

Case Report

Late Traumatic Flap Displacement after Laser In Situ Keratomileusis

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Laser in situ keratomileusis (LASIK) has become the community standard in corneal refractive surgery and is being performed by surgeons in the Army, Navy, and Air Force. LASIK differs from photorefractive keratectomy (PRK) in that a partial-thickness corneal flap is created in the LASIK procedure before removing a microscopic amount of corneal tissue, whereas no flap creation is required in PRK. The benefits of LASIK include minimal discomfort after surgery, as well as a much faster return of visual function. PRK involves a surface ablation and therefore heals differently, involving more discomfort and a slower return of functional vision. LASIK flap integrity is a concern to anyone undergoing the procedure, as well as for those making recommendations on the best form of refractive surgery for military personnel. A case report and a review of the literature are presented on the identification and management of LASIK flap trauma.

Introduction

A traumatic dislocation of a corneal flap after laser in situ keratomileusis (LASIK), is an unusual but potentially devastating event. A review of the medical literature over the past 15 years reported only 22 late flap dislocations. In the civilian setting, prompt evaluation and referral to a corneal specialist is typically available. In a military setting, distance and time often separate the casualty from definitive specialty care. Additionally, active duty personnel, particularly Special Forces personnel, who undergo refractive surgery are younger and more active than a civilian cohort. One of the motivating factors for refractive surgery is the ability to see unencumbered, and protective goggles or glasses are often not worn after the procedure.

LASIK involves creating a corneal flap with a microkeratome, treating the residual stromal bed with an excimer laser, and then laying the flap back over the treated cornea. LASIK differs from photorefractive keratectomy (PRK) in that PRK involves treatment of the corneal stroma without the creation of a flap. The LASIK flap is exceptionally stable after the initial 24-hour window postprocedure. Work by Laurent et al. (unpublished data) at the Navy Refractive surgery center in San Diego on a rabbit model has demonstrated that the flap was nearly impossible to displace using a peripheral air blast 24 hours postsurgery. However, the flap can be lifted for retreatment using a sharp needle or corneal dissector many months to years after the surgery. Most incidents of late dislocated flaps involve a similar mecha-

nism: a sharp object that creates an interface between the flap and the corneal stromal bed. Alternatively, however, there are several case reports of blunt trauma causing deformation and dislocation of the flap.

This case report is of a late (greater than 1 week) displaced LASIK flap. Particular emphasis is placed on the initial triage and ocular care given to the patient as he passed through the medical evacuation system. This case demonstrates the future potential complications that service members and their medical teams may encounter as LASIK becomes more common in the military.

Case Report

A 28-year-old active duty Army captain was hit in the right eye by a softball in a remote location in the Philippines. He was 2 months status post-LASIK surgery for a -4.00 diopter bilateral correction with preinjury uncorrected vision to 20/15 in both eyes. Immediate triage by the medic at the scene determined the patient to have count fingers vision with a displaced LASIK flap in the right eye. After topical anesthesia with proparacaine, the flap was repositioned using a sterile cotton-tipped applicator. A shield was placed over the injured eye. The patient was medevaced by air within 1 hour to a nearby island where an emergency room physician noted vision of count fingers at 5 feet with a hyphema (blood in the anterior chamber), a distorted pupil, and debris and wrinkling of the anterior portion of the cornea. There was concern on the part of the emergency room physician that due to the distorted appearance of the pupil and the previous LASIK surgery, a rupture of the globe may be present. The patient had a shield placed and was expeditiously medevaced to a military ophthalmologist in Okinawa, arriving there within 24 hours of injury. Initial vision 24 hours postinjury was 20/200. The globe was intact and the hyphema had resolved. The patient was brought to the operating room where, after topical anesthesia and placement of a lid speculum, the flap was lifted using a blunt 26-gauge cannula, and debris was irrigated from the interface. The flap was then repositioned. The patient was started on a topical antibiotic (ciprofloxin) every 4 hours, frequent non-preserved artificial tears (Gentel), and a pupil-dilating drop (homatropine) twice a day. Best-corrected visual acuity after this procedure was 20/100. The patient was medevaced to a cornea specialist in San Diego, arriving within 72 hours of the initial injury. His best-corrected visual acuity was 20/40 with a manifest refraction of +1.00-0.75 × 050. There was moderate microstriae and small amount of debris noted in the interface, but no evidence of diffuse lamellar keratitis (DLK). The patient

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was brought to the operating room once again and the flap was lifted. Using dry Weck-Cel sponges and a Paton spatula, the flap was then stretched back into position, taking care not to damage the epithelium. The patient was continued on topical ciprofloxacin and was started on topical steroids (prednisolone acetate) every 2 hours. A bandage contact lens was placed. One day after repositioning the flap, the patient's vision had improved to 20/25 and by postoperative day 7 was 20/20 with no debris noted. Small amounts of microstriae remained but were not visually significant. Two months postinjury, the patient had continued stable, excellent vision without evidence of microstriae.

Discussion

Late dislocation of a LASIK flap is a decidedly unusual event with potentially devastating sequelae. A Medline search of the past 10 years using keywords "surgical flaps," "keratomileusis," "laser in situ," "dislocation," and "eye injuries" produced 17 articles describing 22 eyes that had flap dislocation-, infection-, or trauma-related problems more than 1 week post-LASIK. Once the flap is adequately repositioned, the potential complications of trauma to a LASIK flap are similar to the complications that can occur during or immediately after the procedure itself: infection, DLK, macro- and microstriae, and epithelial ingrowth.

The scope and degree of the inciting trauma is remarkable. There is only one report in the literature of a displaced flap occurring 4 months postoperation without any inciting trauma.¹ Four case reports describe displacement after seemingly minor trauma from placement of contact lens,² inadvertent brushing with a fingernail,^{3,4} and contact with the edge of a shopping bag.⁵ The remainder of the traumatic events range in severity and disparity from contact with a pet bird's beak,⁶ a pecan falling from a tree,⁷ a cable injury,⁷ airbag injuries,⁷⁻⁹ a tree branch,¹⁰ playing basketball,⁴ contact with a snowball,⁴ and contact with a dog's paw.⁴ Chaudrey¹¹ reported on a displaced flap in a post-LASIK eye during a vitrectomy 4 months post-LASIK.

The mechanism of trauma and possible inoculum of foreign material in the flap interface is critical in the history and geographic location of the injury. Kim et al.¹² reported a *Nocardia* keratitis in a repositioned flap in a Marine who sustained flap dislocation in a field setting due to a gun spring. Despite immediate referral to ophthalmology with repositioning and initiation of topical ofloxacin, he developed an infection with gram-positive filaments identified as *Nocardia*. The infection was susceptible to topical trimethoprim sulfamethoxazole. Thirteen months after the trauma, the patient's spectacle corrected visual acuity was 20/20 with a manifest refraction of $-2.25-1.00 \times 080$. Read¹³ reported an infection with a fungus, *Acremonium atrogriseum*, after a wood chip injury post-LASIK. Because of the unusual inoculums present with LASIK trauma, close observation by a trained specialist with access to a slit lamp and culture material is critical.

It is critical to note that not only seemingly minor trauma has caused flap dislocation, but that corneal epithelial trauma without flap dislocation has been reported to "induce" DLK.^{14,15} DLK is an idiopathic sterile inflammatory condition that affects the corneal interface after surgery with an incidence of 0.2 to 3.2%.¹⁶ DLK is treated with topical steroid drops, and in a traumatic flap situation, prophylaxis for DLK with topical ste-

roid drops must be tempered with the risk of infection and should be initiated only by an ophthalmologist with close follow up.

The major contributor to decreased vision reported here, despite proper flap placement, was flap irregularities. The induced striae or folds can be macro- or microstriae. Macrostriae are typically caused by flap malposition and are readily seen under a slit lamp. The microstriae, which were present in the case report, are best seen using a retroillumination technique at the slit lamp. The techniques for eliminating microstriae include refloating the flap with or without the use of hypotonic saline, stretching and smoothing the stromal bed and the flap, and suturing the flap. The use of a bandage contact lens is valuable in keeping the flap in proper position.

The initial management of an isolated traumatic eye injury, particularly one as serious as this case, is first to rule out a ruptured globe. There are only two case reports on traumatic ruptured globes post-LASIK in the literature. Sun et al.¹⁷ report on a corneal perforation caused by a rock that displaced the flap but perforated the corneal bed. Cosar¹⁸ describes a corneal laceration caused by hammering metal, which did not necessitate lifting the corneal flap. There does not appear to be any propensity for LASIK-treated eyes to be more susceptible to rupture after blunt trauma, although no definitive published animal study has been done to demonstrate this. In Laurent's unpublished study of a shearing trauma in post-LASIK rabbit eyes, force sufficient to cause extensive internal damage to the eye (hyphema, iris dehiscence, and retinal detachment) did not cause displacement of the LASIK flap as soon as 2 days after surgery.¹ If globe rupture is suspected, then placing an eye shield that avoids direct contact with the eye, beginning intravenous antibiotics and antiemetics (keeping the patient nil per os), and expeditious medevac are warranted.

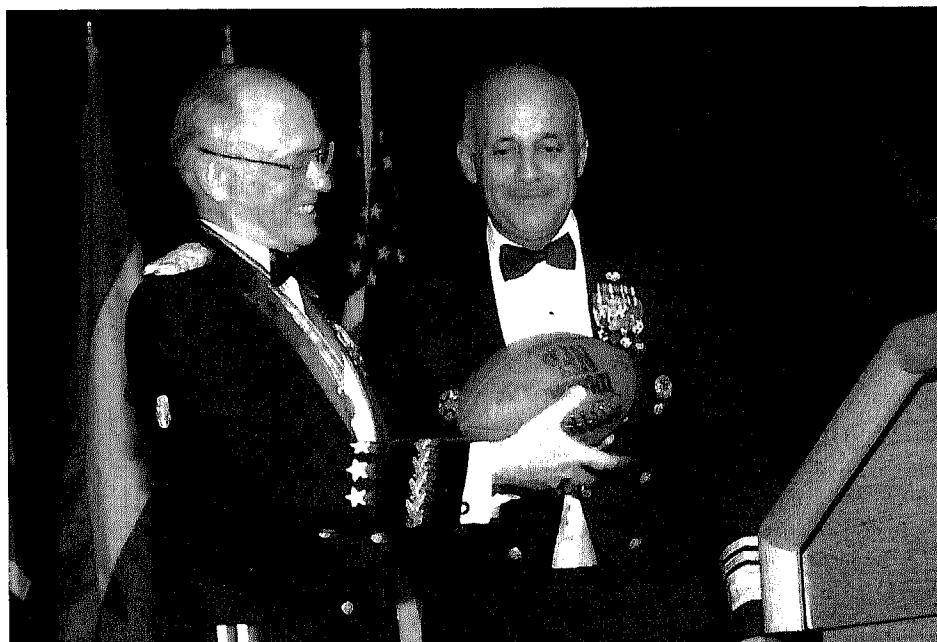
In a post-LASIK traumatized eye, initial management should consist of gentle irrigation and replacement of the flap as best as possible before an extensive medevac. One should "never" attempt to remove or "brush away" loose tissue from the eye. This tissue may be the displaced corneal flap, which can be properly repositioned by a trained ophthalmic surgeon. A broad-spectrum topical antibiotic such as ciprofloxacin (Ciloxan) or trimethoprim and polymyxin (Polytrim) should be started. Microstriae should be looked for with retroillumination and the flap should be refloated as soon as possible by a qualified ophthalmologist. Expeditious medevac to a corneal specialist will probably be required in most cases of a displaced flap due to the present and potential complications discussed.

This case report involved Special Forces military personnel who had undergone LASIK. LASIK does have several advantages as a refractive procedure over PRK. In PRK, the four- to five-cell layer-thick epithelium needs to be scraped or removed before laser treatment. It is the scraping and subsequent regrowth of this epithelium that causes discomfort and slower visual recovery in PRK as opposed to LASIK. Thus, LASIK allows groups traveling for treatment to return to their base and full duty sooner. Although the procedure takes longer (30 minutes vs. 15 minutes for PRK), LASIK in general does not require the intensive, week-long, post-PRK follow up as the epithelium heals, nor does it require months of postoperative eye drops (LASIK typically requires eye drops for 1 week, whereas PRK requires the

use of eye drops for 2 to 4 months). Although the results of PRK and LASIK are nearly identical after several months, LASIK allows the faster return to full duty, again favoring its use in Special Forces. As these cases indicate, however, there is a very real risk of flap complication postprocedure, which would not be present with PRK. Given the risk and benefits, particularly in Special Forces, the potential complications and medevac capabilities must be weighed when considering which treatment option to undergo. If LASIK is prescribed, long-term dislocations are possible and eye protection should be worn when in a potentially dangerous environment. Medics will need to be trained in the emergency treatment of ocular injuries involving a post-LASIK patient, and the medevac system will need to be used in a timely manner to avoid long-term sequelae of a displaced LASIK flap.

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Outgoing President VADM Richard Carmona "passes the football" to incoming President LGEN James Peake