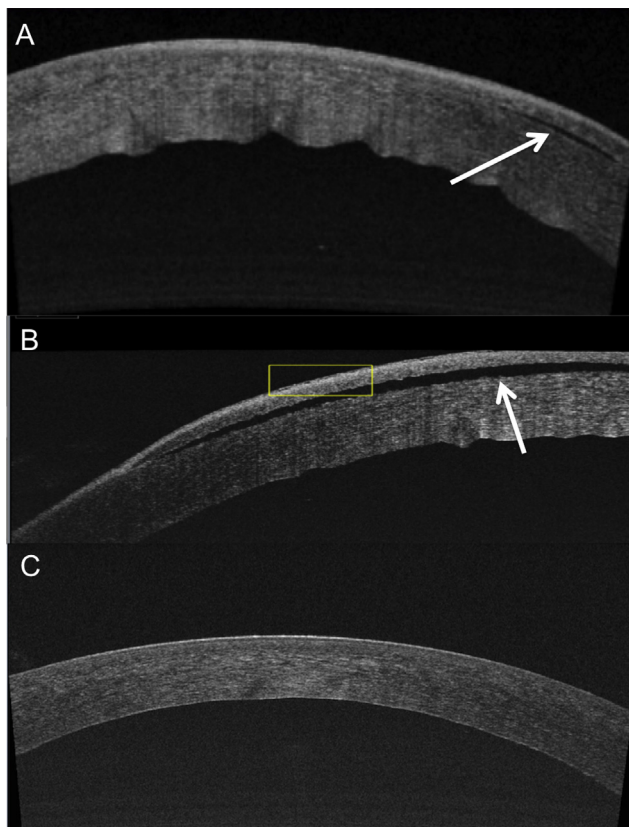


Fig. 1. Anterior Segment OCT confirmed the presence of fluid in the LASIK interface (arrows). (A) Images taken 5 days and (B) 3 weeks after phacoemulsification. (C) Six weeks after the surgery, the fluid transiently disappeared from the interface.

The first postoperative day severe corneal edema with folds in the Descemet’s membrane, severe inflammatory reaction of anterior chamber and a dilated and irregular pupil, were seen. IOP (Goldmann applanation tonometry) was 18 mmHg. Five days later a small amount of fluid in the LASIK interface was evident. This last finding was confirmed by anterior segment OCT (Fig. 1A and B).

This clinical presentation was interpreted as part of a TASS syndrome and secondary IFS. The fluid-filled space in the

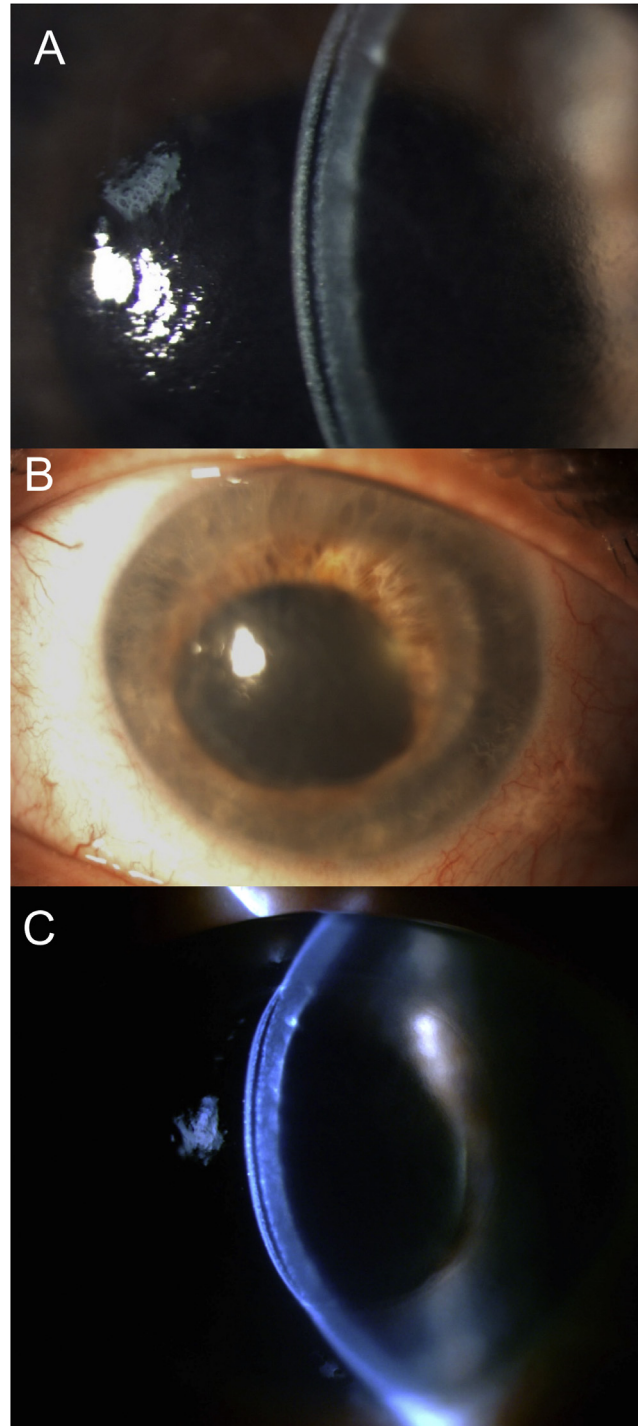


Fig. 2. (A) Presence of IFS at slit lamp examination 6 months after the phacoemulsification. (B) Corneal edema, areas of iris atrophy and a fixed pupil. (C) 5 months later, just before DMEK, the pocket of fluid was still present.

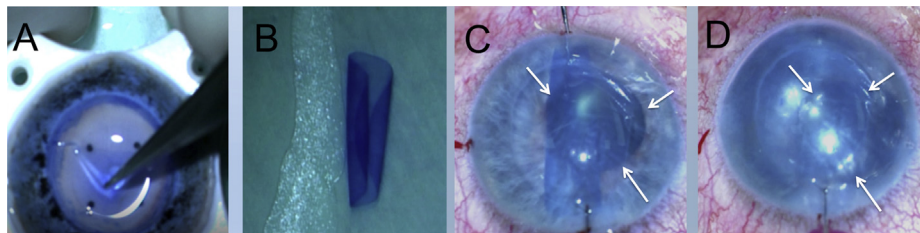


Fig. 3. (A) and (B) Donor tissue preparation for DMEK. (C) and (D) DMEK procedure intraoperative images. The dyscoric pupil is visible, whose position changed slightly after the injection of the air bubble in the anterior chamber to unfold the donor tissue (arrows).

interface progressively enlarged during the following three weeks and IOP readings diminished in the central cornea (2–6 mmHg).

Five weeks after phacoemulsification, as the corneal edema did not improve, the patient was placed on the corneal transplant waiting list (for DMEK technique). However, due to the shortage of donor tissue in our country, we could perform the surgery only until 11 months after phacoemulsification.

Six months after phacoemulsification the fluid collection persisted, and central IOP (applanation tonometry) was zero (Fig. 2A and B). However, measurements were also taken in the peripheral cornea with the Goldmann tonometer with readings within the normal range (9–18 mmHg). Digital tonometry always was considered normal and Schiøtz tonometry was performed once with readings between 10.9 and 12.2 mmHg.

The patient received both topical and subconjunctival steroids while waiting for the DMEK. She was also prescribed timolol and brimonidine, not because of ocular hypertension, but in the hope of helping to reduce corneal edema by lowering intraocular pressure to a certain extent. The condition showed partial improvement, and at some moment (nine weeks after the phacoemulsification) the fluid disappeared from the interface (Fig. 1C). At that time IOP was 14 mmHg. However, corneal edema was never fully resolved, the interface always showed some haze and the fluid reappeared 5 weeks later. Just before the DMEK the fluid-filled space between the flap and stroma was clearly visible with slit-lamp biomicroscopy (Fig. 2C).

The pupil remained throughout the time in fixed medium mydriasis and thinning and atrophy of the iris stroma was progressively evident (Fig. 2B).

DMEK procedure was performed uneventfully. A bubble of air was left in the anterior chamber (Fig. 3).

The first postoperative day some fluid was visible in the LASIK interface, but by the fifth postoperative it had

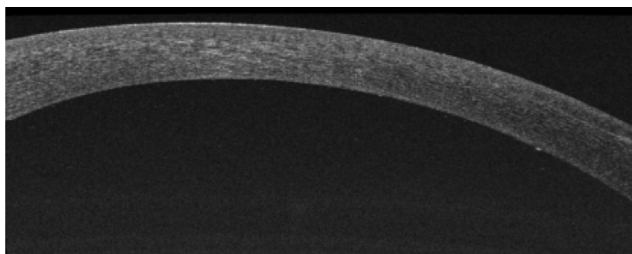


Fig. 4. Anterior segment OCT five days after DMEK confirmed the absence of fluid in the LASIK interface.

disappeared and only a minimal haze in the interface remained. A new OCT confirmed the absence of interface fluid (Fig. 4). The corneal transparency improved and so did the CDVA (Fig. 5). 2 months later endothelial cells density was 1491 cells/mm² and the CDVA improved to 20/40 with –1, 50–1, 50 × 45. The fixed dilated pupil never improved.

Discussion

In the majority of the reports IFS, i.e. fluid accumulation between the LASIK flap and the stromal bed, is related to high IOP usually due to corticosteroid use in a steroid-responder patient but also because of other causes of acute

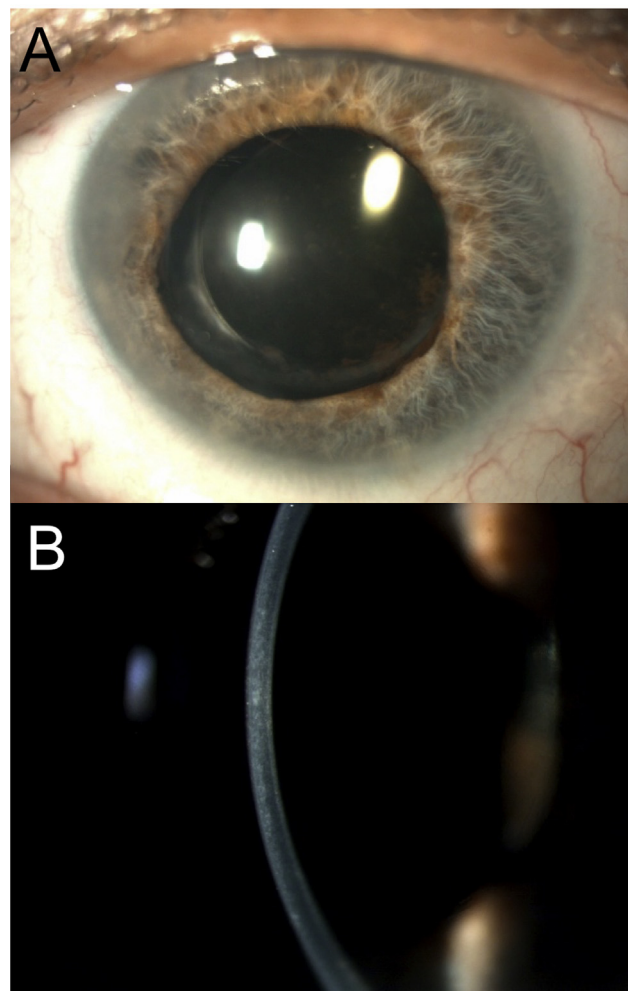


Fig. 5. (A) Clinical image 1 month after DMEK with improvement of the corneal transparency. (B) Absence of fluid in the LASIK interface.

ocular hypertension.^{3,7,8,18–26} In some cases it has led to advanced and even terminal glaucoma with severe visual loss because the condition was mistakenly confused with diffuse lamellar keratitis (DLK), and IOP was wrongly considered low due to the erroneous readings of the applanation tonometry performed in the central cornea.^{22–25} The cases of IFS might be more frequent than previously thought since around five percent of the general population is high steroid responders presenting significant increases in IOP (more than 15 mm Hg above baseline), and these medications are used after LASIK and intraocular surgeries. Elevated IOP should be thus present in around this percentage of the patients undergoing LASIK or those with a history of LASIK undergoing another intraocular procedure.²⁷ Recently Gab-Alla in Egypt in LASIK patients who received a postoperative regimen of topical dexamethasone for 1 month found that 2,9% presented IFS.²⁸

However, on the other hand, endothelial failure, without ocular hypertension, has been the triggering factor in at least nine published cases of IFS.^{6,9–17} In some other reports a combination of both mechanisms is the most probable cause.^{18,19,29,30}

The case described herein, according to our knowledge, is the first presenting IFS associated to secondary endothelial dysfunction (as a consequence of TASS) in a patient without Fuchs' endothelial dystrophy and with normal IOP. As mentioned above we compared IOP readings using Goldmann tonometer in the central and peripheral cornea, and performed in addition Schiøtz tonometry, to make sure that IOP was not high. Therefore the cause of the fluid interface fluid accumulation most probably was the endothelial failure. Such statement was then backed up by the resolution of IFS after DMEK. Restoring the endothelial function seems to be the appropriate treatment in those situations, and recently DMEK have been reported as a good option by Luceri et al and Shajari et al.^{16,17}

In 2008 Hoffman et al performed Descemet-Stripping Endothelial Keratoplasty (DSEK) in a patient with IFS, and following the surgery fluid accumulated in both the LASIK interface and anterior to the donor corneal tissue. Later the graft fully adhered but the pocket of fluid in the interface persisted. Eventually it resolved after lifting and repositioning the flap.¹⁴ It is still not clear if DMEK might be a better option than DSEK or Descemet-Stripping Automated Endothelial Keratoplasty (DSAEK), in these cases.

As Dawson et al. clearly showed in their experiment on human donor corneas that had previous LASIK, the IFS might exhibit three stages.² However, since the pocket of fluid is not visible at slit lamp examination in stage 1 and rarely in stage 2, Galvis et al. suggested that interface fluid syndrome might not be the ideal name to describe them. Furthermore, stages 1 and 2, according to the staging system proposed by Dawson et al, have been called PISK by other researchers,^{2,3} however, as mentioned, the disorder might not be related to IOP, therefore this name does not seem appropriate to describe it. Consequently, Galvis et al. in 2012 proposed to call the condition "post-LASIK edema induced keratopathy (PLEK)", which applies to the whole spectrum of the disorder (both PISK and IFS), and the staging system proposed by Dawson et al could be used to describe it in more detail.^{4,5}

When a corneal transplant is necessary, DMEK as in our case and two other published cases, is a feasible alternative.

Surgeons should be aware that it is important to avoid IOP spikes to prevent triggering IFS in the early postoperative period.¹⁸

Conflict of interest

All authors declare that they have no conflict of interest.

Informed consent

Informed consent was obtained from the patient presented in this article.

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