Original Article

Corneal tattooing for esthetic purposes in patients with corneal opacities

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Purpose: This study evaluated corneal tattooing for esthetic purposes in patients with corneal opacification. **Methods:** Eight eyes of eight patients were included in the study (four males and four females). Corneal tattooing was achieved by stromal puncture in five patients, femtosecond laser-assisted corneal tattooing in two patients, and femtosecond laser-assisted corneal tattooing and stromal needling (combined procedure) in one patient. In six of the patients, the entire cornea was stained black; in one patient, the center of the cornea (3 mm) was stained black and the periphery was stained dark brown; and in the last patient, the corneal periphery was stained dark brown. Patient satisfaction was evaluated on the first day after surgery and at the last visit as follows: Very satisfied (4), satisfied (3), moderately satisfied (3), and not satisfied (1). **Results:** The patients ranged in age from 11–80 years. The mean satisfaction score of the patients was 4 and 3.5 on the first postoperative day and at the last visit, respectively. No complication occurred during or after surgery. **Conclusion:** Corneal tattooing for esthetic purposes was successful in both blind eyes and seeing eyes.

Key words: Corneal opacity, corneal tattoo, esthetic purpose

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The practice of staining opacities and scars on the cornea dates back 2,000 years.[1] The first practitioners of corneal tattooing were Galen in 150 AD and Aetius in 240 AD.[2] Corneal tattoos were used for eye diseases in the second half of the 19th century, and in the early 20th century for esthetic purposes.[3-5] However, the practice has lost popularity in recent years because of technological and surgical advances in treating eye diseases.

Corneal tattooing is performed in select cases for esthetic or functional purposes. It is used for esthetic purposes in patients who cannot use cosmetic contact lenses, and for functional purposes to improve visual quality in patients with iris problems and albinism.[6,7]

Chemical staining with gold and platinum, nonmetallic staining with India ink,[8] and lamp black ink and organic dyes are used in corneal tattooing.[9] When staining the cornea, techniques such as simple corneal staining, stromal puncture, intrastromal lamellar dissection,[10] corneal incisions with excimer lasers, and femtosecond lasers are used.[11]

Here, we present the results of corneal tattooing for esthetic purposes using a femtosecond laser and/or stromal puncture.

Methods

Eight eyes of eight patients were included in the study. Six of these eyes were absolute eyes with no light perception. One patient with a history of four prior keratoplasties had a visual acuity of 20/100. The last case had a visual acuity of 20/400 and a history of penetrating keratoplasty and strabismus surgery. None of the patients could use cosmetic lenses. Six cases with no light perception were those who did not accept prosthesis. All patients were informed of the risks associated with the procedures, and corneal tattooing was conducted after obtaining informed consent. This study was reviewed and approved by the Malatya Ethics Committee (protocol code: 2019/117).

In all cases, corneal tattooing was conducted using topical anesthesia (0.5% proparacaine HCl, Alcaine; Alcon, Fort Worth, TX, USA). The dyes used in the procedure were Food and Drug Administration-approved sterile dyes used in skin tattooing applications (Intenze Products, Inc., Rochelle Park, NJ, USA).

The color of the other eye was used to select the color of the dye in each case. Black dye was preferred for dark brown eyes, whereas in one patient with relatively light brown eyes, black was preferred in the central 3 mm of the pupillary area and dark brown dye was used for peripheral corneal staining. Dark brown dye was used for peripheral corneal staining in patients with partial vision.

The clinical characteristics of our patients are listed in Table 1. Corneal tattooing by stromal puncture was used in five patients. Adjacent tunnels from the limbus to the corneal stroma were opened in a centripetal fashion using a 23-gauge angled knife in the half-thickness of the cornea for stromal puncture. Black dye was injected into these tunnels with an insulin syringe. In this manner, the entire cornea was stained.

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In four of these cases, the entire corneal surface was stained black. However, in the other case, the central 3 mm of the pupillary area was marked and stained with black dye while the peripheral corneal area was stained with dark brown dye [Fig. 1].

In two cases, femtosecond laser-assisted corneal tattooing (Intralase FS 150 kHz Femtosecond Laser; Abbott Medical Optics, Santa Ana, CA, USA) was used with the following settings: 100 μm flap thickness, 9.5 mm flap diameter, 90° side cut, and 1.80 muJ raster energy [Fig. 2]. The stromal tunnel was opened by a spatula through a 15° lateral incision at the 90° position, and black dye was injected into this area to complete the staining [Fig. 2].

In one case, femtosecond laser-assisted corneal tattooing and stromal puncture were combined. This patient had a history of four prior penetrating keratoplasty surgeries and peripheral corneal whitening; the best-corrected distance visual acuity was 20/100 in this eye, and 20/20 in the fellow eye. A 200-μm deep lamellar ring-shaped corneal incision was performed using a femtosecond laser from outside (9.5 mm) to inside (8.00 mm). A total of 3 mm of peripheral staining was planned [Fig. 3]. A 15° lateral incision was made at the 0° and 180° positions. The intracorneal incision was separated with a spatula in the temporal area, but the femtosecond intracorneal incision failed. We thought that it was due to nephelion in the nasal area. Therefore, the staining was completed by stromal puncture in the nasal area and direct staining of the temporal area through the laser incision. Dark brown dye was used to match the other normal-appearing eye. The eyes were closed with antibiotic ointment. One drop of ofloxacin eight times per day and one drop of fluoromethanol four times per day were used postoperatively to treat all eyes, followed by epithelial healing.

Patient satisfaction was assessed in front of a mirror. The levels of satisfaction on the first postoperative day and at the last visit were recorded as: Very satisfied (4), satisfied (3), moderately satisfied (2), and not satisfied (1).

Results

Corneal tattooing was conducted on eight eyes of eight patients [Table 1]. Four of our patients were male, and four were female; they ranged in age from 11–80 years [Table 1]. The follow-up periods are listed in Table 2. No patient developed an intraoperative or postoperative complication. Two patients who had visual acuities of 20/100 and 20/400 retained their visual acuities. Corneal epithelization was completed on the second postoperative day in all eyes. On the first day of surgery and at the last visit, the mean patient satisfaction levels were 4 and 3.5, respectively [Table 2]. No additional staining was required in any case. All patients were photographed before and after surgery [Fig. 4].

Discussion

Corneal tattooing is performed in select cases for esthetic and functional purposes. Corneal tattooing is the only option for esthetic purposes, especially in patients with total vision loss and corneal and/or intraocular opacities. We suggest that corneal tattooing for functional purposes is preferable to other options because of the inability to use cosmetic contact lenses in

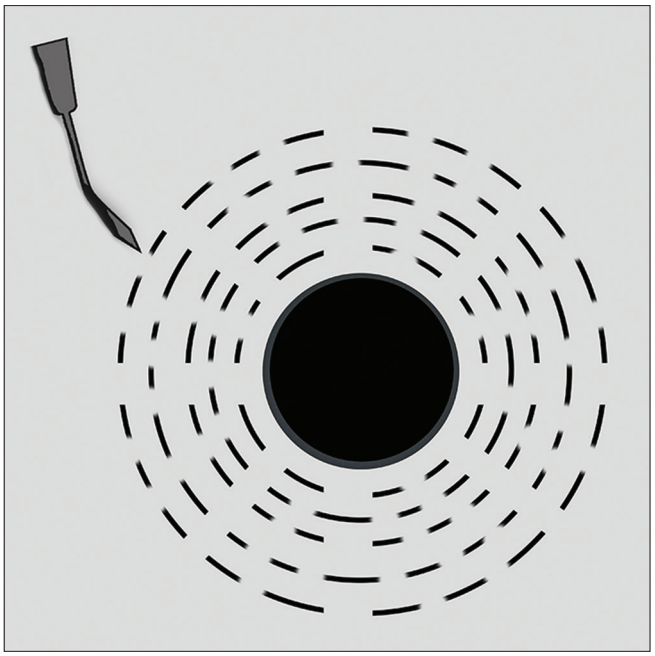

Figure 1: An illustration of stromal puncture method

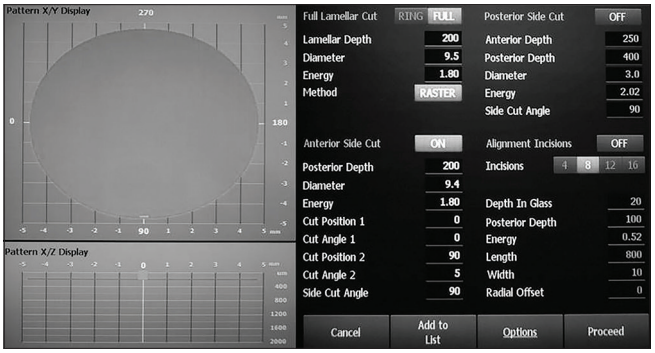

Figure 2: Femtosecond laser profile and energy selection in Case 3 and 7 (total 9.5 mm intracorneal 200 μm depth lamellar incision and 15° side incision plan at 90°)

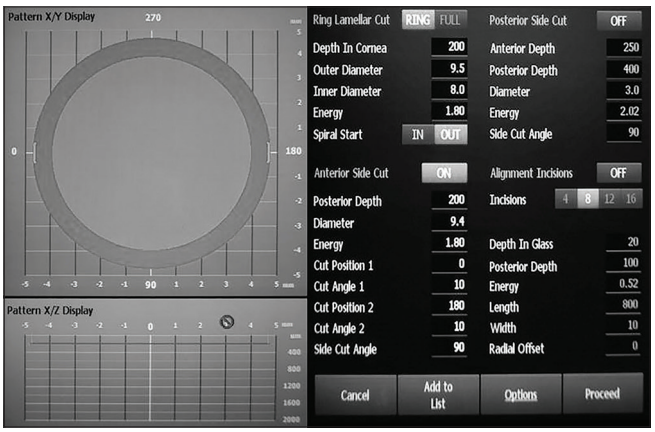

Figure 3: Femtosecond laser profile of Case 2 (intracorneal 200 μm depth lamellar incision with an outer diameter of 9.5 mm and an inner diameter of 8 mm, and 2 15° lateral incisions at 0°–180°)

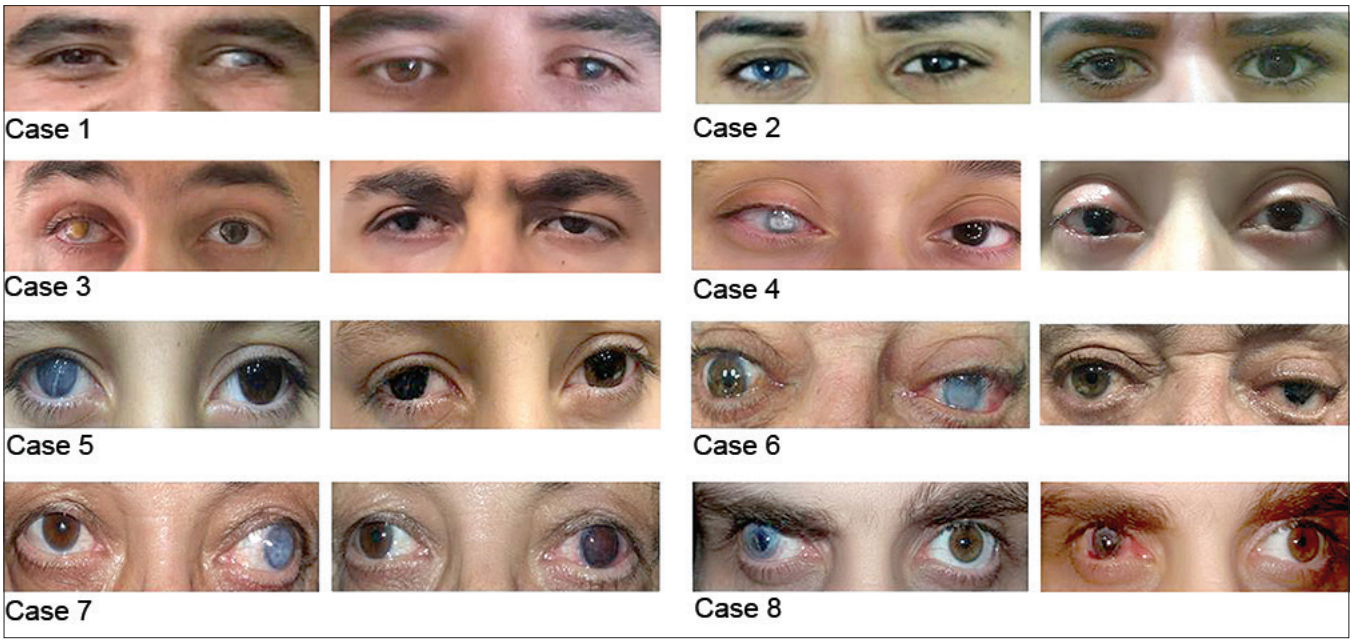

Figure 4: Preoperative and postoperative views of the cases

Table 1: Demographic features of the patients

NOP	Age	Gender	Opacity Reason	Findings	Surgical procedure	IOP (mmHg)
1	31	M	Corneal trauma	Corneal leukoma	Stromal puncture	Hypotonic
2	31	F	Four times keratoplasty surgery	Peripheral corneal opacification	Combined surgery	16
3	25	M	Previous pars plana vitrectomy and glaucoma surgery	Retrocorneal membrane	Femtosecond laser	20
4	32	F	Previous eye injury, pars plana vitrectomy and glaucoma surgery	Corneal leukoma	Stromal puncture	18
5	11	F	Corneal trauma and scar formation	Corneal leukoma	Stromal puncture	Hypotonic
6	80	M	Previous cataract and glaucoma surgery	Corneal leukoma	Stromal puncture	Hypotonic
7	53	F	Previous cataract surgery, and pars plana vitrectomy	Corneal leukoma	Femtosecond laser	17
8	34	M	Penetrating keratoplasty and strabismus surgery	Peripheral corneal opacification	Stromal puncture	15

Table 2: Follow-up time and results of patients

NOP	Follow-up time	Last visit	Patient satisfaction scale	
			PO first day	PO last visit
1	14 months	Minimal fading	4	3
2	11 months	normal	4	3
3	13 months	normal	4	4
4	12 months	normal	4	4
5	11 months	normal	4	4
6	10 months	normal	4	3
7	8 months	normal	4	4
8	7 months	normal	4	4

PO: Postoperative

deformed corneas, rejection of prosthetic eyes by patients, poor long-term outcomes of keratoplasty in blind and vascularized eyes, and the esthetically unacceptable results of keratoplasty.

In our study, corneal tattooing was conducted in eyes with and without a degree of visual acuity, but only for esthetic purposes.

Various methods for corneal tattooing have been described. There are advantages and disadvantages to these methods. The impregnation method was the first corneal tattooing method, but penetration and the staining ability of the dye in the cornea are limited. In the stromal puncture technique, corneal perforation may occur in very thin areas of the cornea during the procedure, in addition to a lack of full (homogeneous) dye distribution. In manual lamellar keratectomy or femtosecond laser-assisted intrastromal incision techniques, the dye spreads homogenously and the visual results are more satisfactory. In particular, corneal tattooing can be made easier and faster using a femtosecond laser-assisted process. We performed femtosecond laser-assisted corneal tattooing in three cases. In one of our patients, because an esthetic problem occurred due to the retrocorneal membrane and the cornea was transparent,

we were able to perform the surgery very easily, quickly, and successfully. In another case, the femtosecond laser made the desired incision of approximately 180° in the temporal cornea, while the femtosecond laser-assisted intrastromal incision at 180° in the nasal quadrant failed because of opacities in the peripheral cornea. Therefore, we had to complete the tattoo using the stromal puncture technique in the nasal area, while staining through the intrastromal incision in the temporal area. It is important to carefully inspect the scar tissue in the cornea when planning for femtosecond laser-assisted corneal tattooing, especially in the area to be incised. As is well-known, the femtosecond laser system fails in areas with corneal scars.

One of the most important problems in corneal staining is matching the color with the other eye. In our patients, we preferred to use black in cases with a dark brown iris, and in other cases with relatively light brown eyes, we adjusted the brown tone with dye mixtures according to the color of the other eye. In four of our eight patients, we performed corneal staining entirely in black. Peripheral corneal staining was performed in two patients that we planned and in two other patients with a relatively light brown eye color. In these patients, we performed black staining in the pupillary center (3 mm), and brown staining in the peripheral area. Based on our experience, colors other than black are difficult to match. We found that esthetically satisfactory results were obtained with black staining in eyes with a dark brown iris. However, in a study series of three patients, it was reported that there were serious color changes, which may occur in tattoo paints over a period of 5–6 years.[12] Due to the short follow-up period for our cases, we did not observe color changes. In one study, it was necessary to repeat the staining in six cases of insufficient staining.[13] In another study, restaining was performed in five of seven patients.[14] In a series of seven cases, Recep *et al*.[15] reported that restaining was performed in one patient. In that study, one patient had mild fading, and in another patient, there was a pale appearance due to neovascularization of the cornea, although there was no problem in staining the cornea.

There is suspicion that the dyes used in corneal tattooing may have toxic effects. Because the dye pigments do not dissolve in water, there is a low potential for toxic effects; however, some complications such as iridocyclitis, non-healing corneal epithelial defects, corneal ulceration, and granulomatous keratitis have been reported.[16] In our study, corneal re-epithelization was completed on the second day after the tattooing procedure.

Conclusion

Although the number of patients in our study was limited, corneal tattooing produced satisfactory results both in absolute eyes and in eyes with some degree of vision. In such cases, corneal tattooing should be used more frequently instead of complicated procedures. Furthermore, we found that femtosecond laser-assisted corneal tattooing is an effective, practical, and fast technique for homogenous dye staining in patients with suitable corneas.

Ethical standards

This study was conducted on human participants. The study was approved by the Ethical Committee of Inonu University, Malatya, Turkey. (Reference number: 2019/117).

Declaration of patient consent

Informed consent was obtained from all participants included in the study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Galen C. De compositione medicamentorum secundum locos. In: Kühn CG, editor. Claudii Galeni Opera Omnia. Hildesheim: Olms; 1965. vol 12. p. 696-803.
2. Ziegler SL. Multicolor tattooing of the cornea. Trans Am Ophthalmol Soc 1922;20:71-87.
3. Knapp P. Eine neue Methode der Hornhauttätowierung. Klin Monatsbl Augenh 1925;75:693-700.
4. Holth S. Die Technik der Hornhauttätowierung, speziell der mehrfarbigen. Klin Monatsbl Augenh 1926;77:289-302.
5. Gifford SR, Steinberg A. Gold and silver impregnation of cornea for cosmetic purposes. Am J Ophthalmol 1927;10:240-7.
6. Pitz S, Jahn R, Frisch L, Duis A, Pfeiffer N. Corneal tattooing: An alternative treatment for disfiguring corneal scars. Br J Ophthalmol 2002;86:397-9.
7. Islam N, Franks WA. Therapeutic corneal tattoo following peripheral iridotomy complication. Eye 2006;20:389-90.
8. Sekundo W, Seifert P, Seitz B, Loeffler KU. Long-term ultrastructural changes in human corneas after tattooing with non-metallic substances. Br J Ophthalmol 1999;83:219-24.
9. Panda A, Pangtey MS, Sony P. Corneal tattooing. Br J Ophthalmol 2002;86:1461.
10. Kymionis GD, Ide T, Galor A, Yoo SH. Femtosecond-assisted anterior lamellar corneal staining-tattooing in a blind eye with leukocoria. Cornea 2009;28:211-3.
11. Anastas CN, McGhee CN, Webber SK, Bryce IG. Corneal tattooing revisited: Excimer laser in the treatment of unsightly leucomata. Aust N Z J Ophthalmol 1995;23:227-30.
12. Calas E, Gueudry J, Muraine M. Severe color change in corneal tattoos: Report of 3 cases. J Fr Ophtalmol 2018;41:469-75.
13. Alsmman AH, Mostafa EM, Mounir A, Farouk MM, Elghobaier MG, Radwan G. Outcomes of corneal tattooing by rotring painting ink in disfiguring corneal opacities. J Ophthalmol 2018;2018:5971290.
14. Kim C, Kim KH, Han YK, Wee WR, Lee JH, Kwon JW. Five-year results of corneal tattooing for cosmetic repair in disfigured eyes. Cornea 2011;30:1135-9.
15. Recep ÖF, Cağıl N, Hasıripi H. Tattooing for the treatment of corneal opacities. Türkiye Klinikleri J Ophthalmol 2008;17:156-60.
16. Sharma A, Gupta P, Dogra MR, Hidayat AA, Gupta A. Granulomatous keratitis following corneal tattooing. Indian J Ophthalmol 2003;51:265-7.