Effect of intraoperative optical coherence tomography on anatomic and cosmetic results of intrastromal tattooing

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Abstract:

PURPOSE: The aim of the study was to evaluate the effect of intraoperative optical coherence tomography (i-OCT) on anatomic and cosmetic outcomes of intrastromal keratopigmentation (i-KTP) performed by novice lamellar corneal surgeons.

METHODS: Thirty patients presenting with unilaterally disfiguring corneal scar and nil visual prognosis were subjected to i-OCT-guided intrastromal tattooing with rotring ink, by ophthalmology residents undergoing training in corneal surgeries at our center, who were later asked for a subjective feedback and mean stromal depth dissected was measured objectively. All patients were followed up for 9 months after surgery, and the subjective satisfaction of the patient, an independent observer, and surgeon was graded as poor, good, and excellent.

RESULTS: The mean age of the patients was 29.53 ± 13.82 years (8–56 years). The most common cause of corneal opacity was healed keratitis with (6/30) or without (3/30) adherent leukoma, trauma-induced ocular disfigurement (7/30), and bullous keratopathy (6/30). All residents reported that feed-back images on i-OCT were “helpful” in all eyes and “very helpful” in eyes with corneal thinning, stromal scarring, adherent leukoma, bullous keratopathy, and hypotony. The mean depth of lamellar dissection was 51.16% ±4.62% of preoperative corneal thickness. The cosmetic results as perceived by the patient, an independent observer, and the surgeon were excellent and good in 23 and 7, 26 and 4, and 20 and 10 patients, respectively.

CONCLUSION: I-KTP may be employed as a primary method of cosmetic correction of unsightly corneal scars. Centers equipped with i-OCT may employ this tool for teaching i-KTP to their ophthalmology residents for better surgical results with minimal complications.

Keywords: Adherent leukoma, corneal perforation, intraoperative optical coherence tomography, intrastromal tattooing

INTRODUCTION

Unilateral corneal opacities are cosmetically disfiguring and can adversely affect the social and professional lives of the affected individuals. Commonly utilized methods of cosmetic improvement include iris-colored contact lenses and orbital prosthesis (after enucleation or evisceration). However, the need for repeated application and removal, risk of infections, accidental loss, and poor satisfaction, tolerance, or fittability may not always make them feasible in developing countries.\(^{[1,2]}\)

Cosmetic penetrating keratoplasty (PKP) may also be limited by the availability of donor tissues and antecedent complications such as rejection, failure, and suture-related problems. Corneal tattooing or keratopigmentation is an effective alternative method of treating unsightly corneal scars and symptom causing iris defects.\(^{[3-9]}\) Surface tattooing with chemical reduction effectually stains the cornea black, but, may be associated with an imperfect geometrical configuration, early postoperative discomfort, and rapid fading of the stain.\(^{[4,10-12]}\)

Intrastromal keratopigmentation (i-KTP) with carbon impregnation provides a faster and less symptomatic postoperative recovery (by
decreasing trauma to the corneal epithelium and Bowman’s membrane) besides providing a more homogenous and long-lasting color by means of dual surface tattooing and intracellular entry of carbon-containing materials. Rotring ink is a type of stationery available and long-lasting painting ink sterilized form of which has been used successfully for staining of the cornea. Different colors of the ink can be mixed to match contralateral iris color in individuals with light iris. Although the exact composition of this dyeing material remains elusive, the presence of 85% water and 10% water-insoluble carbon compounds makes it biocompatible and resistant to chemical changes with sterilization. Numerous techniques described to introduce carbon-containing coloring agent into the corneal stroma include multiple micropunctures guided by needle, manual dissection, microkeratome-assisted flap creation, or lamellar keratectomy. However, all these techniques have difficulty in accurately predicting the depth traversed by the needle or the blade due to their blind nature and can result in inadvertent damage to Bowman’s membrane or corneal perforation. Utilizing advanced microsurgical methods such as femtosecond laser and intrastromal corneal rings for the creation of intrastromal pockets may also be limited by doubtful penetration of the former through the dense corneal opacities and risk of perforation with the latter in eyes with irregular corneal thickness or adherent leukomas, alongside their inflated cost and limited availability.

Microscope-integrated intraoperative optical coherence tomography (i-OCT) is a relatively recent addition to the armamentarium of corneal surgeons that incorporate optical coherence tomography (OCT) in the operating microscope. The heads-up display unit of OCT incorporated microscope provides real-time dynamic feedback images of interaction between ocular structure and instruments and is indispensable in guiding various anterior as well as posterior lamellar corneal surgeries. The adjunct use of histology level feedback provided by the modality, thus, may be expected to enhance the safety and precision of lamellar dissection during intrastromal tattooing and make it a controlled, predictable, and reproducible procedure with better anatomical outcomes.

In the present study, we describe the effect of i-OCT on lamellar dissection and in gauging the end point of tattooing during i-KTP with rotring ink by novice lamellar corneal surgeons and its results on surgical and cosmetic outcomes.

### Methods

This was a nonrandomized, noncomparative, prospective, interventional, and multisurgeon study carried out at Dr. Rajendra Prasad Centre for Ophthalmic Sciences and was approved by Ethical Board Committee of the institute. The tenets of Helsinki declaration were followed, and adequate written informed consent was obtained for each patient.

### Selection of patients

Thirty eyes of thirty consecutive systemically healthy patients presenting to our cornea clinic with unilateral cosmetic disfigurement from corneal or noncorneal disorders with nil visual prognosis were included in the study. Any patient with active intraocular/extraocular inflammation/masses was excluded from the study. All patients were subjected to thorough slit-lamp examination, intraocular pressure assessment, anterior segment OCT (ASOCT), B-scan ultrasonography, and visually evoked potential (VEP) measurement. ASOCT was chosen over ultrasound bio-microscopy as it is a noncontact procedure, can be undertaken in hypotonous eyes and children, does not carry risk of bullae rupture, and provides relatively more magnified details of the cornea layers and angle structures. All the patients/guardians (in case of a minor) were offered the other methods of cosmetic enhancement including cosmetic contact lenses, keratoplasty, and prosthetic eye implants. The need for retreatments was explained to all patients/guardians and preoperative slit-lamp and face photographs were obtained for comparison. The surgical procedure was undertaken at least 6 months after suppression of primary inflammation. i-KTP was performed using rotring ink (gmbh; Hamburg, Germany) by ophthalmic surgeons undergoing senior residency course at our center. These residents were trained in PKP (n ≥ 100) but inexperienced in lamellar corneal surgeries (n ≤ 10). They were given a feedback form to share their experience about the role of i-OCT as “very helpful” or “helpful,” or “not helpful” during surgery. The cosmetic appearance perceived by the patient, an independent observer, and the surgeon were graded separately as “poor,” “good,” or “excellent” [Table 1] at every follow-up after the surgery.

### Surgical technique

The surgery was carried out under general anesthesia in children and peribular anesthesia in adults [Figure 1a-I] SDC-1. At the beginning of the procedure, the cornea and the anterior chamber were screened from limbus-to-limbus using an 8 × 8 cube on i-OCT (OPMI LUMERA 700 and Rescan 700, Carl Zeiss Meditec AG, Oberkochen, Germany) to determine the areas of corneal thinning and

| Parameter | Grading |
|-----------|---------|
| Observer’s evaluation | |
| Poor: Unacceptable aesthetic aspect and cosmetic appearance not comparable to the fellow eye | 0 |
| Good: Acceptable aesthetically and cosmetic appearance comparable to the other eye | 1 |
| Excellent: Excellent aesthetic aspect and cosmetic appearance similar to the other eye | 2 |
| Patient’s satisfaction | |
| Poor: Unhappy and wants repeat tattooing | 0 |
| Good: Happy | 1 |
| Excellent: Very happy | 2 |
| Surgeon’s satisfaction | |
| Poor: Stain density significantly decreased and needs repeat tattooing | 0 |
| Good: Stain density decreased but does not need repeat tattooing | 1 |
| Excellent: Stain density not decreased | 2 |
the presence of any underlying iris adherence. The site of tattooing was marked using disposable trephines, especially in cases of localized tattooing. A 4 mm partial thickness clear corneal incision aimed at 50% depth (the depth was decided based on prior studies) was created 1 mm away from the limbus with a microcrescent knife (Sharpoint, Surgical Specialties Corporation, Wyomissing, PA; USA). This was appreciated on i-OCT as a hyporeflective pocket surrounded by hyperreflective stromal layers on either side. The instrument-stroma relationship was assessed constantly on i-OCT and a 2 mm wide lamellar pocket was created centripetally and sideways from the main incision. Further dissection was carried out only when the tip of the dissector was visualized in the right plane on i-OCT, and immediate corrective maneuvers were performed whenever required. Black color rotring ink sterilized in a sterile infusion bottle at 121° for 20 min in an autoclave was introduced into the pocket through the main incision after placing it on lamellar dissector or iris spatula. A merocel sponge (Beaver-Visitech International, Inc. New York, US) was placed at the incision site to soak any excess ink leaking from it at the time of injection. Complete shadowing of underlying structures on i-OCT was considered as the end point of i-KTP, and the stroma was stained repeatedly till this end point was reached. At the end of the procedure, the excess dye was liberally washed with balanced salt solution (BSS), a drop of prophylactic antibiotic was placed in the inferior cul-de-sac and eye was patched overnight. The allied supplemental Digital Content 1 shows the surgical steps of the i-KTP.

Follow-up

Prophylactic preservative-free antibiotics (moxifloxacin hydrochloride 0.5%), low potency steroid (dexamethasone 0.1%), homatropine 2% cycloplegia, and lubricants (carboxymethylcellulose o. 5%) were prescribed for 2 weeks. The patients were followed up on the 1st day, the 1st week, and at 1 month, 3 months, 6 months, and 9 months after the surgery and the cosmetic appearance was graded at every follow-up. The central corneal thickness was assessed preoperatively and compared with residual postoperative central corneal thickness.

Results

The mean age of the patients was 29.53 ± 13.82 years (8–56 years). The most common cause of corneal opacity was healed keratitis with (6/30) or without (3/30) adherent leukoma, trauma-induced ocular disfigurement (7/30), and bullous keratopathy (BK, 6/30). The VEP was extinguished in all eyes.

Summary of surgical experience

All residents subjectively reported that the feed-back images on i-OCT were “helpful” in smooth and safe limbus to limbus lamellar dissection in all eyes and “very helpful” in eyes with irregular corneal thinning, stromal scarring, adherent leukoma, BK, and hypotony [Table 2]. They also stated that the external video display panel was superior to the “heads-up” image for visualization of tissue details due to the size and quality of the images. All residents described that the utilization of i-OCT
images did not interfere with the surgical procedure and that they were more likely to use it in their future practice due to its obvious benefits [Video 1].

The peripheral screening of the anterior segment anatomy at the onset of the procedure aided in determining the site of initial incision depending on the stromal thickness and iris adhesions, in selecting an appropriate instrument and determining the amount of force required for lamellar dissection in areas of fibrotic scar and in procedural completion by guiding the end point of tattooing. This was particularly helpful in children where poor patient cooperation limited preoperative assessment of various ocular details. All residents preferred temporal incision (due to underlying surgical experience in phacoemulsification) for lamellar dissection and site the incision was shifted to

| Age/sex | Eye | Diagnosis | Site of pocket creation | Concomitant procedure | Remarks on dissection | Preoperative and postoperative CCT | Surgical feedback on i-OCT |
|---------|-----|-----------|--------------------------|-----------------------|----------------------|----------------------------------|--------------------------|
| 8/female | OS | Posttraumatic repaired corneal perforation | Inferotemporal | - | Fibrotic scar | 600/356 | Helpful |
| 26/male | OD | Lipid keratopathy | Temporal | - | Uneventful | 808/538 | Helpful |
| 28/male | OS | Failed PKP | Temporal | - | Dissection limited to graft | 685/370 | Helpful |
| 46/female | OS | Aphakic BK | Deep temporal, superficial inferior | ED with ASP | Multiplanar | 1010/580 | Very helpful |
| 22/female | OD | Repaired scleral perforation with cataract | Temporal | - | Hypotony, deviation from desired plane | 540/254 | Very helpful |
| 55/male | OD | Pseudophakic BK | Deep temporal, superficial inferior | ED with ASP | Uneventful | 947/495 | Very helpful |
| 28/male | OD | Adherent leukoma | Superotemporal | - | Uneventful | 584/300 | Very helpful |
| 22/male | OS | Traumatic aniridia with cataract | Temporal | - | Uneventful | 498/250 | Helpful |
| 13/female | OS | Healed keratitis with BSK | Superior | BSK removal | Thinning | 465/220 | Helpful |
| 29/female | OD | Previously operated intrastromal tattooing | Temporal | - | In the previously dissected plane | 768/380 | Very helpful |
| 23/male | OS | Aniridic IOL induced BK | Temporal | Squint surgery | Uneventful | 987/504 | Helpful |
| 45/male | OD | Healed keratitis with Vascularised LCO | Temporal | - | Uneventful | 479/248 | Helpful |
| 32/female | OD | Healed keratitis | Temporal | - | Thinning | 525/246 | Very helpful |
| 13/female | OS | Posttraumatic corneal opacity | Superior | - | Fibrotic scar | 723/345 | Helpful |
| 12/male | OS | Healed keratitis | Superior | - | Uneventful | 532/269 | Helpful |
| 25/male | OD | Posttraumatic atrophic bulbi with shrinkage | Inferotemporal | - | Thinning | 520/260 | Very helpful |
| 34/female | OS | Adherent leukoma with BSK | Superotemporal | BSK removal | Uneventful | 545/280 | Helpful |
| 56/female | OD | Pseudophakic BK | Deep Temporal, superficial inferotemporal | ED with ASP | Multiplanar | 1101/561 | Very helpful |
| 18/female | OD | Failed PKP | Superior | - | Uneventful | 670/348 | Helpful |
| 47/male | OD | Posttraumatic repaired corneal perforation | Temporal | - | Fibrotic scar | 643/302 | Very helpful |
| 28/female | OS | Failed penetrating keratoplasty | Temporal | - | Dissection limited to Graft | 689/325 | Helpful |
| 36/female | OD | Pseudophakic BK | Temporal | ED with ASP | Uneventful | 761/331 | Very helpful |
| 53/male | OD | Aphakic BK | Deep temporal, superficial superior | - | Multiplanar | 854/426 | Very helpful |
| 27/male | OS | Posttraumatic repaired scleral perforation with cataract | Superotemporal | - | Hypotonus eye | 487/238 | Very helpful |
| 9/female | OD | Lipid keratopathy | Temporal | - | Uneventful | 564/278 | Helpful |
| 48/male | OS | Healed keratitis with vascularised LCO | Temporal | - | Thinning | 598/287 | Very helpful |
| 26/male | OD | Failed PKP | Superior | - | Uneventful | 747/396 | Helpful |
| 22/male | OD | Posttraumatic corneoiridic scar | Inferotemporal | - | Fibrotic scar | 689/365 | Helpful |
| 16/female | OS | Adherent leukoma | Inferotemporal | Squint surgery | Uneventful | 538/243 | Helpful |
| 39/female | OD | Healed keratitis with phthisis bulbi | Temporal | - | Uneventful | Difficult to assess | Helpful |

*Age in years. PKP=Penetrating keratoplasty; BK=Bullous keratopathy; IOL=Intraocular lens; LCO=Leumocatous corneal opacity; MB=Microcrescent blade; ED=Epithelial debridement; ASP=Anterior stromal puncture; BSK=Band shaped keratopathy; CCT=Central corneal thickness in microns; i-OCT=Intraoperative optical coherence tomography; OD= Oculus dextrus; OS= Oculus Sinister
other locations depending on the area of corneal thinning/scarring or iris adhesions as depicted on i-OCT in 13 patients. The mean central corneal thickness and the attained depth of dissection were 673.65 ± 173.41 μm and 346.96 ± 117.85 μm, respectively [Table 2 and Figure 2]. The mean depth of dissection was 51.16% ±4.62%. The depth of dissection was modified based on the distribution of stromal thickness and any at-risk (of perforation) areas of the cornea were left undissected and unstained to be planned later for a localized chemical reduction based on the postoperative appearance and patient satisfaction.

In eyes with iridocorneal adhesions, dynamic tracking of the instruments on i-OCT prevented accidental iris trauma and subsequent bleed during dissection by identifying the site of iris adhesions. In one eye where the plane of dissection deviated from the desired depth intraoperatively, an immediate corrective maneuver was undertaken under the guidance of i-OCT [Figure 3a]. In five eyes with clinically undetected deep stromal vascularization, accidental intrastromal bleeding [Figure 3b and c] was identified on i-OCT by the presence of hyperreflective dots in the hyporeflective plane of dissection, and the pocket was washed with BSS. In four cases with thick fibrotic stromal tissue secondary to ocular trauma, the scar tissue was visualized as a full-thickness hyperreflective lesion on real-time OCT, and this was dissected with a microcrescent knife [Figure 3d and e]. In one eye with previously operated i-KTP on conventional ophthalmic microscope, i-OCT aided in the identification of the previous plane of dissection [Figure 3f and g]. This plane could be appreciated because the ink is usually found as linear clumps in the stroma with minimal scarring or fibrosis.

In 4 eyes with BK where i-OCT showed thickened epithelium, epithelial debridement (using 10% alcohol) followed by multiple (≤30) anterior stromal punctures (ASP) using 30G needle and placement of bandage contact lens (removed at 7 days after surgery) was undertaken [Figure 3h and i]. i-OCT aided in maintaining the needle tip superficial to the previously dissected plane during ASP. In three eyes with BK, a second plane of dissection was created superficial to the previous plane, and this was tattooed additionally as the residual anterior stroma depicted hyperreflectivity on i-OCT.

Complications
No intraoperative perforations were noted in the present study, and the intrastromal dissection was successful in all eyes without giving away either anteriorly or posteriorly. In first few eyes where the rotting ink was injected into the stromal pocket using an intradermal syringe attached to a 30G needle/cannula, seepage of the ink into the surrounding tissues that was difficult to wash away with BSS, unnecessary staining of conjunctiva and redness, and irritation immediately after surgery were noted. No similar side effects were noted when lamellar dissector laden with ink was used to stain the stroma. The epithelial defect at wound site healed completely by 1st postoperative day in all patients and no leakage of ink was noted in the postoperative phase in any patient. One patient with preexisting glaucoma developed raised IOP immediately after surgery which was successfully controlled on topical antiglaucoma medications.

Postoperative course
All patients completed the 9-month follow-up and described their subjective cosmetic appearance as good (7/30) to excellent (23/30) with none reporting poor satisfaction with the procedure [Figure 4]. The cosmetic results as analyzed by an independent observer and the operating surgeon were classified as excellent and good in 26 and 4 and 20 and 10 patients, respectively. While the surgeon noted fading of the ink in ten eyes (6 BK, 3 failed graft, 1 healed keratitis) and all patients were ready for a repeat procedure, none required it till 9-month follow-up.

Discussion
With recent advances in contact lenses and keratoplasty techniques, the use of corneal tattooing seems to be decreasing with time. Although i-KTP seems to be gaining popularity due to an extensive work undertaken by Alio et al., the last study on intrastromal tattooing (using metallic agents) in Indian eyes was conducted in 1984, and to the best of our knowledge, this is the first study on i-OCT-guided intrastromal tattooing using rotting ink in Indian population.\[^{5-9,12}\]

![Figure 2: Preoperative (a-c) and corresponding postoperative (d-f) corneal thickness of patients](image-url)
Despite establishing the long-term safety of rotring ink in animal and human studies, its ocular or systemic toxicity cannot be ruled out and every attempt should be made to prevent its inadvertent intraocular entry.\textsuperscript{11,16} Lack of intraoperative perforation in any of our patient could be mainly attributed to the use of i-OCT during lamellar dissection. However, even previous studies on intrastromal tattooing conducted without the aid of i-OCT have not reported any perforation till date. Nevertheless, in contrast to the previous studies where blind lamellar dissection was usually performed by an experienced surgeon(s), the surgeries in our study were performed by resident ophthalmic surgeons inexperienced in lamellar corneal surgeries.\textsuperscript{12,16} To the best of our knowledge, this is the first study reporting potential benefits of i-OCT on
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It is already known that novice surgeons experience more stress when compared to the experienced surgeons, especially during the beginning of the surgery and therefore may be at higher risk of making errors and i-OCT holds a putative advantage as a learning tool for these residents.\[26-28\] During i-KTP, the precise depth of the main incision and further dissection, visibility of which may be particularly compromised in opacified corneas, remain the most crucial steps in determining success. While Ultrasonic pachymetry and ASOCT can also be employed for this purpose, these are preoperative imaging modalities and cannot be used intraoperatively without disturbing the surgical sterility.\[6,9\] At present, i-OCT is the only noninvasive, noncontact imaging modality that can provide real-time visualization of intraoperative cross-sectional details of the corneal tissue and dynamic stroma-instrument interaction. The high-definition scans obtained on i-OCT helped all surgeons in guiding not only the desired depth of dissection but also the end point of tattooing in our study. These high-quality feedback images also enhanced the surgical performance of our residents and favored their subjective surgical experience by converting blind dissection into a predictable surgeon-controlled procedure. As this sustained learning is expected to persist even when the direct i-OCT assistance is removed, the centers equipped with this facility should, therefore, make it a norm to train ophthalmic residents keen toward learning i-KTP under the guidance of i-OCT irrespective of its subsequent availability to the trainee in his/her practice.\[29,30\] This i-OCT-assisted sustained learning is expected to boost the confidence of residents and encourage them to undertake i-KTP even on a conventional ophthalmic microscope at an affordable cost in future. However, whether this learning translates into improved anatomic and cosmetic outcomes need to be justified with larger comparative trials considering the inflated cost and limited availability of i-OCT in the present scenario. While a smooth wound configuration and absence of dye leak with spatula application decreased the need of suturing the main wound in our study, it is up to the discretion of the operating surgeon to suture the wound based on their discretion and preference. In our study, while a preoperative ASOCT-guided appropriate case selection, serial postoperative ASOCT images allowed comparison of CCT measurements and uniformity of dye application. Larger ASOCT and i-OCT-based studies infuture may also favor an exact amount of ink needed for best long-term results.

The use of lamellar dissector for stromal staining in our study can be justified as direct injection of ink into the stromal pocket with the aid of 30G needle/cannula in the first few cases resulted in leakage of ink in the intraoperative phase, conjunctival staining, irritation, and redness during the early postoperative period [Figure 5]. Furthermore, surface penetration of cornea with 27 or 30G needles may be associated with epithelial healing problems (especially in already decompensated corneas), Bowman’s membrane damage, patchy pigmentation, early fading of the dye, and epithelial ingrowth.\[6,16,20,29,31\] Yet, large long-term randomized controlled trials are essential to verify the superiority of one technique over the other and until then any technique can be adopted based on surgeon preference and experience.

To the best of our knowledge, this is the first study using the shadowing effect of ink on underlying structures (as depicted on i-OCT) as an end point of corneal tattooing. This demonstrated excellent cosmetic results in 76.66% of eyes with none reporting poor cosmetic outcome despite the surgeon reporting fading of the stain on slit-lamp examination in 33.33% of eyes. This indicates that the patient’s personal and social perception of the disfigurement is more important than the surgeon’s interpretation of corneal staining. As partial clearing of pigments has been reported in eyes with BK owing to the fluctuating nature of corneal edema, any residual anterior stromal haze was overcome with i-OCT-guided multiplanar tattooing whenever deemed necessary in these eyes.\[3\] Concomitant procedures such as strabismus surgery, BSK removal, and ED with ASP were also performed successfully with i-KTP with minimal fear of perforation in our study, thereby reducing the need for more extensive and invasive reconstructive ocular procedures.\[1,5,7,12,19\] Our study also demonstrated that i-KTP can be a successful primary method of cosmetic correction in phthisical eyes and eyes with calcific corneal deposits, corneal neovascularization (deep or superficial), and impeded corneal epithelization, etiologies usually excluded in prior studies.\[1,5,19\]

This study was limited by a small and nonrandomized sample size, a case selection bias towards more straightforward cases based on the surgeon’s preference (patients with adequate CCT on preoperative ASOCT were only selected), relative inexperience of the operating surgeons, a short-term follow up, and a possibility of bias in the cosmetic results due to subjective satisfaction ratings. Larger, randomized controlled studies would provide more definitive results regarding the potential benefit of i-OCT in operative efficiency and postoperative outcomes of i-KTP.

Figure 5: Spread of ink and conjunctival staining after injection of ink with 30G needle/cannula (a-c) and minimal spread with iris repositor (d)
CONCLUSION

The present study demonstrates encouraging results of i-OCT in facilitating the surgical experience and optimal decision-making of the novice corneal surgeons during i-KTP. Centers equipped with i-OCT may employ this an effective tool for enhancing learning of their ophthalmology residents as well as for better surgical results with minimal complications. The combination of new technology with an old technique might increase the popularity of the tattooing procedure in the coming times with more novice surgeons adopting to this technique as a primary method of cosmetic correction in disfiguring corneal scars along with a willingness for a repeat procedure whenever necessary.

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Conflicts of interest

There are no conflicts of interest.

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