CORRESPONDENCE

Complications of ocular tattooing: a Canadian case series

Body modification is the practice of deliberate alterations to the human body, such as tattoos, piercings, and scarification, to achieve self-expression or control over one's body.[1] The "body modification movement" has seen an increasingly popular practice of tattooing the eye. Typically, ink is injected into the subconjunctival space with pigmentation of the episclera and/or sclera. This has resulted in complications ranging from conjunctival edema and nodules[2] to more serious complications such as orbital cellulitis,[3] scleritis, panuveitis,[4] and secondary glaucoma.[5] Here we present 3 Canadian cases of ocular tattooing resulting in complications ranging from scleral laceration and serious corneal and anterior segment injury to endophthalmitis requiring enucleation. These cases reinforce the need for specific legislature surrounding ocular tattooing in Canadian provinces.

A 39-year-old female (case 1) presented with severe left eye pain after allowing her partner (case 2) to attempt scleral tattooing at home using tattoo ink ordered from an online source (StarBrite, Somers, Conn). They did not have access to topical anaesthetics and used a 31-gauge insulin needle to perform the tattoo. She was otherwise healthy and did not take any ocular or systemic medications.

On examination, her visual acuity was 6/6 in both eyes, with intraocular pressures of 18 mm Hg in the right eye and 13 mm Hg in the left eye. Slit-lamp examination revealed a shallow left anterior chamber and a Seidel-positive puncture wound temporally, where there was blue tattoo dye staining. Dilated fundoscopic examination findings were within normal limits bilaterally without any obvious evidence of intraocular penetration of tattoo dye in the left eye. To allow a complete examination and closure of the apparent wound, she was taken to the operating room. Despite an extensive exploration, a leaking scleral puncture wound was not found. The conjunctiva was closed in a watertight closure technique with 9-0 Vicryl. Postoperatively, her anterior chamber deepened, and her temporal sclera was Seidel-negative. An epithelial defect required a temporary bandage contact lens. She recovered well in the next week but was subsequently lost to follow-up.

A 41-year-old male (case 2) presented with vision loss in his right eye after inadvertent globe penetration and intraocular injection of blue tattoo ink (StarBrite) during self-administration of the dye. After watching a YouTube video, the patient attempted to tattoo his lateral right sclera. Increased force had been applied to the plunger to clear an obstruction, which resulted in the needle penetrating his eye. He injected approximately 1 mL of blue tattoo ink into his eye.

On examination, his uncorrected visual acuity was light perception in the right eye and 6/6 in the left eye. Intraocular pressures were 44 and 12 mm Hg in the right and left eyes, respectively. Slit-lamp examination of the right eye revealed blue tattoo dye filling the anterior chamber (Fig. 1A) and evidence of inferotemporal needle penetration (Fig. 1B). There was no posterior view, and B-scan ultrasonography showed mildly echogenic opacities just anterior to the retina. Examination findings of the left eye were within normal limits, except for subconjunctival and episcleral blue tattoo dye inferonasally. Computed tomography of the orbits revealed a hyperdense material in the anterior right globe (Fig. 1C, D).

The patient was taken to the operating room for an anterior chamber washout and injection of antibiotics (ceftazidime 2 mg/0.1 mL and vancomycin 1 mg/0.1 mL) in his right eye (Supplementary Video 1, available online). A total volume of 850 mL of balanced salt solution was used to wash out the blue dye and a white, chalky material. The inferior one-third of the corneal endothelium was stained blue. The patient tolerated the procedure well, but by postoperative day 1 the anterior chamber had refilled with blue dye. The anterior chamber washout was repeated and a pars plana vitrectomy performed. Hidden pockets of blue dye welled up into Berger's space while performing the vitrectomy. All dye was removed from within the eye, and the patient was started on topical timolol maleate 0.5% BID in addition to hourly prednisolone acetate 1%, atropine 1% BID, and ofloxacin QID. The vitreous sample was negative for bacterial growth. Two days later, the patient returned with complete right corneal staining (Fig. 2A) and microcystic edema, with evidence of a fibrinous reaction in the anterior chamber. Due to suspicions of possible endophthalmitis, he was given an additional dose of intravitreal ceftazidime and vancomycin, and tissue plasminogen factor to the anterior chamber. He continued to have persistent severe corneal edema with a central corneal thickness of approximately 1000 μm, suggesting corneal endothelial decompensation. His inflammation improved, but he returned 4 days later with zonular dehiscence and lens luxation (Fig. 2B). The patient had a pars plana lensectomy and insertion of a sulcus intraocular lens. On postoperative day 1, the visual acuity of his right eye was 6/120, improving to 6/60 with pinhole correction. He was thereafter lost to follow-up.

A 24-year-old male (case 3) presented with a history of decreased vision and significant pain in his right eye for 3 days after an attempted scleral tattoo. The patient described that the tattoo artist used a fine-gauge needle on a syringe to inject organic, metal-free tattoo ink (Fusion Tattoo Ink, Riverside, Calif) by holding the needle perpendicular to the globe. An injection of tattoo ink was performed on the medial aspect of the globe without complication, but the second inferior injection was associated with significant pain and immediate decrease in vision. The procedure was stopped at that point, but no medical attention was sought until 3 days later.

On examination, he had light perception visual acuity in the affected eye and there was significant conjunctival chemosis with black subconjunctival staining. The anterior chamber was filled with black ink with no posterior view (Fig. 3). Findings on B-scan ultrasonography examination were consistent with vitritis, with an abscess on the posterior pole of the eye.

An anterior chamber washout, pars plana vitrectomy, and lensectomy (due to lens damage from the penetrating needle)

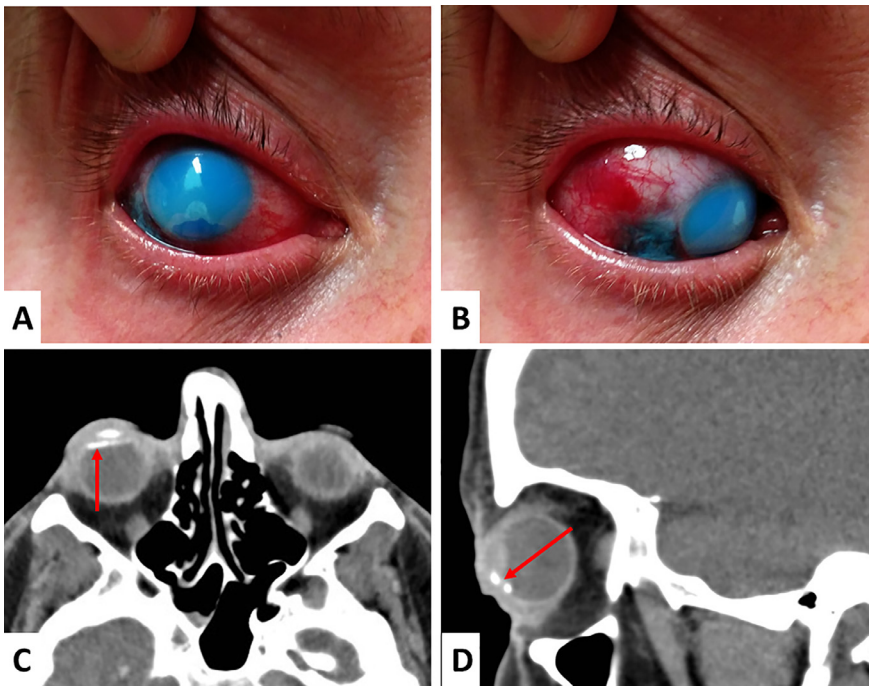

Fig. 1—(A) Right eye demonstrating complete anterior chamber filling with blue tattoo ink and early inferior corneal staining (darker blue). (B) Right eye in adduction to better show the temporal sclera. Axial (C) and sagittal (D) cuts of computed tomography scan of the orbits reveal hyperdense material (arrows) in the anterior segment and anterior vitreous of the right eye.

were performed with intravitreal injection of antibiotics (vancomycin 1 mg/0.2 mL and ceftazidime 2.25 mg/0.1 mL) and steroids (dexamethasone 1 mg/0.1 mL) (Supplementary Video 2, available online). Postoperatively, the patient received topical moxifloxacin drops QID and erythromycin ointment QID, as well as oral moxifloxacin 400 mg once daily. There was no improvement in his visual acuity, and the cornea had significant grade 4+ edema with folds in Descemet's membrane, as well as endothelial staining. Bacterial cultures of the vitreous fluid were positive for *Alcaligenes faecalis*, susceptible to ceftazidime.

An additional vitreous tap and injections of ceftazidime and dexamethasone were performed on postoperative day 2 due to increasing pain and lack of clinical improvement. Additionally, a new abscess was revealed on B-scan ultrasonography (Fig. 4). Intravitreal injections of ceftazidime and dexamethasone were repeated 5 days later as poor visualization precluded any attempts at vitrectomy. The corneal edema improved to allow a second pars plana vitrectomy on postoperative day 10. Endolaser was applied to the inferior retina at the site of the intraocular penetration.

On follow-up, 3 weeks after his initial presentation, the patients' vision remained at light perception with significant pain and new phthisical changes. He had persistent corneal edema and endothelial staining, and a new a retinal detachment was identified on B-scan. The patient was referred for enucleation, which was performed 2 months after the initial injury. Pathology specimens demonstrated staining of the inner retina, sclera, and the corneal endothelium, as well as endothelial cell loss and corneal edema (Fig. 5).

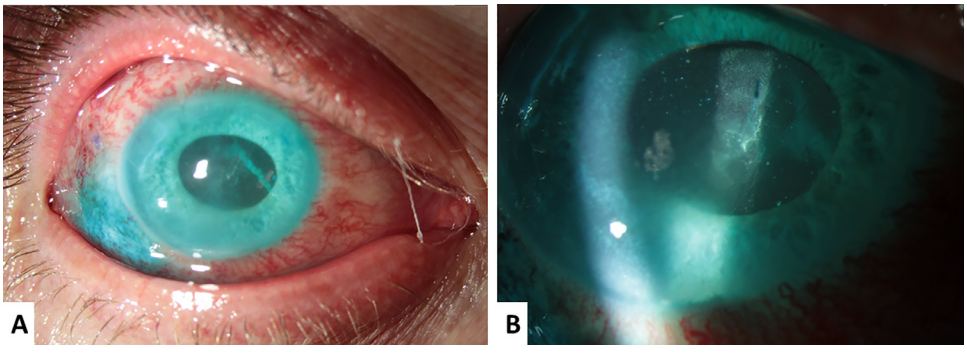

Fig. 2—(A) Right eye exhibiting complete blue corneal staining and edema 2 days after the initial anterior chamber washout. (B) Slit-beam view of the right eye demonstrating microcystic corneal edema, anterior chamber reaction, and lack of lens. Anterior vitreous is seen with the posterior slit beam.

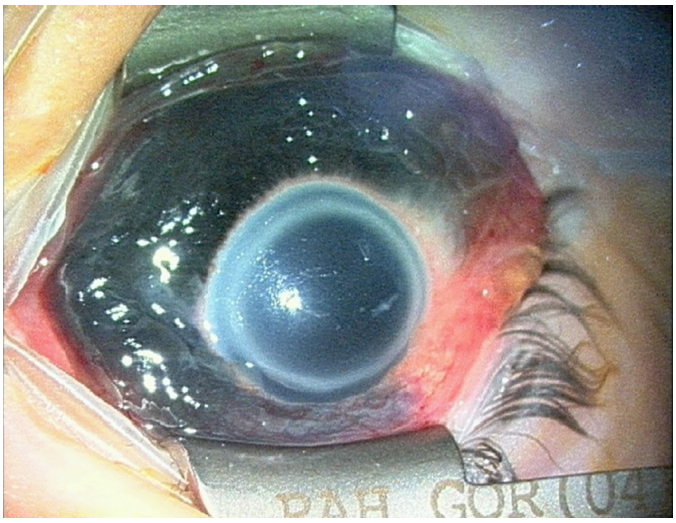

Fig. 3—Preoperative view of the tattooed eye with subconjunctival black staining and black tattoo ink filling the anterior chamber.

We present 3 cases of ocular tattooing that demonstrate a broad spectrum of possible complications. The tattoo ink used by the first 2 patients contained titanium dioxide and copper phthalocyanine.[6] Titanium dioxide nanoparticles have been found to increase inflammation in vascular endothelial cells through release of superoxide[7] and cause increased leakage.[8] It is possible that the titanium dioxide in the tattoo dye could cause similar effects on the corneal endothelium, which could explain the extent of the corneal edema. Copper phthalocyanine is a structurally similar dye to copper(II) phthalocyanine-tetrasulfonic acid, which has been found to cause posterior uveitis and retinal ganglion cell loss in an *in vivo* animal model.[9] In combination with titanium dioxide, this could be contributory to the severe inflammatory reaction seen in the second patient.

The labelling on the ink used in the patient from case 3 lists pigments from unspecified "organic sources" in addition to containing distilled water, witch hazel, and alcohol. The presentation of *A. faecalis* endophthalmitis, with abscess formation, suggests contamination of either the tattoo equipment or the ink itself. *A. faecalis* is a gram-negative bacillus that is present in soil and contaminated water, and is a rare cause of postoperative endophthalmitis or keratitis.[10–12] In a case series of 5 patients with *A. faecalis* endophthalmitis,[12] visual acuity outcomes varied from 6/24 in 2 patients, to 6/190 to 6/380 in 2 patients, to no light perception in the fifth patient. The poor visual outcomes and eventual enucleation of our third case are consistent with the poor outcomes in *A. faecalis* endophthalmitis.

Ophthalmologists need to be aware of the risks and poor outcomes that may result from attempted scleral tattooing, whether it is self-inflicted (cases 1 and 2) or done by a commercial tattoo artist (case 3). The individuals performing the tattooing may not have adequate knowledge of the eye's anatomy. Furthermore, unregulated access to tattoo ink on the internet may pose additional safety risks.

Within North America, only certain U.S. states have any legislation restricting tattooing in or around the eyes. For example, in Georgia, it is "unlawful to tattoo within 1 inch of the eye socket" (Ga. Code § 16-12-5, 2010), whereas in Oklahoma, it is illegal to perform scleral tattooing (21 OK Stat § 21-842.1, 2014). Indiana has also recently passed legislation banning scleral tattooing.[13] Canadian body art legislation is province-dependent and does not restrict which areas

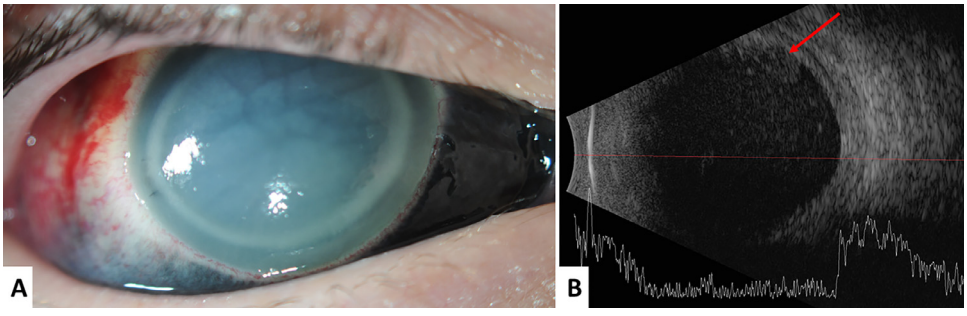

Fig. 4—(A) Silt-lamp photograph at postoperative day 2, demonstrating corneal edema, endothelial staining, and scleral staining with black pigment. (B) B-scan ultrasonography of the eye showing an abscess in the posterior pole (arrow).

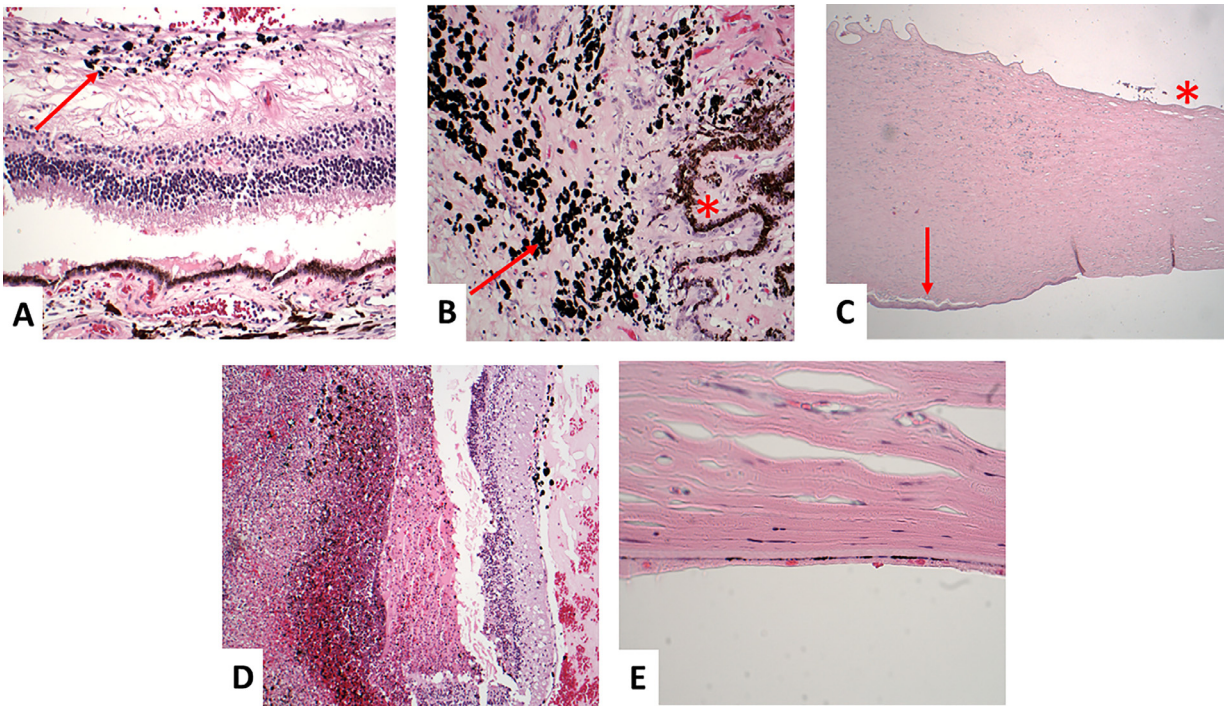

Fig. 5—(A) Detached retina with tattoo ink in macrophages in epiretinal membrane (arrow). (B) Melanin pigment in ciliary epithelium (asterisk) and black tattoo ink in macrophages in fibrovascular tissue (arrow). (C) Thick edematous vascularized cornea with wrinkled Descemet's membrane (arrow) and thin superior stained cornea with artefactually missing epithelium (asterisk). (D) Detached retina with adjacent vitreous abscess. (E) Tattoo ink in residual endothelial cells beneath vascularized stroma and unremarkable Descemet's membrane (hematoxylin–eosin; original magnifications × 20 [A and B], × 4 [C], × 10 [D], × 40 [E]).

of the body can be tattooed. Nova Scotia specifically did not have any laws regulating the health and safety of body art until the Safe Body Art Act was passed in 2011 and does not contain any anatomical restrictions. This piece of legislation was not proclaimed until March 6, 2018, meaning that it will not be enforceable until February 1, 2019.[14] Ontario is the only province to have recently amended their Health Protection and Promotion Act to include prohibitions of ocular tattoos and jewelry (Bill 160, Schedule 3) largely due to a high-profile case that occurred in Ottawa in 2017.[15] Alberta does not have any specific legislation regarding ocular tattoos or body modification procedures.

With the rise in popularity of ocular tattooing in Canada, ophthalmologists should be aware of the serious morbidities associated with ocular tattooing and assist provincial regulatory bodies in establishing appropriate public safety measures.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.jcjo.2019.03.013.

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