Anterior segment optical coherence tomography findings in epithelial ingrowth after neodymium:YAG laser treatment

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We describe the case of a patient with recurrent epithelial ingrowth treated with a neodymium:YAG (Nd:YAG) laser after flap relifting and removal of the ingrowth. Spectral domain anterior segment optical coherence tomography (AS-OCT) was performed preoperatively and several times during the first postoperative year. Clinical biomicroscopy showed recurrent Machat grade 3 epithelial ingrowth associated with the flap border. The AS-OCT showed ingrowth as a highly reflective stromal band and laser craters with endothelial band disruption recorded immediately after laser impacts. After 1 year, the visual acuity improved, corneal topography was more regular, and corneal transparency with residual scarring was observed. The AS-OCT showed recovered stromal hyporeflectivity, residual hypereflection, and regular epithelial and endothelial band hyperreflection. The AS-OCT is a useful tool to show epithelial ingrowth involution and corneal healing after Nd:YAG laser treatment for recurrent epithelial ingrowth after laser in situ keratomileusis.

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Epithelial ingrowth is a relatively frequent complication after laser in situ keratomileusis (LASIK), with an incidence ranging from 4% to 9%; 1% to 2% of cases require flap relifting and removal of the ingrown cells to prevent further growth, flap melting, or surface distortion. Clinically significant ingrowth is more frequent when the relifting procedure is performed 3 or more years after primary LASIK (7.7% versus 1.0%). Neodymium:YAG (Nd:YAG) laser photodisruption is a less invasive treatment and has been shown to decrease ingrowth-induced corneal astigmatism and improve visual acuity.

Recently, spectral-domain anterior segment optical coherence tomography (AS-OCT) was used as a tool to observe and follow the corneal wound-healing process in several cases of corneal ulceration. The detailed AS-OCT images of all the corneal layers were correlated with clinical findings to better understand the wound-healing process in each case. We report the clinical and AS-OCT findings in a case of recurrent epithelial ingrowth treated with an Nd:YAG laser after failed relifting of a flap and debridement.

CASE REPORT

A 49-year-old man with recurrent epithelial ingrowth after LASIK re-enhancement was treated with the Nd:YAG laser (3000LE, Alcon Laboratories, Inc.) after failed flap relifting and ingrowth debridement. The patient had had myopic LASIK in 2001 (for corrected distance visual acuity [CDVA] of −9.25 −2.50 × 30 in the right eye and −10.25 −2.0 × 180 in the left eye) and uneventful laser enhancement in the right eye in September 2010. The postoperative uncorrected distance visual acuity (UDVA) in the right eye was 0.9 and was stable until September 2013. At that time, the UDVA was 0.6, and Machat grade III epithelial ingrowth was diagnosed and treated by flap relifting, debridement, and a contact lens. The UDVA improved to 0.7, but visual complaints continued until November 2014, when epithelial ingrowth recurred and the UDVA decreased to 0.6.

The Nd:YAG laser (Abraham capsulotomy Nd:YAG laser lens, Oculus Instruments) was used to treat the ingrowth. Topical anesthesia (chlorohydrate tetracaine 1 mg and chlorohydrate tetracaine oxybuprocaine 4 mg [Colircusi anestésico]) were instilled immediately before
laser treatment. The laser impacts, which ranged from 0.4 to 0.8 mJ, were delivered over the affected area until an explosion bubble was observed and the procedure was repeated. The space between impacts varied, and care was taken to avoid overlapping impacts. Topical tobramycin 0.3%-dexamethasone 0.1% (Tobradex) was prescribed 3 times a day for 7 days and topical hyaluronate acid 0.15% 5 times a day for 1 month.

Spectral domain AS-OCT was performed before the Nd:YAG laser treatment, immediately after the treatment, and 6 weeks and 1 year postoperatively. Slitlamp biomicroscopy of the right eye showed inferotemporal white nests of epithelial ingrowth (Machat grade III) associated with the flap margin; visual acuity was 0.7 (Figure 1, A). Corneal topography (Orbscan, Bausch & Lomb) showed an irregular anterior surface, an incomplete corneal profile, and −0.6 diopter (D) astigmatism at 37 degrees. The AS-OCT of the area of corneal epithelial ingrowth is shown in Figure 1, B. Figure 1, C (slitlamp biomicroscopy) shows the clinical findings immediately after Nd:YAG laser treatment and Figure 1, D (AS-OCT), the craters over the treated area. Craters varied in width and were measured with the caliper tool included on the tomographer for this purpose.

Six weeks after the Nd:YAG treatment, the patient was asymptomatic and the UDVA in the right eye was 0.8 (slight improvement with −0.75 × 45). The biomicroscopy findings are shown in Figure 1, E, and the AS-OCT images, in Figure 1, F. At 1 year, the UDVA remained stable at 0.8, topography showed a regular corneal anterior surface, pachymetry could be measured, and the astigmatism decreased to −0.4 × 25. Figure 1, G (clinical) and H (AS-OCT), shows corneal stromal findings at 1 year.

DISCUSSION

Epithelial ingrowth after LASIK is a complication that can potentially compromise visual acuity because of flap irregularities, melting, or visual axis compromise. In the latter cases, flap relifting and epithelial mechanical debridement are indicated.1–4 Caster et al.5 report a higher risk for clinically significant epithelial ingrowth with flap lifting retreatment performed 3 or more years after primary LASIK. In our case, the retreatment was performed 9 years after primary LASIK; clinically significant epithelial ingrowth was diagnosed 2.5 years later and treated with flap relifting and mechanical debridement. Vision decreased due to a recurrence 1.5 years after debridement, and Nd:YAG treatment was chosen as a second treatment. In the case of ingrowth recurrence after mechanical debridement reported by Caster et al.5 was successfully removed 166 days later with flap lift retreatment. Their report concluded that relifting the LASIK flap after healing had occurred, approximately 3 years after flap creation, had resulted in an increase in clinically significant epithelial ingrowth.

Neodymium:YAG laser treatment has been reported to improve visual acuity, astigmatism, and topography in cases with clinically significant epithelial ingrowth, although LASIK flap complications have been reported with the use.6,8 The Nd:YAG laser emits focal energy at 1064 nm and acts through plasma-mediated tissue ablation with posterior tissue photodisruption.3 Corneal Nd:YAG laser applications include anterior stromal punctures for recurrent erosions, epithelial ingrowth, adjuvant for crystalline keratopathy treatment, and Descemet membrane detachment.10–12 In 1989, Geyer et al.13 reported the disappearance of several argyrotic deposits after Nd:YAG laser shots that caused bubbles in the cornea anterior to iridotomy sites. Ayala et al.14 also reported vacuoles that disappeared gradually after Nd:YAG treatment of epithelial ingrowth.

In our case, stromal epithelial nests, photoablation, stromal healing, and residual scar tissue were revealed with AS-OCT. Normal corneal AS-OCT shows a hyporeflective epithelial layer, the stroma shows variable hyporeflectivity, Descemet membrane is hyporeflective, and the endothelium layer is hyporeflective, whereas epithelial ingrowth is observed as hyporeflective stromal lines with AS-OCT.14,15 In our case, the corneal bubbles were observed clinically and the stromal craters, or vacuoles, revealed with AS-OCT immediately after the Nd:YAG laser treatment. The craters varied in thickness between 280 μm and 490 μm due to the range of energy applied and were not observed clinically or with AS-OCT 6 weeks after treatment. In addition, the stromal hyporeflective band, corresponding to the epithelial nests, progressively regressed, as evidenced by increased stromal hyporeflection and greater corneal transparency. At 1 year, biomicroscopy showed corneal transparency in the treated area and minimal circumscribed scarring, which correlated with tomography stromal hyporeflection and residual circumscribed hyporeflection.

Shen et al.16 observed complete cultured human corneal reepithelialization, loose fibrous tissue filling the ablated stroma, haze, and no endothelial damage after 1 to 25 μm thick craters created with an erbium:YAG laser. Although the Nd:YAG laser craters were larger in our case, epithelial band regularity, restored stromal hyporeflection, and residual hyporeflection suggest that stromal healing, as described by Utsunomiya et al.’s7 observations of corneal wound healing, correlated with clinically observed corneal transparency and scar formation. They also registered residual scarring up to 4 years after the initial insult (foreign-body ulcers) on AS-OCT, and Shen et al.16 concluded that the intensity and time of haze development appeared dependent on the depth of the ablation. Anterior segment OCT also revealed crater overlapping, which indicates greater care should be taken to increase space between laser shots. Further follow-up will determine clinical and OCT findings.
Figure 1. Slitlamp biomicroscopy shows an inferotemporal white geographic area of epithelial ingrowth more than 2.0 mm beyond the flap edge before the Nd:YAG laser treatment and dispersed peripheral nests at 4 o’clock. A: Spectral-domain AS-OCT shows normal corneal hyperreflective epithelial and endothelial band, with stromal (171 µm depth) hyperreflective bands of varying depths (51 to 171 µm). B: Slitlamp biomicroscopy shows multiple Nd:YAG laser impacts over the affected area. C: Anterior segment OCT shows corresponding Nd:YAG laser well-confined ablation craters, measuring from 280 to 490 µm, along the ingrowth hyperreflective band and epithelial and endothelium band irregularity. D: Six weeks after Nd:YAG laser treatment, slitlamp biomicroscopy shows increased corneal transparency and residual corneal scarring (E); AS-OCT image (F) shows larger areas of stromal hyporeflectivity, peripheral scar regression with residual central hyperreflectivity; craters are no longer observed. One year after Nd:YAG laser treatment, slitlamp biomicroscopy shows inferotemporal corneal transparency and a residual oval scar (G). The AS-OCT shows hyperreflective epithelial and endothelial layers and focal stromal irregular hyperreflectivity with increased hyporeflectivity (H).
In conclusion, we believe that AS-OCT is a useful tool to evaluate corneal healing after Nd:YAG laser treatment for recurrent epithelial ingrowth.

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