provided insight into the evolution of traumatic maculopathy and pathogenesis of traumatic macular hole formation. Further advanced imaging may improve our ability to prognosticate and intervene following ocular trauma.

Jennifer Kung, MD
Loh-Shan B. Leung, MD
Theodore Leng, MD, MS
Y. Joyce Liao, MD, PhD

Author Affiliations: Byers Eye Institute at Stanford, Stanford University School of Medicine, Palo Alto, California. Correspondence: Dr Leng, Byers Eye Institute at Stanford, 2452 Watson Ct, Palo Alto, CA 94303 (tedleng@stanford.edu).

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Corneal Graft Alterations After Descemet Stripping: Implications for Split Cornea Transplantation

In recent years, there has been tremendous progress in improving lamellar keratoplasty techniques such as deep anterior lamellar keratoplasty and Descemet membrane endothelial keratoplasty. Splitting of a single donor cornea into an anterior part (including epithelium, its basement membrane, Bowman layer, and stroma) for use in a deep anterior lamellar keratoplasty procedure in a patient with anterior stromal disease (eg, keratoconjunctivitis) and in a posterior part (endothelium–Descemet membrane layer) for use in a Descemet membrane endothelial keratoplasty procedure in a patient with endothelial disease (eg, Fuchs endothelial dystrophy) can reduce the need and cost for corneal donor tissue by up to 47%. Since it is thus far unclear what time limits are acceptable for storing anterior and posterior grafts in split corneal transplantation, we investigated split corneal tissue for temporal morphologic alterations after Descemet stripping.

Methods. Eighteen pairs of healthy human donor corneas unsuitable for corneal transplantation were included in this experimental study performed in conformance with the tenets of the Declaration of Helsinki. All corneoscleral buttons were organ cultured in Dulbecco modified Eagle medium containing streptomycin, penicillin (Biochrom), and fetal calf serum (Linaris) at 34°C. The mean (SD) donor age was 60 (24) years, the mean (SD) donor tissue stored in organ culture up to 1 week as well as anterior lenticules—depending on endothelial cell count prior to stripping—up to 3 weeks before grafting. However, no conclusions regarding the reversibility of those alterations can be drawn. Therefore, probably an even longer interval between splitting and grafting may be feasible. Further studies are necessary, especially to define the minimum tolerable donor endothelial cell count for Descemet membrane endothelial keratoplasty and the effect of different preservation media on graft alterations.

For histologic and ultrastructural analyses, 10 split and 10 full-thickness buttons were compared after 1 and 3 weeks in culture using Mann-Whitney test. P < .05 was considered statistically significant.

Results. For anterior donor lamellas, the mean (SD) central corneal thickness increased nonlinearly from 770 (140) μm prior to splitting to 1057 (128) μm at 1 hour, 1122 (118) μm at 1 day, 1179 (131) μm at 1 week, and 1230 (139) μm at 4 weeks after splitting.

The mean (SD) endothelial cell count of posterior lenticules decreased linearly from 2683 (142) cells/mm² prior to splitting to 2517 (227) cells/mm² postoperatively, 2468 (238) cells/mm² at 1 week, 2336 (393) cells/mm² at 2 weeks, 2269 (366) cells/mm² at 3 weeks, and 2006 (293) cells/mm² at 4 weeks after stripping (ie, mean loss of 128 cells/mm² per week).

By light microscopy (Figure 1) and electron microscopy (Figure 2), corneal epithelium and stroma revealed significantly more edematous alterations after stripping than full-thickness corneas (P < .02), with a significant increase from 1 to 3 culture weeks (P < .02) and significant anterior keratocyte loss within 3 culture weeks (P < .02). Descemet membranes showed an intact and viable endothelium up to 3 culture weeks in split and non-split buttons.

Discussion. Longer storage of split donor tissue would simplify the logistics of split cornea transplantation. However, it was thus far unclear which (potentially irreversible) graft alterations occur after longer storage of the anterior and posterior lamellas.

In this study, anterior grafts revealed chronic edematous changes with anterior keratocyte loss starting after 1 week in culture, and posterior grafts showed a sharp increase of endothelial cell loss between 3 and 4 weeks in culture. These morphologic findings suggest that anterior lenticules can be stored reliably up to 1 week and posterior lenticules—depending on endothelial cell count prior to stripping—up to 3 weeks before grafting. However, no conclusions regarding the reversibility of those alterations can be drawn. Therefore, probably an even longer interval between splitting and grafting may be feasible. Further studies are necessary, especially to define the minimum tolerable donor endothelial cell count for Descemet membrane endothelial keratoplasty and the effect of different preservation media on graft alterations.

Nevertheless, our data support the safety of anterior donor tissue stored in organ culture up to 1 week as well as posterior donor tissue stored in organ culture up to 3 weeks for use in deep anterior lamellar keratoplasty and Descemet membrane endothelial keratoplasty surgery,
Figure 1. Histopathologic analysis of split (A, B, D, and E) and full-thickness (C and F) donor corneas after 1 (A-C) and 3 (D-F) additional weeks of organ culture showing more epithelial and stromal edema after Descemet stripping with marked loss of keratocytes in the anterior stroma at 3 culture weeks and Descemet membrane with intact and viable endothelium up to 3 culture weeks without significant differences between stripped and nonstripped buttons (hematoxylin-eosin, original magnification ×200).

Figure 2. Transmission electron microscopy of split (A-C and G-I) and full-thickness (D-F and J-L) donor corneas after 1 (A-F) and 3 (G-L) additional weeks of organ culture showing more epithelial (A, D, G, and J) and stromal (B, E, H, and K) edema after Descemet stripping and Descemet membrane with intact and viable endothelium (C, F, I, and L) up to 3 culture weeks without significant differences between stripped and nonstripped buttons (scale bars = 2.5 µm).
Transitional cell carcinomas (TCCs) of the lacrimal sac are uncommon tumors that can have variable clinical and histologic features. Bloody tears, also known as dacryohemorrhhea, have been reported only once previously as a presenting sign of the tumor. We describe a case of lacrimal sac TCC manifesting with epiphora, dacryohemorrhhea, and medial canthal mass.

Report of a Case. A 54-year-old man had right lower eyelid swelling and bloody tears for 6 months. On examination, his visual acuity was 20/25 OD and 20/20 OS, with no relative afferent pupillary defect. Intraocular pressure was 12 mm Hg OU. On external examination, there was a palpable subcutaneous mass in the medial canthal area; on palpating the lacrimal sac, a flesh-colored mass with serosanguineous discharge protruded from the lower eyelid punctum. Nasolacrimal duct irrigation was deferred. Computed tomography demonstrated a heterogeneous soft-tissue mass, measuring 1.8 × 2.2 × 1.8 cm, centered on the right lacrimal sac fossa and extending into the proximal aspect of the nasolacrimal duct (Figure 1A).

The patient underwent an incisional biopsy of the lacrimal sac. It was noted intraoperatively that the lesion was friable and discohesive on opening the sac (Figure 1B). On histologic examination, the specimen exhibited papillary proliferation of atypical transitional epithelial cells with conspicuous mitotic figures and severe nuclear pleomorphism (Figure 2A and B). The tumor did not invade the basement membrane. Diagnosis of TCC in situ was confirmed. The specimen was subsequently evaluated for p16 expression, a marker for human papillomavirus 16, and was strongly positive (Figure 2C), suggesting human papillomavirus as an underlying cause. The patient was referred to otolaryngology for multidisciplinary resection and reconstruction; however, to date, he has refused any further surgical intervention.

Comment. Epithelial tumors of the lacrimal sac arise from the transitional epithelium. Histologically, these tumors are divided into squamous cell carcinoma, TCC, and adenocarcinoma. Transitional cell carcinomas of the lacrimal sac carry the worst prognosis. Like the more common TCC of the urinary bladder, cells show marked pleomorphism, prominent nucleoli, and conspicuous mitotic figures.

We found a total of 37 cases of TCC of the lacrimal sac in the literature. The mean age was 50 years, with no sex predilection. The most common presenting symptoms were epiphora and medial canthal mass. Bloody tears are a rare presenting symptom for TCC of the lacrimal sac, and, to our knowledge, they have been reported only once in the literature.

While it is possible to suspect a diagnosis of TCC of the lacrimal sac based on clinical history, physical examination, and imaging studies, previously reported cases were frequently misdiagnosed as dacryocystitis, nasolacrimal duct obstruction, and mucocele. Accurate diagnosis in most published cases was made at the time of surgery and after histologic evaluation.

Treatment for lacrimal sac TCC consists of surgical excision alone or in combination with radiation therapy. The average mortality rate for patients with TCC of the lacrimal sac is 45%.

Author Affiliations: Department of Ophthalmology, University Hospital of Cologne, Cologne (Drs Heindl, Stephan, Riss, and Cursiefen), and Eye Hospital (Dr Riss) and Departments of Ophthalmology (Dr Riss) and Medical Informatics, Biometry, and Epidemiology (Dr Adler), Friedrich-Alexander University Erlangen-Nürnberg, Erlangen, Germany.

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