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Case Report Open Access

Transected Lamellar Cut Following Second Pass with a Femtosecond Laser after Incomplete Flap Construction during Laser *In Situ* Keratomileusis

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Abstract

Background: The majority of complications of Laser in Situ Keratomileusis leading to vision loss are related to the corneal flap. Uses of the femtosecond laser for flap construction has been shown have improved safety and predictability when compared to mechanical keratome use. We report a case of irregular astigmatism following second pass with a femtosecond laser performed due to incomplete flap construction.

Methods: Single observational case report.

Results: Examination revealed a horizontal linear opacified stromal scar likely representing a discontinuity of the deeper second flap plane with transection into the original flap plane. This complication caused a loss of six lines of best corrected visual acuity.

Conclusion: This case demonstrates that complications resulting in persistent significant visual loss are possible with use of the femtosecond laser for a second pass following incomplete flap construction.

Introduction

Laser *In Situ* Keratomileusis (LASIK) is the most common corneal refractive surgery performed today. Many vision threatening complications are related to creation of the flap. Intraoperative flap related complications with microkeratome use are reported to occur in 0.3% [1] to 5% [2] of cases and include: partial flaps, buttonholes, thin, thick, or irregular flaps, free flaps, decentered flaps, irregular flap edges, epithelial abrasions, and flap tears. These complications commonly lead to delayed recovery and in rare cases can cause permanent loss of vision. In a review paper which included studies utilizing the Hansatome (Bausch and Lomb, San Dimas, CA), the Moria LSK-One (Moria Surgical, Doylestown, Pennsylvania), the Moria M2 (Moria Surgical, Doylestown, Pennsylvania), the NIDEK MK-2000 (NIDEK, Aichi, Japan), the Automated Corneal Shaper (Bausch and Lomb, San Dimas, CA), and the MicroPrecision keratome (Microprecision Instrument Company, Inc., Phoenix, AZ), the use of the femtosecond laser was seen to have improved the safety and predictability [3] of flap construction. The femtosecond laser was also found to produce less induced astigmatism and higher order aberrations [3]. Partial flap creation is still possible, mainly occurring due to suction loss. The overall reported incidence of flap related complication with use of the femtosecond laser is 0.37%, none of which were vision threatening [4]. The use of a second pass with a femtosecond laser following partial flap creation has been described [4,5]. For incomplete flap resections due to suction loss, the manufacturer's instructions for the IntraLase femtosecond laser (Abbot Medical Optics, Inc., Santa Ana, CA), recommends recutting a second time using the same applanation lens patient interface and the same settings to avoid variations in flap creation character due to variance in glass thickness in surgical equipment. If the surgeon decides to operate on a different day, the manufacturer recommends cutting at least 40 um deeper to avoid the possibility of gas interface bubbles entering the primary interface resulting in stromal bed irregularity [6]. A recent study utilizing porcine eyes reported the possible occurrence of an uneven lamellar cut when using a second pass with a femtosecond laser [7].

We report a case of an uneven transected lamellar cut with the use of the IntraLase femtosecond laser following a second pass after incomplete flap creation.

Case

A 47-year-old male was seen in consultation 10 months after receiving simultaneous bilateral LASIK surgery for the correction of low mixed astigmatism. His pre-operative refraction was -1.25 + 2.00 x 170 OD, -1.25 + 1.75 x 015 OS, with a best spectacle corrected visual acuity (BSCVA) of 20/15 in each eye. He did not have deep set orbits or a small palpebral fissure.

Initial surgery on the right eye was completed without intraoperative complications. Initial surgery on the left eye was notable for incomplete flap creation of the left eye due to suction loss (IntraLase, flap thickness set at 110 microns). Suction loss occurred at ¾ of the distance of the planned initial cut. The left eye surgery was aborted at that time. Five days later, the patient was brought back for a second pass with the IntraLase (Abbot Medical Optics, Inc., Santa Ana, CA) with the flap thickness set at 150 microns. An irregular contour of the stromal bed was noted at that time following the second pass for attempted flap construction. It was noted by the surgeon intraoperatively that the second pass cut bisected into the initial partial flap. Ablation was performed on the left eye at that time. Following the surgery, the patient reported he had very poor vision out of his left eye. He reported

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that he was unable to see anything clearly without the use of a rigid gas permeable contact lens in his left eye. The goal of the original surgery was to attempt monovision in his non dominant right eye.

On examination, he was noted to have an unaided visual acuity of 20/200 in the right eye and 20/60 in the left eye. He notes that his uncorrected visual acuity out of the left eye was blurry and doubled. Manifest and cycloplegic refraction of the right eye was -2.75 +1.25 at axis 94 yielding a visual acuity of 20/20. The left eye was -4.00 +2.50 at axis 95 yielding a visual acuity of 20/60. Slit lamp examination of the right and left cornea revealed some peripheral superficial map-dot-fingerprint lines consistent with anterior basement membrane dystrophy in each eye. There was no central corneal involvement of the anterior basement membrane dystrophy. The left eye had a distinct horizontal linear opacified scarring underneath the primary keratectomy flap at the superior portion of the pupillary axis (Figure 1). Computerized video keratography showed central steepening in the right eye as well as the left eye. The left eye had markedly irregular central steepening present corresponding to the area of the abnormality (Figure 2). There was no evidence of ectasia on posterior float on Orbscan or Pentacam imaging. The corneal thickness in the affected area of the left eye was 621 microns on Pentacam imaging which did not suggest tissue loss.

Discussion

A significant number of vision threatening LASIK complications are related to the creation of the flap. Introduction of the femtosecond laser and its use in flap construction has been an important step forward with improved safety and predictability of flap construction [3]. We present a case of a flap complication due to a second pass following incomplete flap creation utilizing a femtosecond laser. The exact nature of the horizontal linear opacity is not clear. We postulate that the horizontal linear opacified stromal scar likely represents a discontinuity of the deeper second flap plane with transection into the original flap plane, as was noted by the surgeon intraoperatively. It is also possible that transection could have occurred due to interface bubbles causing tissue loss due to the proximity of the second pass with the initial interface plane leading to stromal irregularity. Another consideration would be the possibility of a horizontal sliver of tissue being lost during the initial suction loss. Rubinfeld et al. [8] have previously reported on the potentially serious complications resulting in permanent vision loss associated with a second pass with a mechanical keratome after incomplete flap creation. Our report demonstrates that such complications are possible with the use of the femtosecond laser, and can result in significant loss of vision, in our case six lines of BCVA.

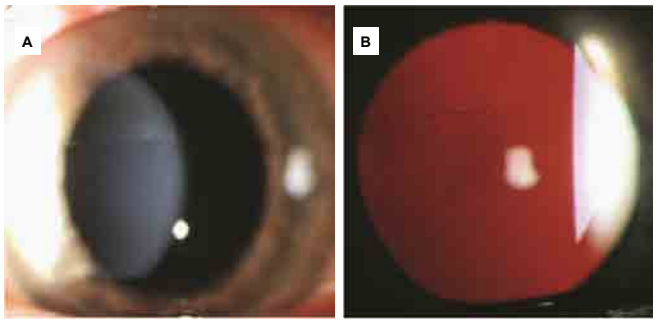

Figure 1: 1A, 1B. Slit lamp examination ten months post surgery revealing linear opacified scarring underneath the primary keratectomy flap at the superior portion of the visual axis.

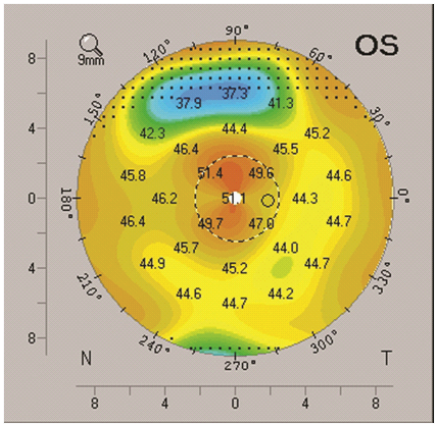

Figure 2: Corneal topography ten months post surgery, demonstrating marked irregular central steepenening corresponding to the area of the flap discontinuity.

Although it has been shown that the depth of flap creation by femtosecond laser is more accurate when compared to flap creation by microkeratome, there is still variation in the depth of cut actually performed by the femtosecond laser. The standard deviation reported in the literature with a flap depth set at 110 microns ranges from 5 to 18 microns [9-11]. As noted by Binder [11], this variability increases when the flap depth is set higher, increasing to a standard deviation of 26 microns for a depth set at 140 microns. In our patient, if the initial cut set at 110 microns occurred a little deeper that set, and the second pass set at 150 microns was shallow, the possibility of transection is well within the published data.

There were no identifiable pre-operative risk factors of suction loss in our patient. He did not have deep set orbits or a small palpebral fissure. The possibility of this complication should be considered when managing incomplete flap construction with a femtosecond laser. The safety of surface ablation following flap complications has been demonstrated [12-16]. While some recommend a second pass [4,5], we feel that one strategy of avoiding this potential complication would be to abort the case. We would allow time for healing of the flap, and perform surface ablation augmented with Mitomycin C at a later date. If a second pass is attempted, and there is any significant irregularity of the stromal bed noted, the ablation should be aborted at that time.

It is possible that topography guided excimer laser ablation as well as future advanced treatments may aid in the treatment of flap complications such as the one reported in this case.

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