



## Case report

## LASIK flap stability after severe ocular injury

Timothy Todd<sup>a,\*</sup>, Todd Mondzelewski<sup>a</sup>, John Cason<sup>a</sup>, Elizabeth Hofmeister<sup>a</sup>, Stephen O'Connell<sup>b</sup>, Christopher Richmond<sup>a</sup>

<sup>a</sup> Naval Medical Center San Diego, San Diego, CA, USA

<sup>b</sup> Naval Hospital Camp Pendleton, Camp Pendleton, CA, USA



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## ABSTRACT

**Purpose:** To report two cases of LASIK flap stability after severe ocular trauma.

**Observations:** Two patients suffered open globe injuries several years after undergoing uneventful LASIK with femtosecond laser corneal flap. Both underwent primary ruptured globe repair, during which no LASIK flap dislocation was identified. Histopathologic examination of one of the cornea specimens confirmed an intact LASIK flap.

**Conclusion and Importance:** In these cases, the femtosecond LASIK flap remained in place despite significant injury to the cornea. The presence of a femtosecond LASIK flap did not complicate surgical management of the injury, and did not contribute to the patient's loss of BCVA.

## 1. Introduction

The flap produced in LASIK creates the potential for additional complications from trauma, even years after the procedure. The risk of these LASIK flap complications has led some authors to conclude that LASIK is not safe in populations that are at high risk of traumatic injury, such as those in the military.<sup>1</sup> We report two cases of severe ocular injury, one resulting from penetrating trauma and the other from blunt trauma. In both cases the LASIK flap was neither displaced nor a limiting factor in the visual outcome.

## 2. Findings

## 2.1. Case 1

A 27-year old active duty Marine with a manifest refraction of +1.75–2.75 × 003 in the right eye and +2.25–2.50 × 173 in the left eye, and a best-corrected visual acuity (BCVA) of 20/15–2 in the right eye and 20/20 + 2 in the left eye underwent uneventful bilateral femtosecond wavefront-guided LASIK utilizing the iFS femtosecond laser and VISX Star S4 excimer laser (Abbott Medical Optics, Santa Ana, CA, U.S.A.). The LASIK flaps were programmed for a depth of 100 μm, a diameter of 9.25 mm, and a non-beveled side cut angle of 90°. The post-operative course was uncomplicated and he had an uncorrected visual acuity (UCVA) of 20/15 OU four months after the procedure.

Twenty-seven months later he sustained a penetrating injury from a

metallic spike (Fig. 1). A fellow Marine had been helping to loosen the tool from his vest when it suddenly released, resulting in the penetration of the cornea. He was not wearing eye protection at the time. Visual acuity at presentation was light perception. Examination revealed a 10 mm vertical full thickness corneal laceration with lens disruption. There was extensive posterior retinal injury, but no exit wound. The LASIK flap, however, was not displaced (Fig. 2). The laceration was primarily repaired on the day of presentation under general anesthesia with 10–0 nylon sutures (Fig. 3a and b). The LASIK flap was noted to be completely adherent to the corneal bed and no modification of suturing technique was required.

Vision two days after primary repair was light perception with projection. His early post-operative course was notable for the development of a tractional retinal detachment requiring a pars plana vitrectomy. Bare sclera was seen at the temporal macula along the inferior arcade and superotemporally outside of the posterior pole during the vitrectomy. Lensectomy and silicone oil placement were also performed at that time. Three months after injury he developed elevated intraocular pressures requiring placement of a tube shunt, which was performed in conjunction with silicone oil removal. Seven months later he underwent penetrating keratoplasty with iridoplasty and tube shunt revision. Histopathologic examination of the corneal button revealed integrity of the flap interface (Figs. 4 and 5). Fifteen months after injury his BCVA with aphakic correction was 20/80. The reduction in vision was felt to be due primarily to retinal scarring.

\* Corresponding author. US Naval Hospital, Guam Bldg #50, Farenholt Ave Tutuhan, 96910, Guam.

E-mail address: [Timothy.d.todd8.mil@mail.mil](mailto:Timothy.d.todd8.mil@mail.mil) (T. Todd).

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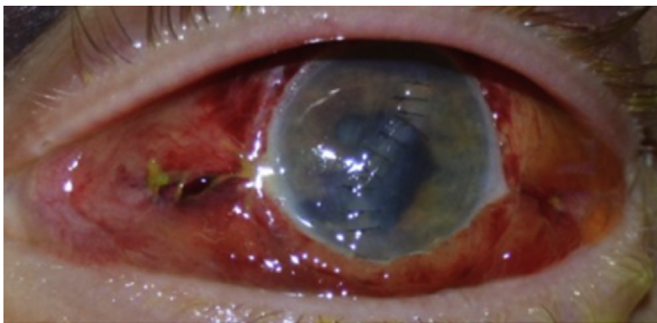
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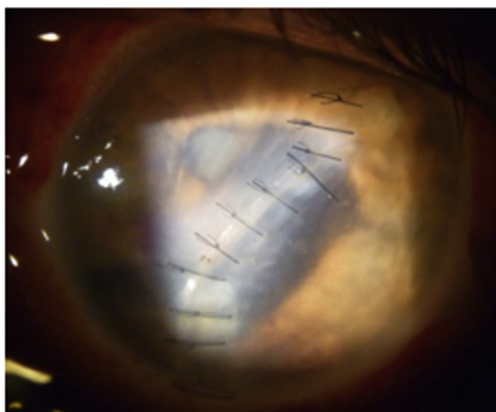
Fig. 1. Metallic spike.



Fig. 2. Large corneoscleral laceration, case 1.



a



b

Fig. 3. a and b: Corneoscleral laceration status post repair.

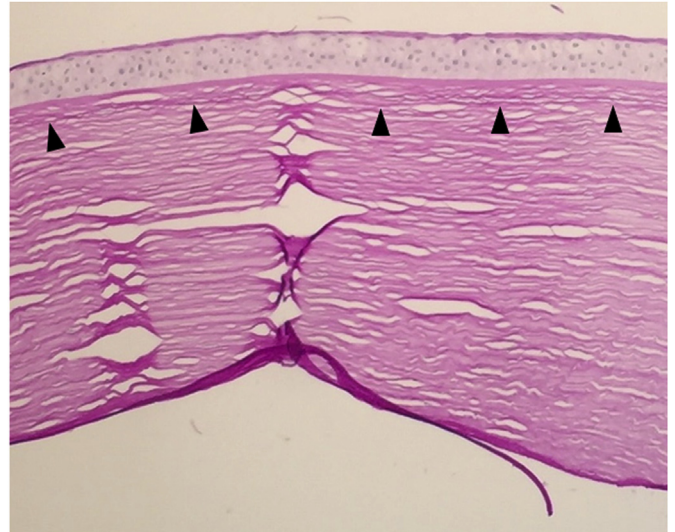


Fig. 4. Low power H&E stain of region outside of injury demonstrating flap interface integrity.

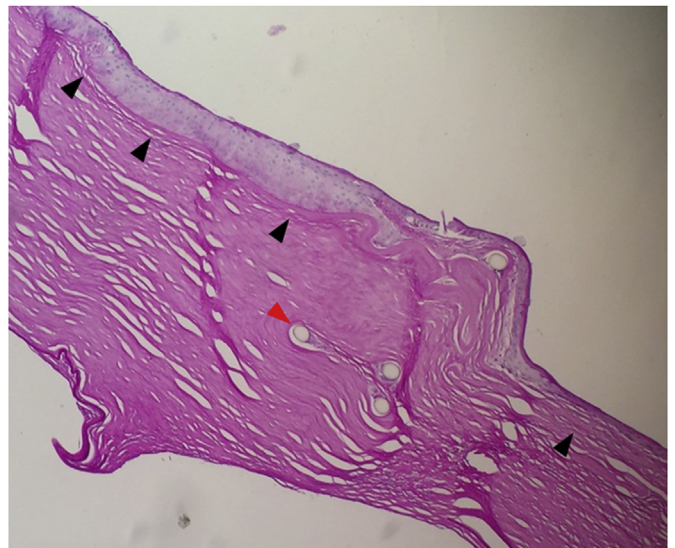


Fig. 5. Low power H&E stain of area of initial injury, demonstrating extensive fibrosis and post-surgical changes in region of sutured full thickness laceration with demonstration of flap interface integrity (black arrows). Sutures are in place amid region of fibrosis (red arrow). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

### 2.2. Case 2

A 39 year old active duty Marine with manifest refraction of +5.00–2.75 × 022 in the right eye and +2.00–0.50 × 160 in the left eye, and a BCVA of 20/25 in the right eye and 20/15 in the left eye underwent uneventful bilateral femtosecond wavefront-guided LASIK utilizing the iFS femtosecond laser and VISX Star S4 excimer laser (Abbott Medical Optics, Santa Ana, CA, U.S.A.). The LASIK flaps were programmed for a depth of 100 μm, a diameter of 9.5 mm, and a non-beveled side cut angle of 90°. The post-operative course was uncomplicated and he had an UCVA of 20/25–1 in the right eye and 20/15–1 in the left eye after the procedure.

Four years later he was struck in the left eye with a softball resulting in an open globe injury as well as frontal and maxillary bone fractures. He was not wearing eye protection at the time. He was stabilized and repaired at an outside facility prior to presentation to our clinic one



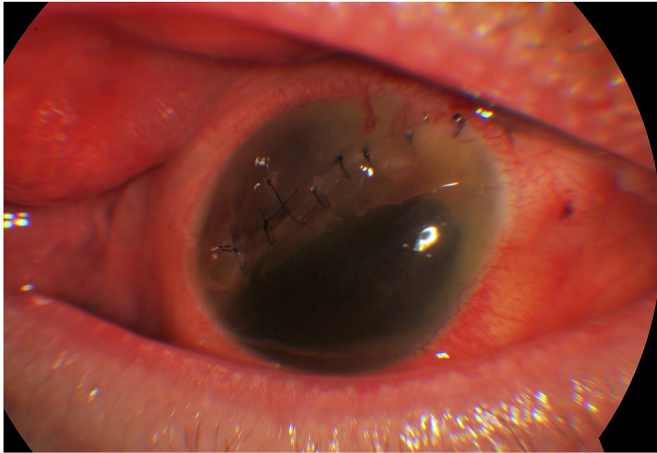


Fig. 6. Large corneoscleral laceration, case 2.

month after the injury. Examination revealed a 12 mm full thickness corneo-scleral laceration from the limbus at 7 o'clock extending just past the limbus at the 2 o'clock position with 10–0 nylon sutures in place (Fig. 6). The LASIK flap was not displaced. The lens and iris were not well visualized. Visual acuity was light perception. Five months after injury he underwent penetrating keratoplasty and vitrectomy at an outside institution, vision remained light perception. At ten months post-injury, the eye became phthisical and visual acuity was no light perception.

### 3. Discussion

Previous authors have reported concerns about the safety of LASIK flaps for the military population.<sup>1</sup> Xiao et al. stated in a 2012 article in the Chinese Journal of Traumatology that LASIK was not safe for military personnel, citing that there was a “high risk of potential traumatic flap problems”.

One such potential risk is flap dislocation. There are several reports of late traumatic LASIK flap dislocations, occurring up to nine years after surgery.<sup>2–12</sup> Late traumatic LASIK flap dislocations have been described in U.S. military personnel, but in most cases the surgery was performed using bladed microkeratomes.<sup>3,11,13</sup> The U.S. military has since abandoned the use of bladed microkeratomes with the advent of femtosecond lasers that can provide reverse-bevel geometry and very stable flaps. LASIK flaps created with femtosecond lasers have been shown to be much less prone to postoperative displacement than those created with bladed microkeratome.<sup>14,15</sup> Furthermore, U.S. Navy studies have shown that LASIK flaps are very resistant to blast injuries and G-forces. The blast energy required to dislodge a LASIK flap is enough to destroy the globe itself.<sup>16</sup> The dislocated LASIK flap can often be surgically replaced, and visual outcomes in these cases are often excellent. Even with complete flap amputation, visual outcomes can be superb in the absence of injury to other ocular structures.<sup>11</sup>

Another potential concern with LASIK flaps, particularly in the military population, is how their presence would affect the repair of more serious ocular injury. Our patients suffered severe ocular injuries, yet the LASIK flaps remained undisturbed and no modification of repair technique was required. Cosar et al. described a similar case in which a patient suffered a penetrating corneal injury with an intraocular foreign body without displacement of the LASIK flap.<sup>17</sup>

The U.S. Navy has a wealth of practical experience with LASIK flaps in situations with high risk of traumatic injury. Navy ophthalmologists performed 25,100 LASIK procedures from 2006 to 2011. Three service members experienced late traumatic LASIK flap dislocations during that same time period, for an incidence of 0.012%, or 1 case in every 8367 procedures performed. The visual outcome for each of these patients

was excellent: 20/20 or better uncorrected. Of the 2500 ocular injuries in U.S. military personnel serving in Iraq and Afghanistan tracked by the U.S. Military Joint Trauma Registry since 2002, only one soldier is known to have suffered a traumatic LASIK flap dislocation on the battlefield. This soldier suffered a gunshot wound to the head, and the exact mechanism of LASIK flap dislocation is unknown. Concomitant ocular injuries included a hyphema and retinal hemorrhages. The LASIK flap was refloated prior to the patient's evacuation out of theater and the flap was not a limiting factor in the soldier's final best corrected visual acuity.

In conclusion, LASIK flaps can be traumatically dislocated, but the incidence of such injuries is extremely low in the U.S. Navy and U.S. Marines. In the rare event that an isolated LASIK flap dislocation or flap amputation occurs, visual outcomes are often excellent. Additionally, these case reports demonstrate that the presence of a LASIK flap may not further complicate repair in cases of severe ocular injury. In these two cases the LASIK flap did not influence the final visual outcome. The potential benefits of corneal refractive surgery therefore far outweigh the risks in populations that are at high risk of traumatic injury.

### Patient consent

Consent to publish the case report was not obtained. This report does not contain any personal information that could lead to the identification of the patients.

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### Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

### Declaration of competing interest

The following authors have no financial disclosures: TDT, TJM, JBC, EMH, SRO, CJR.

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### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ajoc.2020.100608>.

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