Surgical Technique

Application of two-part glue technique in epithelial ingrowth after laser *in situ* keratomileusis flap dislocation

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A 59-year-old woman who underwent uneventful laser *in situ* keratomileusis surgery 16 years ago presented with traumatic flap dislocation complicated by an epithelial ingrowth in the right eye. The epithelial ingrowth was managed with re-lifting the flap, mechanical debridement, soaking with 70.0% alcohol, and irrigation. The flap was repositioned and secured with a two-part glue technique. Serial anterior segment-optical coherence tomography demonstrated a well-attached flap with no gap or haze in the flap-stromal interface. Three weeks postoperatively, the patient returned to emmetropia and the uncorrected distance visual acuity improved to 20/20. Twelve months postoperatively, the patient's visual acuity remained 20/20, and there was no evidence of recurrent epithelial ingrowth.

Key words: Epithelial ingrowth, fibrin glue, LASIK flap dislocation

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Traumatic flap dislocation is a rare complication after laser *in situ* keratomileusis (LASIK) that occurs in about 1–2% of cases.[1] Flap dislocation may be complicated by an epithelial ingrowth despite immediate successful repositioning. Treatment of epithelial ingrowths involves lifting the flap followed by mechanical debridement of the ingrowing cells, adjunctive chemical debridement with ethanol or mitomycin-C, phototherapeutic keratectomy, neodymium-doped yttrium aluminum garnet laser, and flap suturing as previously described.[2] However, despite various techniques, the recurrence rate after ingrowth removal has been reported to be as high as 44%.[2]

Here, we describe a case who presented with epithelial ingrowth after traumatic LASIK flap dislocation. Modified surgical technique, consisting of re-lifting the flap, mechanical debridement with 70% alcohol soaking, and two-part glue-assisted flap adhesion, was performed with good refractive and visual outcomes. Serial anterior segment-optical coherence tomography (AS-OCT) images visualized the associated corneal structural changes postoperatively. No recurrence of epithelial ingrowth was found at the 12-month follow-up.

Surgical Technique

A 59-year-old woman with a history of uncomplicated simultaneous bilateral LASIK 16 years ago presented with painful blurred vision in the right eye after minor blunt trauma. She visited an outside facility where post-LASIK flap dislocation and epithelial ingrowth was diagnosed and managed with repositioning and application of a bandage soft contact lens. She experienced progressive painful blurred vision in the following weeks and was referred to our clinic 1 month after the trauma for evaluation of the epithelial ingrowth. Upon arrival at our clinic, her corrected distance visual acuity (CDVA) was 20/70 in the right eye with an autorefraction of +1.75 –3.5 × 10. Slit-lamp examination revealed superficial punctate keratitis and epithelial ingrowth involving the visual axis [Fig. 1a]. AS-OCT demonstrated a band of epithelial nests within the interface [Fig. 1b], and corneal pachymetry showed irregular thickening in the affected area.

The patient underwent surgical intervention under topical anesthesia. The flap was re-lifted, and the areas of epithelial ingrowth were carefully identified and thoroughly removed by mechanical debridement with a blunt blade. Soaking with 70% alcohol for 15 seconds followed by copious irrigation with balanced salt solution was performed. The flap was then repositioned and adhered to the stromal bed using fibrin glue (Tisseel, Baxter International) with a two-part technique as follows: (i) the thrombin component was applied to the stromal bed [Fig. 2a]; (ii) the fibrinogen concentrate was applied to the underside of the flap [Fig. 2b]; and (iii) the flap was repositioned

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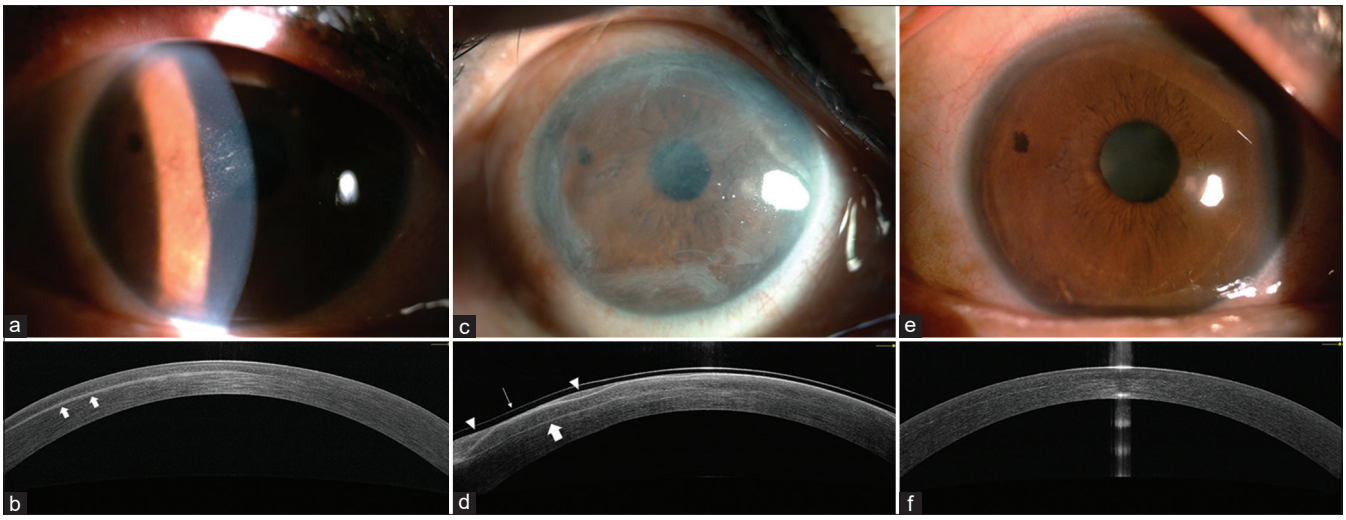

Figure 1: (a) Clusters of epithelial ingrowth in the central cornea preoperatively. (b) Corresponding anterior segment-optical coherence tomography (AC-OCT) revealed a band of epithelial invasion into flap-stroma interface (arrows). (c) Residual fibrin glue on corneal surface at 1 week postoperatively. (d) AS-OCT demonstrated residual fibrin glue on corneal surface (arrowheads) and within interface (arrow). Bandage soft contact lens (thin arrow) could also be visualized. (e) The cornea was clear and there was no recurrence of epithelial ingrowth at 1 year postoperatively. (f) AS-OCT demonstrated well-attached flap with no interface haze or gap

meticulously with gentle stroking motion by spatula [Fig. 2c]. Gentle pressure was applied to smooth the surface and expel excessive glue from the edge [Fig. 2d]. A bandage soft contact lens was applied at the end of the surgery.

The patient was treated with topical prednisolone acetate 1% and moxifloxacin 0.5% 4 times a day postoperatively. At 1 week postoperatively, the CDVA improved to 20/30 with an autorefraction of + 0.5 –0.25 × 135, although slit-lamp examination and AS-OCT demonstrated some residual fibrin glue on the corneal surface [Fig. 1c] and within the interface [Fig. 1d]. At 3 weeks postoperatively, the uncorrected distance visual acuity improved to 20/20 with an autorefraction of + 0.0 D. Serial AS-OCT demonstrated that the fibrin glue dissolved gradually. At the 1-year follow-up visit, she maintained a visual acuity of 20/20 with no recurrence of epithelial ingrowth [Fig. 1e] and the flap remained well-attached with no interface haze or gap [Fig. 1f].

Discussion

Traumatic flap dislocation is a well-known complication after LASIK. Late flap dislocation, defined as one occurring more than 1 week after the initial procedure, is rare.[1] Previous studies have shown that the flap may be vulnerable to traumatic displacement as late as 14 years after LASIK surgery.[3] To our knowledge, our case represents the longest documented interval between an initial surgery and traumatic flap dislocation.

Epithelial ingrowth may be associated with traumatic post-LASIK flap dislocation and can be clinically significant, causing foreign body sensation, pain, glare and halos, decreased vision, flap irregularity, astigmatism, and even flap necrosis.[4] It is likely attributed to poor adherence of the flap edge, allowing epithelial cells to migrate into the interface.[5] Therefore, restoring a tight attachment between the stromal bed and the overlying flap is crucial in managing epithelial ingrowth, to prevent further recurrence. Conventionally, flap suturing has been advocated as a reliable method but has several drawbacks, such as the need for further removal, suture-induced astigmatism, and possible suture-related complications (suture erosions, sterile infiltrates, and infectious keratitis). Fibrin glue has been applied to various ophthalmic surgical procedures, including pterygium excision, extraocular muscle surgery, and corneal perforation repair, and has been shown to have tensile strength comparable to that of sutures, making it a promising material for flap adhesion. Additionally, an *in vitro* study has demonstrated that fibrin glue hinders epithelial cell migration by acting as a physical barrier.[6]

Case reports have shown that epithelial ingrowth after LASIK can be successfully managed with mechanical debridement followed by flap apposition using fibrin glue.[7] In most patients, the fibrin glue was applied to seal the flap edges only.[8] Craig *et al*. described 4 cases in which the pre-mixed fibrin glue was applied across the entire interface.[9] In our study, we carried out a modified technique in which the 2 components of the fibrin glue were not mixed before application as is commonly performed using the conventional method. Instead, the components were kept in separate syringes and applied to the entire stromal bed and underside of the flap, respectively. The flap was then repositioned, and the coagulation cascade ensued. We believe that this modified technique provides ample time for the surgeon to manipulate the flap to a proper position compared with the pre-mixed technique, since clot formation takes place within 30 seconds after the 2 components are mixed.[10] Furthermore, we believe that better flap adherence can be achieved compared to the edge-sealing technique.

There may be concerns about whether the fibrin glue within the flap bed interface will dissolve spontaneously or not, and whether it will cause visually significant stromal haze or astigmatism. We observed that the fibrin glue became more transparent and did in fact dissolve gradually. Serial AS-OCT images precisely visualized the involutional corneal structural change as time went by. These images provide further concrete

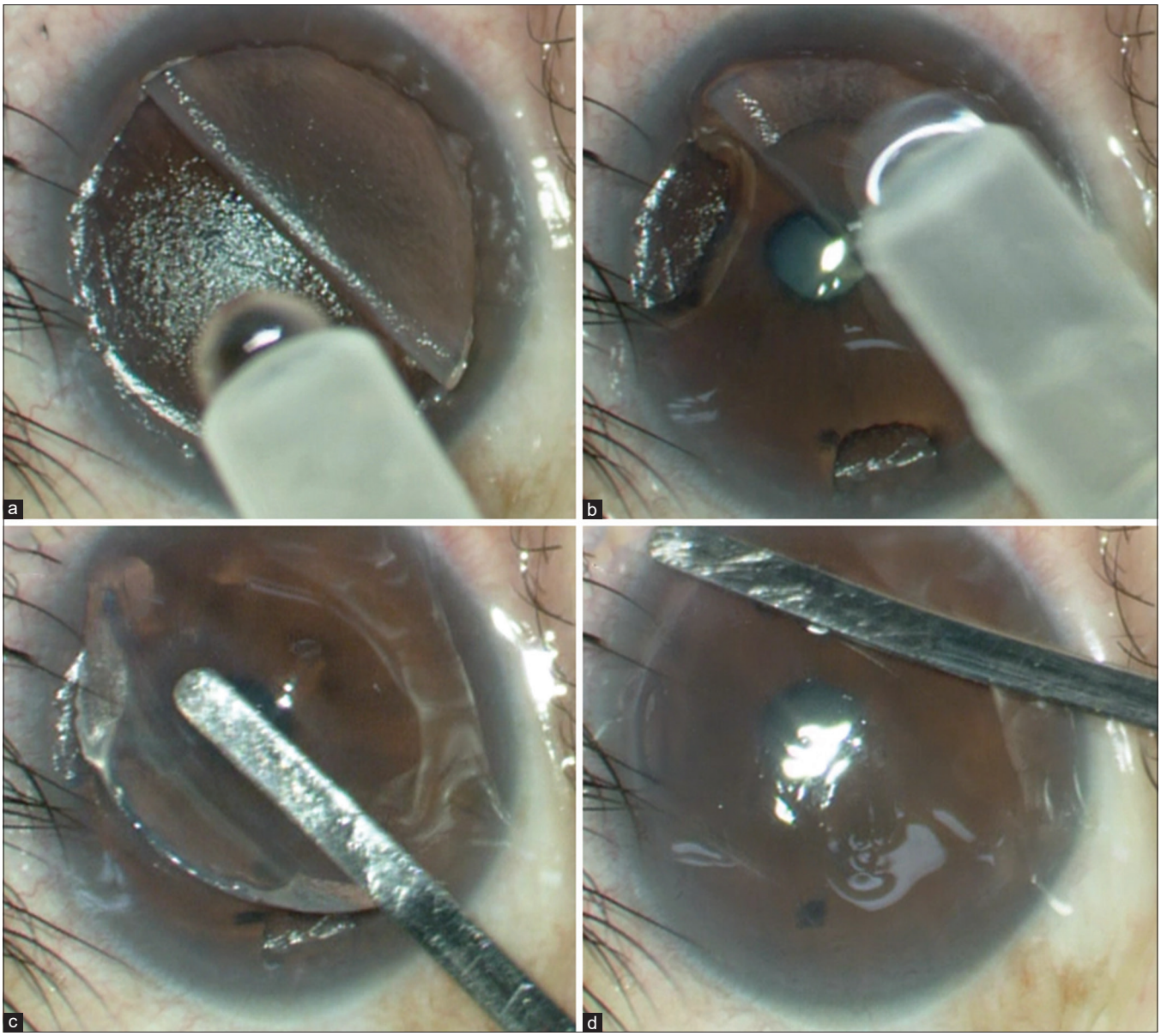

Figure 2: Modified two-part glue technique for flap adhesion. (a) Apply a thin layer of thrombin to the stromal bed. (b) Apply fibrinogen concentrate to the underside of the flap. (c) The flap was flipped over and repositioned to a desired position. (d) Gently stroke the flap to expel excessive fibrin glue from the edge

evidence for the biodegradability of fibrin glue within the interface, demonstrating an excellent anatomical outcome with no interface infiltration or gap. Although the outcome in our case seems promising, further studies are still needed to determine the efficacy of our technique.

Conclusion

In conclusion, we describe a late traumatic flap dislocation occurring 16 years after LASIK in which epithelial ingrowth took place and was successfully managed with mechanical debridement, alcohol soaking, and fibrin glue. The modified technique for fibrin glue application reported in this study is highly feasible for most ophthalmologists and shows excellent refractive, anatomical, and visual outcomes.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Authors' contributions

Study concept and design (YHH); data collection (PHL, YHH); analysis and interpretation of data (PHL, YHH); writing the manuscript (PHL, YHH); critical revision of the manuscript (PHL, YHH); supervision (YHH).

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Conflicts of interest

There are no conflicts of interest.

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