impairment group, 48.8%; in amblyopia group, 50.0%; in UVI group, 56.5%), race (% non-Hispanic white in no impairment group, 70.6%; in amblyopia group, 80.3%; in UVI group, 75.8%) and payor status (% with private insurance in no impairment group, 94.5%; in amblyopia group, 92.2%; in UVI group, 98.3%). Only payor status was statistically significant.

Young adults with UVI or amblyopia were less likely to acquire a license (UVI, 69.4% [$P < 0.01$]; amblyopia, 65.6% [$P = 0.02$]) than those with no impairment (81.0%). See Figure 1. Among licensed drivers, neither UVI nor amblyopia was associated with an elevated crash rate compared with those without UVI/amblyopia (Figure 2, UVI adjHR = 1.08 [95% CI, 0.60-1.95]; amblyopia adjHR = 1.08 [95% CI, 0.85-1.38]).

## Discussion

Our findings suggest that although UVI or amblyopia may reduce license acquisition among young adults, there is no evidence that, given licensure, crash risk differs from that of other young adults.

Reduced licensing among those with UVI and/or amblyopia could result from an inability of some to qualify for a license because of co-occurring medical conditions. We attempted to account for this possibility by excluding young adults with reduced vision in both eyes and/or intellectual disabilities. We were unable to account for current visual acuity or degree of stereopsis because of limited availability of data and the retrospective nature of medical record review. Modifications in drivers' training or driving behaviors to reduce crash risk may be more common among those with UVI/amblyopia at the direction of a parent or healthcare provider.[10] If this is the case, our results suggest that these young adults are modifying their driving in a way that does not leave them more vulnerable to crashes.

Understanding the potential effect of UVI and amblyopia on licensure and driving risk among novice drivers is important for assessing whether this population needs additional support for driving safely. Our results find no evidence that UVI or amblyopia affect crash risk. Further prospective studies are needed to identify the primary underlying reasons for differences in licensing rates and to understand how vision impairments might affect driving behaviors and how to optimize training for young adults with UVI or amblyopia who would like to acquire a driver's license.

## Literature Search

The authors conducted a MEDLINE search on July 31, 2018, using the following terms: (motor vehicle crash OR *drivers license*) AND (*UVI* OR *amblyopia* OR *monocular*).

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# Band keratopathy in children previously treated with diode laser for type 1 retinopathy of prematurity

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**Band keratopathy is a corneal degeneration caused by chronic inflammation, systemic abnormalities, or, rarely, a primary biallelic *SLC4A4* mutation leading to calcium hydroxyapatite deposition in Bowman's layer. We report a series of 16 eyes of 10 children with a remote history of diode laser treated retinopathy of prematurity who developed late-onset band keratopathy without evidence of other prior risk factors. The majority of patients developed band keratopathy bilaterally. Five eyes had visually significant central band keratopathy that required treatment with disodium ethylenediaminetetracetic acid (EDTA) chelation or phototherapeutic keratectomy. Band keratopathy may be an underreported late ophthalmic complication of diode-laser treated retinopathy of prematurity.**

## Subjects and Methods

The medical records of patients who had undergone diode laser treatment for type 1 retinopathy of prematurity (ROP) at Texas Children's Hospital were reviewed to identify cases of band keratopathy (BK) that presented during the period 2001-2008. Visually significant BK was defined as a degradation of the red reflex, causing decreased vision or ocular discomfort (Figure 1). The following data was extracted from the medical record: postmenstrual age at birth, age at laser treatment; age at onset of BK; laser data, when available; presenting symptoms; visual acuity tested, if possible, at a distance of 6 meters using Snellen chart or HOTV matching; and ocular comorbidities.

## Results

Of 340 patients treated during the study period, 10 patients (mean age, 12.8 years; range, 9-14 years) had BK: 10 eyes of 7 patients (3 boys) were found to have BK on routine follow-up, 5 of whom required treatment; 6 eyes of 3 patients (2 boys) did not require treatment. Presenting symptoms included decreased vision in 6 eyes and foreign body sensation or ocular discomfort in 2; the remainder were asymptomatic. Of the 8 asymptomatic eyes, 3 eyes of 2 patients were treated with disodium ethylenediaminetetracetic acid (EDTA) chelation; 2 eyes, with phototherapeutic keratectomy, 1 of which was first treated with disodium EDTA chelation. The mean estimated gestational age at birth of the 10 patients was 24.68 ± 1.30 weeks, and mean postmenstrual age at time of laser was 36.78 ± 1.15 weeks.

Laser data was available for 12 of the 16 eyes; these eyes received laser an average of 9.30 ± 2.37 years (range, 4.5-12.5) prior to detection of BK; an average of 1,802 ± 614 laser spots (range, 1,099-2,663) with a power of 300–450 mW and duration of 200–400 msec.

Visual acuity testing was performed using Snellen chart for 6 patients and HOTV matching for 2 patients; the remaining 2 patients were fix and follow. The average corrected preoperative distance visual acuity for the 5 treated eyes was logMAR 0.564 (Snellen equivalent, 20/73), which improved to logMAR 0.539 (20/69) at the most recent visit. The average corrected distance visual acuity for the 9 untreated eyes was logMAR 0.658 (20/91), not including the 2 patients that had visual acuity of fix and follow. Vision testing was limited by multiple coexisting ocular pathologies: myopia (14 eyes), optic atrophy (5), amblyopia (4), esotropia (3), nystagmus (2), cataracts (2), and retinal detachments without silicone oil (2).

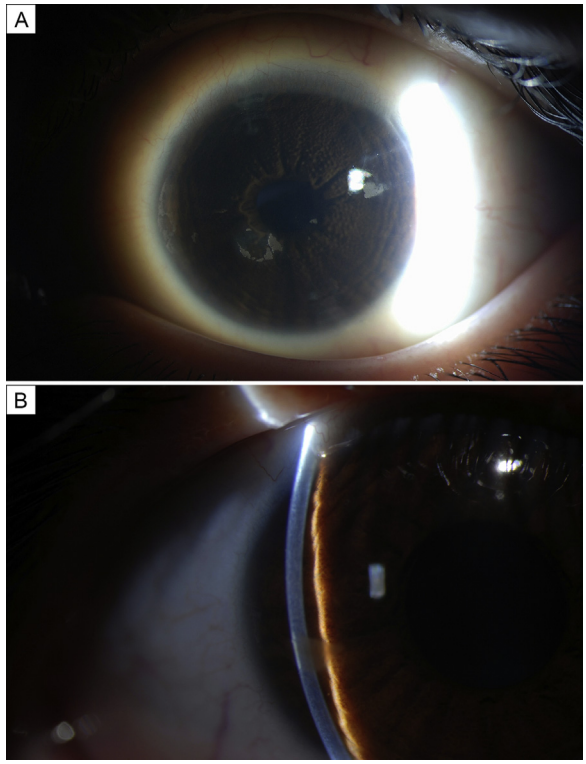


**FIG 1.** Moderate interpalpebral zone band keratopathy noted inferiorly in the central visual axis (A) and centrally (B) in 2 patients, causing decrease in vision and symptomatic ocular discomfort.

After the initial diagnosis, patients were evaluated for etiology. One patient had low-grade anterior chamber inflammation bilaterally treated with topical steroids; another had posterior synechiae and flare unilaterally but exhibited BK bilaterally. Both patients were evaluated by a uveitis specialist and neither had any systemic associations. Six eyes of 4 patients exhibited shallow anterior chambers with 1 developing narrow-angle glaucoma, which required topical treatment. No other patients exhibited any other risk factors.

## Discussion

ROP is a vision-threatening disease that was formerly treated by retinal ablation using cryotherapy or diode laser. We hypothesize that BK may be an underreported long-term complication of diode laser treatment. BK is caused by calcium deposition in Bowman's layer associated with intraocular inflammation, systemic hypercalcemia, silicone oil placement or, rarely, a primary biallelic *SLC4A4* mutation.[1,2] It is treated by removal of the calcium deposition.

Indications for treatment include decreased vision, ocular discomfort, inadequate view of the posterior segment, or unsatisfactory appearance.[3]

BK after ROP treatment was first described by Hittner and colleagues[4] in 1979. Here we present the largest known case series of BK after diode treatment of ROP, with 10 affected patients, or 2.94% of all patients lasered during the same time period. Other published case series cite an incidence of 1.09% (2/184)[5] to 6.45% (2/31).[6]

The etiology of BK after ROP laser treatment is unclear. Salgado and colleagues[5] hypothesized the presence of anterior segment ischemia and inflammation after laser treatment as a predisposing factor. Multiple other studies have suggested the presence of anterior segment ischemia based on the presence of cataracts, iris synechiae, corneal opacification, iris atrophy, and shallow anterior chambers.[7-10] Kaiser and Trese[10] proposed that the mechanism for anterior segment ischemia after retinal laser may be a combination of impairment of blood flow in the long posterior ciliary arteries from scleral depression and confluent tissue ablation.

Salgado and colleagues[5] also noted that prethreshold versus threshold ROP had a higher rate of anterior segment complications and lower mean postmenstrual age of treatment (36.6 weeks for prethreshold vs 37.9 weeks for threshold). Our cohort had an average postmenstrual age of 36.78 $\pm$ 1.15 weeks at treatment, which may be associated with a higher rate of anterior segment complications.

In our series, only 1 patient had low-grade anterior chamber inflammation, noted 10 years after ROP laser; another patient exhibited posterior synechiae and flare without inflammation. Although it is difficult to determine the precise etiology of BK, we hypothesize that diode laser treatment could predispose these eyes to BK by laser-induced anterior segment ischemia or from subclinical post-laser inflammation. Anterior segment ischemia may be more common with a confluent pattern of laser therapy often seen with ROP diode laser treatments.[3-7] Furthermore, many patients with prematurity may display a narrow anterior chamber angle because of arrested development of the anterior segment, as hypothesized by Fledelius and colleagues.[9] The narrowing of the anterior chamber could be associated with intermittent angle closure, elevated intraocular pressure, and secondary anterior chamber inflammation. This narrowing of the angle was seen in 4 of our patients (6 eyes), and 1 of our patients was ultimately diagnosed with narrow angle glaucoma.

BK may be an underreported complication of ROP laser treatment that can be associated with younger postmenstrual age at treatment, anterior segment ischemia, post-laser inflammation, or long-term intermittent angle closure. Continued monitoring of patients with BK is necessary; half our patients required treatment. Although this case series is limited by its retrospective nature, it emphasizes the importance of long-term follow-up of post laser ROP patients for late-onset BK and possible risk of narrow-angle glaucoma.

### Literature Search

PubMed search was last performed in April 2019 using search terms *band keratopathy* and *retinopathy of prematurity*, without language or date restrictions.

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# Personalized pediatric ophthalmology: a case report


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