Management of slipped laser in situ keratomileusis flap following intrastromal corneal ring implantation in post-LASIK ectasia

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Two cases of intrastromal corneal ring (Intacs, Addition Technology) implantation to treat post-laser in situ keratomileusis (LASIK) ectasia developed progressive slippage of the flap over the stromal bed, resulting in progressive flattening of the affected meridian. The flattening was thought to have occurred because the poorly healed flap edge could not withstand the change in corneal shape induced by the ring segments. The flap was lifted, debris was removed, and the flap was sutured to the residual stromal bed using interrupted 10-0 nylon sutures passed through two thirds of the cornea. The sutures induced a localized area of scarring that acted as "welding spots" and prevented further flap slippage. Refractive stability after suture removal supports the hypothesis that a sutured flap restores (at least partially) the biomechanical strength of post-LASIK corneas.

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Post-laser in situ keratomileusis (LASIK) ectasia is among the most serious complications of LASIK.[1,2] Laser in situ keratomileusis weakens the biomechanical stability of the cornea not only by ablation of the central stroma (depending on the attempted correction), but also by creation of the flap.[3] Intrastromal corneal rings (ICRs, Intacs, Addition Technology) have emerged as a significant management option in iatrogenic post-LASIK ectasia cases.[3–8] Refractive stability has been demonstrated for periods up to 5 years following ICR implantation for post-LASIK corneal ectasia.[3] Two cases of post-LASIK ectasia that developed flap slippage and induced astigmatism after paired Intacs placement are reported. The cases were managed by suturing the flap 300 degrees with or without removing one of the segments. Visual rehabilitation and refractive stability were achieved.

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CASE REPORTS

Case 1

A 32-year-old woman with a refraction of −4.50 −1.50 × 16 in the right eye and −4.25 −1.25 × 165 in the left eye (best corrected visual acuity [BCVA] 20/20 in both eyes) had bilateral LASIK with the Moria manual CB microkeratome using a 130 µm head and a Visx Star S2 laser in September 2000. The pre-LASIK topography showed mild inferior steepening in both eyes, and the central corneal thicknesses were 469 µm in the right eye and 481 µm in the left eye. Three and a half years postoperatively, the uncorrected visual acuity (UCVA) had decreased to counting fingers and the refraction was –13.00 –5.00 × 9 (20/50) in the right eye with evidence of post-LASIK ectasia (Figure 1). No flap slippage was noted at that time. The left eye remained stable throughout the follow-up period.

In June 2004, two 450 µm Intacs segments were implanted symmetrically through an incision placed at 95 degrees in the right eye. The achieved depth of the segments was 75% of the corneal thickness, and care was taken not to disturb the flap during insertion of the segments. Four months later, the refraction improved to −5.50 −5.50 ×170 (20/50). The incisional suture was removed. Over the next 2 months, the horizontal meridian progressively flattened and the right eye's refraction changed to −3.75 −7.75 × 2 (20/40). Careful examination of the flap interface revealed that the temporal part of the flap was slipping over the stromal bed,

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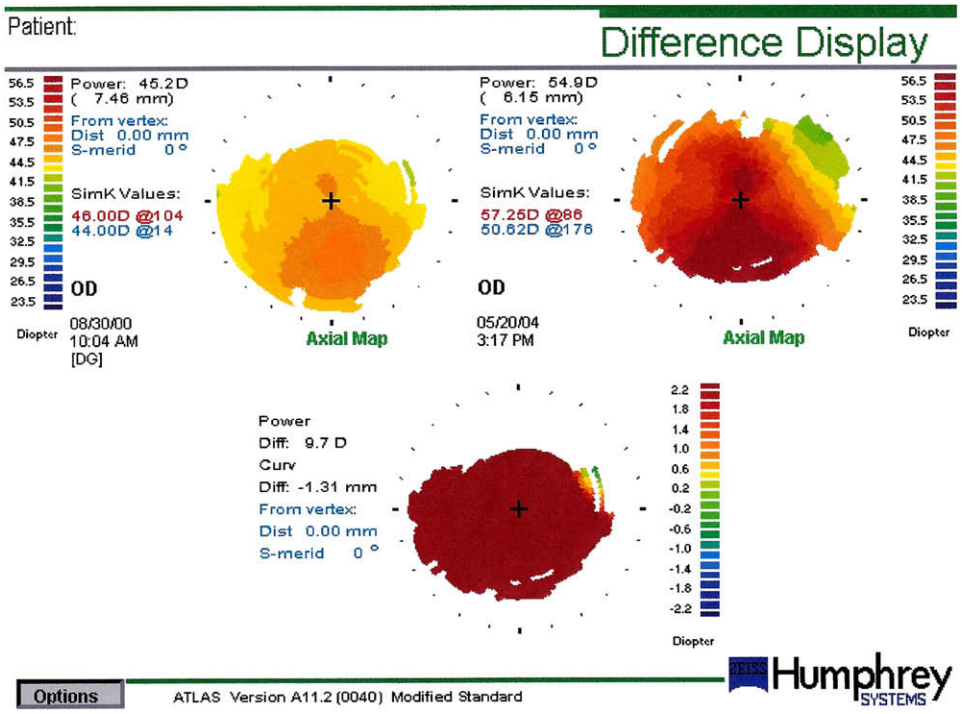

Figure 1. Topography showing the pre-LASIK cornea and post-LASIK ectasia (just before Intacs implantation).

contributing to the induced astigmatism (Figure 2). This was thought to be due to the inability of the poorly healed flap edge to withstand the remodeling effect of the segments.

Since there was no similar case or management option reported in the literature, a surgical management methodology was formulated. The nasal flap was lifted, and a moderate amount of amorphous material was removed from the slipped flap edge. The flap was repositioned, and 7 interrupted 10-0 nylon sutures were placed circumferentially for 300 degrees, except the hinge, to induce stromal scarring at the suture points (Figure 3).

Fifteen months after the suturing and 6 months after removal of all sutures, the UCVA was 20/50 and the refraction remained stable at –4.00 –4.00 × 5 (20/40). A topographic difference map comparing presuturing and the final topography (Figure 4) showed mild progression of the overall corneal curvature.

Case 2

A 23-year-old woman with −6.75 −0.50 × 180 in both eyes (20/20 both eyes) presented for refractive surgery. The

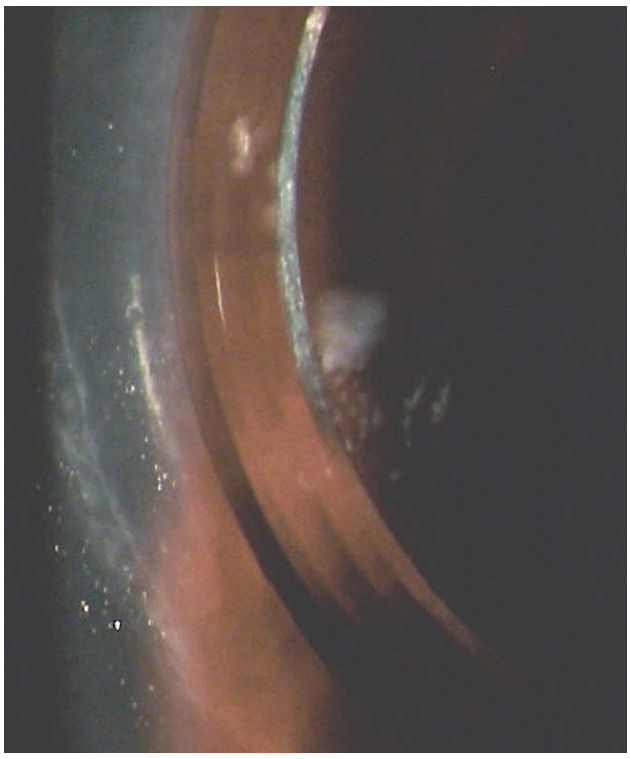

Figure 2. Slipping of the nasal edge of the LASIK flap over the residual stromal bed.

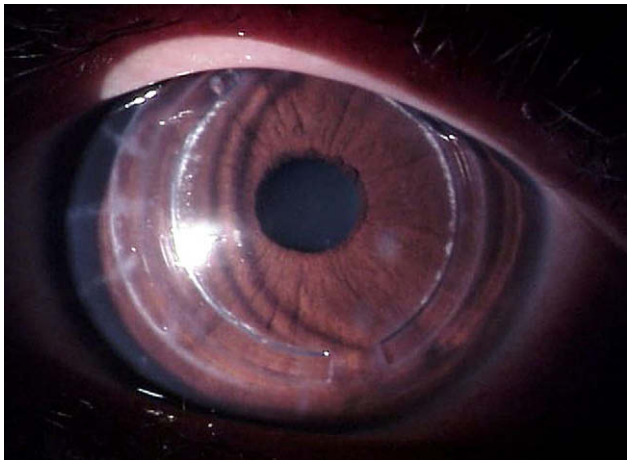

Figure 3. Fifteen months after flap suturing, the stable LASIK flap is held in position by the localized scarring induced by the sutures.

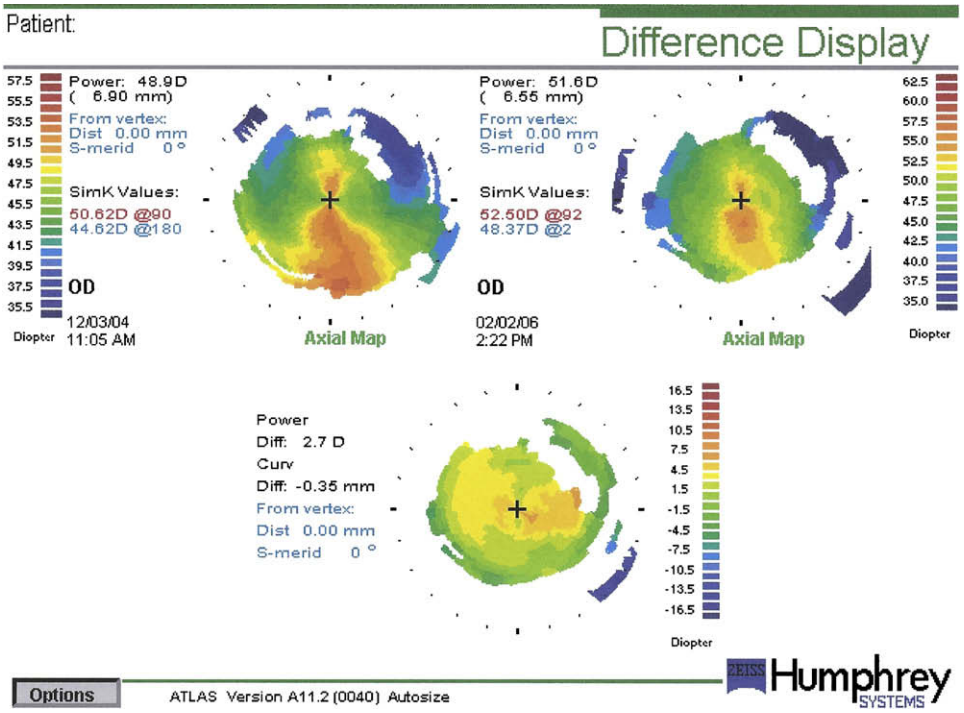

Figure 4. Topography showing the displaced flap following Intacs implantation and the cornea 15 months after the flap suturing procedure (6 months after the sutures were removed). Notice the improvement in topography.

preoperative topography showed a normal pattern in the right eye and a "vertical D" pattern in the left eye (Figure 5). Central corneal pachymetry was 540 µm in the right eye and 546 µm in the left eye. Bilateral LASIK was performed with a manual Moria CB microkeratome using a 130 µm head and a Visx Star 2 excimer laser in March 2001. The UCVA was stable at 20/20 in both eyes for 21 months.

In March 2003, the patient complained of decreased visual acuity in the left eye. An enhancement of +0.25 –1.50 × 146 was performed by lifting the flap. Intraoperative pachymetry revealed that the stromal bed was 318 µm before the 11 µm enhancement. The UCVA was restored to 20/20. Thirty-eight months after the first LASIK procedure, the UCVA in the left eye was 20/200 and the BCVA was 20/30 with +2.25 −2.50 × 133; corneal ectasia was diagnosed (Figure 5). No flap slippage was noted at that time.

In July 2004, because of the degree of topographic asymmetry, 2 asymmetric Intacs segments were implanted,

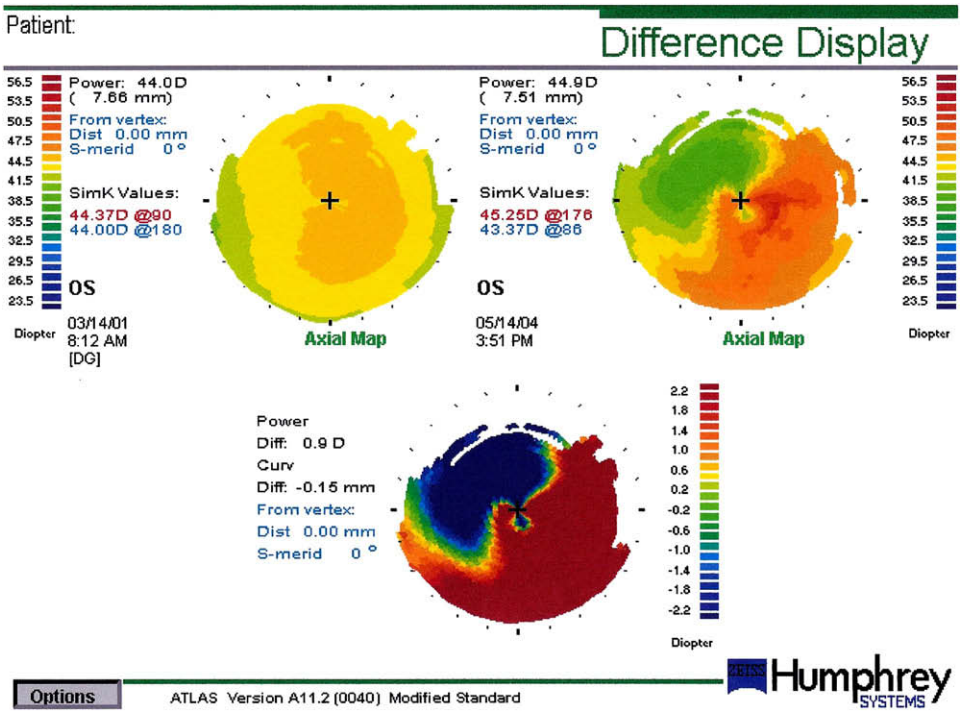

Figure 5. Topography showing the pre-LASIK cornea and post-LASIK ectasia (just before Intacs implantation). Notice the vertical D pattern reflecting the horizontal asymmetry present in some keratoconus suspect patients.

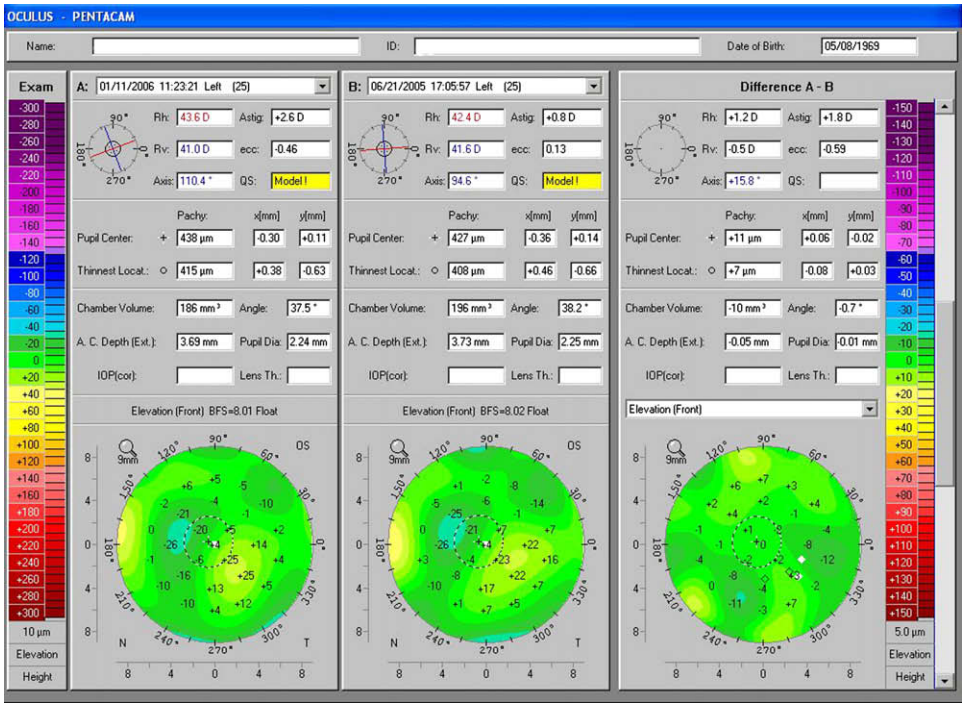

Figure 6. Pentacam (Oculus, Inc.) analysis showing stability of the anterior surface for 6 months after removal of the corneal sutures.

a 300 µm segment superonasally and a 250 µm segment inferotemporally, with the incision placed at 45 degrees. The achieved depth of placement of the segments was 75% of the corneal thickness. Care was taken to avoid undue manipulation of the LASIK flap during insertion of the segments.

Six months later, the astigmatism had worsened to +3.00 –7.00 × 105 (20/50). Based on the experience in Case 1, the flap was lifted completely, fibrous/amorphous material was removed from the edge of the flap, the superonasal segment was removed (because of the persistence of topographic asymmetry), and the flap was sutured for 300 degrees, except the hinge.

One year after the flap suturing and 6 months after suture removal, the UCVA in the left eye was 20/60, with a refraction of plano –2.50 × 120 (20/30) (Figure 6). The UCVA in the right eye was 20/20, with no sign of ectasia.

DISCUSSION

With the increasing number of LASIK procedures, more cases of post-LASIK keratectasia are being reported.[2,9–12] Reduced biomechanical strength of the cornea (due to underlying keratoconus or a residual stromal bed that is too thin) is thought to be the reason for the development of postoperative ectasia.[1,2,11–13] Several studies have shown the efficacy of Intacs in eyes with post-LASIK corneal ectasia.[3–8] To date, the longest prospective follow-up is 5 years and demonstrates positive visual results and long-term biomechanical stability.[3] In our 2 cases, gradual slipping of the LASIK flap was noted over the stromal bed. Since Intacs act by pushing the corneal tissue at the body of the segment[14] inward and the healing process is weak at the edge of the flap, the flap could slip over the stromal bed where the body of the segment is located. This results in flattening of that meridian. In histological and immunohistochemical examinations of LASIK-treated corneas, Philipp et al.[15] found the wound-healing response is generally poor. Anterior stromal lamellae are known to contribute more biomechanical strength to the cornea than deeper layers,[15] but in the context of poor wound healing, the LASIK flap is biomechanically ineffective, which may contribute to keratectasia.

Sutures have been used to repair wounds and induce wound strength. The inflammatory reaction that ensues at the suture tract activates corneal fibroblasts and increases the production of extracellular matrix, producing a strong adhesion between the tissues.[16] Based on this principle, Seo et al.[17] found that flap suturing early in the course of post-LASIK ectasia seemed to limit the progression. A hypothetical example of a case with an extremely thin residual stromal bed is Descemet-stripping anterior lamellar keratoplasty, where corneal ectasia does not commonly occur. This might be due to the healing process along the deep vertical edges aided by suturing, as explained above.

Differential topographic maps have shown that when a single Intacs segment is placed, it tends to push the cornea beneath it, with compensatory steepening of the opposite hemicornea. This was the reason to remove the segment over the flat part of the cornea in Case 2 and also to make room for tight closure of the corneal flap.

Corneal crosslinking with ultraviolet-A rays and riboflavin has been proposed as a method to prevent progression of keratoconus[18] or post-LASIK ectasia.[19] Since the flap slippage described in our cases is a localized phenomenon and the flap does not contribute much to the structural integrity of the cornea, we do not think corneal crosslinking would reverse the slipping phenomenon. However, once a more regular corneal contour is achieved with sutures, corneal crosslinking could be used to keep the stromal bed in this state.

Both cases responded positively to flap suturing, and the eyes with sutured LASIK flaps demonstrated refractive stability. The technique provides further evidence that sutured flaps restore a more regular corneal contour and, at least partially, biomechanical stability in post-LASIK corneas.

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