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Refractive and visual outcomes after surgery for pediatric traumatic cataract

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Purpose: To describe refractive and visual outcomes of pediatric traumatic cataract requiring surgery and evaluate the factors influencing success.

Setting: Hospital for Sick Children, Toronto, Ontario, Canada.

Design: Retrospective case series.

Methods: Charts of children having lensectomy for traumatic cataract between January 1, 2000, and June 30, 2015, were reviewed for demographic information, visual and refractive outcomes, complications, and surgical details.

Results: One hundred six children (mean age 7.6 years ± 3.9 [SD]) were included. The median follow-up was 41 months (range 3 to 155 months). Seventy-nine children had open-globe injuries and 27 had closed-globe injuries. Patients with open-globe injuries were younger than those with closed-globe injuries (mean age 6.9 versus 10.4 years; $P < .05$). The final corrected distance visual acuity (CDVA) was 20/40 or better in 47 children. In the 94 children who had intraocular lens placement, 54% with open-globe injuries and 55% with closed-globe injuries achieved a mean absolute prediction error of 1.0 diopter or less in the early postoperative period. Open-globe injuries and amblyopia were associated with worse visual outcomes (odds ratio [OR], 2.8 and $P = .03$ versus OR, 2.4 and $P = .04$) and refractive outcomes (OR, 3.1 and $P = .02$ versus OR, 3.8 and $P = .04$). Age younger than 5 years was associated with worse refractive outcomes (OR, 2.88; $P = .02$).

Conclusions: Children requiring surgery for traumatic cataract can have good visual and refractive outcomes. Those with open-globe and those with closed-globe injuries both had good early postoperative refractive accuracy. Sixty-three percent of children with closed-globe injuries attained a CDVA of 20/40 or better at the final follow-up.

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Between 12% and 46% of all pediatric cataracts are attributable to ocular injury.[1] The risk for amblyopia and the ongoing growth of the eye make the management of traumatic cataract in the pediatric population particularly challenging.[2] Refractive rehabilitation after cataract surgery with intraocular lens (IOL) placement, when possible, is considered the safest and best practice in children with traumatic cataract.[3,4] However, difficulties obtaining accurate biometry and controversy regarding the optimum timing for lensectomy and IOL placement complicate the refractive rehabilitation in cases of pediatric traumatic cataract.[1]

Few studies have published refractive outcomes after IOL placement in the management of pediatric traumatic cataract.[4–6] These studies involved small numbers from geographically varied populations (Kenya, Pakistan, and South India, respectively) and described refractive outcomes in terms of the magnitude of the mean spherical equivalent (SE).[4–6]

The purpose of our study was to describe the refractive and visual outcomes for pediatric traumatic cataracts requiring surgical intervention and evaluate the factors that influenced the success of surgery in this population. We believe this is the first study to extensively report refractive outcomes and the factors influencing them.

PATIENTS AND METHODS

Approval for the study was obtained from the Hospital for Sick Children's Research Ethics Board. Children who had lensectomy

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performed for traumatic cataract at the hospital between January 1, 2000, and June 30, 2015, were identified through surgical databases. Patients were included if they had a minimum follow-up of 3 months after cataract surgery. Children were excluded if they had preexisting visually significant ophthalmic disease (eg, optic nerve hypoplasia) or were unable to complete visual acuity testing. Data were collected on patient demographics, injury details, surgical procedures, complications, biometry measurements, and postoperative corrected distance visual acuity (CDVA) and refraction.

Injuries were classified as open-globe or closed-globe injury using the Birmingham Eye Trauma Terminology.[7] Zones of injury were determined based on the International Ocular Trauma Classification Group.[1] Complications documented included amblyopia, retinal detachment (RD), glaucoma, glaucoma-associated surgery, and corneal transplantation. Amblyopia was considered to be present if there was a documented diagnosis in the chart or if any occlusion therapy was used in the child's management regimen.

The 2 primary outcome measures were the CDVA and the mean absolute prediction error in refraction. The final CDVA was the age-appropriate visual acuity measured at the most recent follow-up, converted to Snellen acuity for categorical analysis. Refractive outcomes for those who had an IOL as part of their rehabilitation were calculated as the mean absolute prediction error. Spherical equivalent refractions within 6 months of IOL placement and at the final visit were used. The mean absolute prediction error was calculated as the absolute difference between the SE refractive measurements and the refractive target that was documented at the time of IOL placement or identified through biometry and clinical notes. Emmetropia was assumed as the refractive target unless otherwise stated. Biometry of the affected eye was used for IOL measurements if possible; otherwise, data from the fellow eye were used.

Primary repair of open-globe injuries was performed as a separate procedure before cataract management. Patients with an open-globe injury and those with a closed-globe injury were divided into Group A and Group B based on the timing of cataract management and IOL placement. Group A comprised those who had combined lensectomy and IOL surgery and Group B, those who had lensectomy followed by secondary IOL placement as a separate procedure.

For continuous variables, the mean, standard deviation (SD), median, and range were recorded. Categorical variables were expressed as proportions and percentages. The means and medians of continuous variables were compared using the unpaired *t* test. Categorical variables were compared using the Fisher exact test and chi-square test. Logistic regression modeling was used to analyze the relationship between final visual and refractive outcomes and predictor variables. Predictors of interest were further incorporated into a multiple regression model. A *P* value less than 0.05 was considered statistically significant.

RESULTS

Lensectomy surgery for traumatic cataract was performed on 119 children. Thirteen were excluded from the study because of preexisting visually significant ophthalmic disease or an inability to perform visual acuity testing. Of the 106 patients included, 79 (75%) had open-globe injuries, the majority of which were penetrating injuries (76 [96%]). Intraocular foreign bodies (2 [3%]) and a combined intraocular foreign body and perforating injury (1 [1%]) made up the remainder. Four of the penetrating eye injuries (5%) had self-sealing corneal wounds that did not require primary repair.

Table 1 shows the patients' demographics and final lens status. The cohort was predominantly male. Patients with the open-globe injuries were statistically significantly younger than those with closed-globe injuries ($P < .05$). The median follow-up was significantly longer in the open-globe injury group than in the median closed-globe injury group.

Visual Acuity and Refraction

Figure 1 shows the distribution of final CDVA by injury type. In the overall cohort, 47 patients (44%) attained a CDVA of 20/40 or better at their final follow-up visit. The final visual outcome was significantly better in the closed-globe injury group, with 17 (63%) attaining a final CDVA of 20/40 or better compared to 30 (38%) in the open-globe injury group.

Fifty-eight open-globe injuries (73%) involved zone 1, 19 (24%) zone 2, and 2 (3%) zone 3. The percentage of children with final CDVA of 20/40 or better with open-globe injuries in zone 1 and zone 2 was 40% (22) and 42% (8), respectively. No children with a zone 3 open-globe injury attained this level of vision. No children in the study had zone 1 closed-globe injuries based on the inclusion criteria. Eighteen (67%) of closed-globe injuries were zone 2 and 9 (33%) were zone 3 injuries. Whereas 14 (78%) zone 2 injuries attained 20/40 or better vision, only 3 (33%) with zone 3 injuries did.

Intraocular lenses were implanted in 94 children as part of their refractive rehabilitation. Seventy-four of these had refractive information documented within 6 months of IOL placement and 90 had a final refraction documented. Incomplete refractive information resulted from severe corneal injuries and difficulties with patient cooperation. Figure 2 shows the refractive outcomes of open-globe injury and closed-globe injury groups at these timepoints. Within 6 months of IOL placement, the mean absolute prediction error was 1.0 diopter (D) or less for 11 (55%) closed-globe injuries and 29 (54%) open-globe injuries. At the final follow-up, the mean absolute prediction error for 16 (64%) of closed-globe injuries was 1.0 D or less compared with 24 (37%) of open-globe injuries.

Univariate analysis on factors that potentially influence visual and refractive outcomes is shown in Table 2. Age 5 years or less was associated with worse final refractive outcomes (odds ratio [OR], 2.88; $P = .02$). Open-globe injuries and amblyopia were associated with both worse final visual (OR, 2.8, $P = .03$ and OR, 2.4, $P = .04$, respectively) and refractive outcomes (OR 3.1, $P = .02$ and OR 3.8, $P = .04$, respectively).

Five patients were excluded from the comparative analysis between Group A and Group B because their lensectomy was completed as part of the primary open-globe injury repair. There was no difference in outcomes with different surgical timing for lensectomy and IOL placement (simultaneous or delayed) between Group A and Group B. Posterior segment involvement for closed-globe injuries (zone 3) was associated with worse visual and refractive outcomes (Table 3).