Ocular Complications after Organ and Bone Marrow Transplantation in Children

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Background: Organ and bone marrow transplantation commonly are performed in children. Ocular complications usually are described as secondary to post-transplantation medications. The complication rate is unknown. ***Methods:*** A retrospective chart review was performed of 93 children who were younger than 18 years of age and had transplantation surgery from 1989 to 2004. The rate and type of ocular complications, including those requiring ocular surgery, were analyzed. Medications and visual loss associated with adverse effects also were studied. ***Results:*** Of the 93 patients, 74 patients met the entry criteria. Sixty-one patients had at least 1 year of follow-up, and the longest follow-up duration was 14 years. The 1-year post-transplantation complication rate was 16.0% (95% confidence interval 6.8–24.4%). Adverse effects included cytomegalovirus (CMV) retinitis, cataract, graft-versus-host disease, lymphoproliferative disorder, persistent strabismus, and transient visual loss. Four patients underwent eye surgery, including lensectomy for cataract, tarsorrhaphy for corneal ulcer, and iris biopsy. They had surgery 0.9 to 4.7 years after transplantation. Most patients were taking prednisone and cyclosporine when their complication was diagnosed. One patient's visual acuity deteriorated to no light perception in one eye and 20/250 in the other eye secondary to CMV retinitis. Most patients had a final visual acuity ≥20/40. ***Conclusion:*** Transplantation surgery in children produces a significant risk of ocular impairment. The 1-year complication rate was 16.0%. Eye surgery may be required within the first few years after transplantation. Although most patients maintained a final visual acuity of 20/40 or better, one patient became bilaterally legally blind. (J AAPOS 2005; 9:426-432)

Organ, bone marrow, and hematopoietic stem cell transplantation increasingly have become the standard of care for treatment of various childhood malignancies and diseases.[1-3] In the past few decades, advancements in surgical techniques and better immunosuppressive agents have contributed to higher patient survival rates. As more children survive with such intervention, their likelihood of developing an ocular complication rises. The complications often are attributed to immunosuppressive therapy and graft-versus-host disease (GVHD). Conventional post-transplantation management includes annual eye examinations. Surveillance of cataracts, ocular GVHD, opportunistic fungal and viral retinal infections, and glaucoma are recommended.[4]

The ocular complication rate after transplantation surgery in adults has been well reported. Secondary cataract has been cited in various studies to occur in 25-50% of patients undergoing renal transplantation.[5-8] Bone marrow transplantation recipients are 7.5 times more likely to develop ocular sequelae, 15.3 times more likely to develop cataracts, and 3.9 times more likely to develop dry eyes than the normal population.[9] The incidence of chronic ocular GVHD after bone marrow and stem cell transplantation ranges as high as 60-90%.[4,10] Ocular infection after renal, cardiac, or bone marrow transplantation is reported between 1.3-5%.[6,11-13] Elevated intraocular pressure is rarely observed, occurring in 1-2% of patients with prolonged oral steroid therapy after transplantation.[5,6,14]

Similar data, however, are poorly documented in the pediatric age group. The ocular complication rate after transplantation surgery in such a population is unknown. The purpose of this study is to determine the ocular complication rate after transplantation surgery in a pediatric patient population. In addition, the type and timing of ophthalmologic side effects, visual loss, and necessity of ocular surgery are analyzed.

SUBJECTS AND METHODS

The medical records of all children who underwent transplantation surgery at our institution between 1989 through 2004 were reviewed retrospectively. Patients were required to be younger than 18 years of age at the time of transplantation. Transplantation surgery included organ, bone marrow, or hematopoietic stem cell transplantation.

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If a patient had more than one transplantation, the initial transplantation date was used in assessing time between surgery and complications. Exceptions were made only if the second transplantation surgery was documented as the direct cause of the ocular complication (ie, GVHD that occurred months after a stem cell transplantation in a patient who underwent a bone marrow transplantation several years ago).

Patients were included in the study only if they had pre- and post-transplantation eye examinations. The examinations were conducted by a pediatric ophthalmologist at our institution or by outside ophthalmologists or optometrists with records available in the patient's medical chart.

Data collected included: patient diagnosis, type of transplantation surgery, age at transplantation, pre- and post-transplantation eye examinations, post-transplantation ocular complication, prescribed medications at the time of complication diagnosis, surgery required to address the ocular complication, and any visual acuity loss as a result of the complication. Institutional review board approval for the study was obtained before we initiated the study.

RESULTS

Of the 93 patients who received transplantation surgery, 74 patients met the entry criteria and comprised our study group. Of the 74 patients, 31 had an examination by an ophthalmologist at our institution, and 43 had an examination by a local ophthalmologist or optometrist. The mean age at the time of transplantation was 7.6 years (range, 4 months to 18 years). The organ transplantations comprised mainly of renal (n = 26) and liver transplants (n = 25). The most frequent diagnoses included obstructive nephropathy secondary to congenital dysplastic kidneys, and primary biliary atresia resulting in end- stage liver disease. Bone marrow or stem cell transplantation (n = 18) were most frequently performed for acute lymphocytic leukemia. All bone marrow transplantation patients underwent total body irradiation. The remaining 5 patients had combinations of liver and renal transplantation, liver, small intestine, and pancreas transplantation, bone marrow followed by stem cell transplantation, or bone marrow followed by renal transplantation.

Duration of follow-up after transplantation surgery ranged from less than 1 month to 14 years. The mean follow-up duration was 2.3 years. Sixty-one (82%) patients had at least 1 year of follow-up, whereas 14 (19%) patients had 3 years or more of post-transplantation eye examinations.

Intraocular pressure (IOP) was documented in only 20 patients, all of whom were older than 12 years of age. All IOP measurements were found to be less than 21 mm Hg. No patient had glaucomatous optic neuropathy, nor was anyone prescribed pressure-lowering topical medications. All 20 patients had taken systemic prednisone immediately after their transplantation, and most were on a low oral dose at the time of their eye evaluation.

The 1-year post-transplantation ocular complication rate was 16.0% (95% confidence interval 6.8–24.4%). Fifteen patients developed ocular complications, of which 11 occurred within 1 year after transplantation. The remaining 4 complications occurred 1.6, 2.0, 4.1, and 4.6 years after transplantation. Complications included cataract, keratoconjunctivitis sicca secondary to GVHD, cytomegalovirus (CMV) retinitis, posttransplantation lymphoproliferative disorder (PTLD), strabismus, transient visual loss, preseptal cellulitis, allergic periorbital edema, and conjunctivitis (Table 1).

Of the 15 patients who developed an ocular complication, 14 were prescribed either systemic prednisone, cyclosporine, or a combination of both as part of their post-transplantation regimen. Five patients (patients 1-3, 7, 8) developed posterior subcapsular cataracts between 9 months to 4.2 years after transplant. The cataracts in patients 1 to 3 were believed to be steroid-induced because no ocular inflammation was noted during examinations. In patients 7 and 8, cataract formation may have been caused by a combination of high-dose steroid use and ocular inflammation secondary to CMV retinitis. All 5 patients received high doses of prednisone at the time of their transplantation.

Three patients (patients 4-6) developed GVHD after undergoing bone marrow or stem cell transplantation. They were diagnosed with keratoconjunctivitis sicca between 3.5 and 9 months after transplantation. All 3 patients had decreased tear production by Schirmer testing after complaining of foreign body sensation and decreased vision. Their Snellen acuity measured between 20/25 and 20/60, whereas pretransplantation visual acuity was documented at 20/20 in each eye for all patients. Treatment included topical steroids, lubricants, and punctal plugs. Patient 4 and 5 had resolution of their symptoms with such management. Their final Snellen acuity measured 20/20 in each eye. An 18 year-old patient (patient 6), with no measurable tear production in either eye, required a temporary tarsorrhaphy. She developed a noninfectious corneal ulcer that failed to resolve with conservative management, including topical cyclosporine. The ulcer diminished after 3 weeks of lid closure, leaving a mild central stromal scar. Her final Snellen acuity was 20/40 in the affected eye and 20/25 in the fellow eye.

CMV retinitis was diagnosed in 2 patients (patient 7, 8). Patient 7 underwent a liver transplantation for primary biliary atresia at 13 months of age. Within 2 months, she developed CMV retinitis bilaterally after becoming seropositive. Her medications included high-dose intravenous prednisone and cyclosporine. The infection initially responded to intravenous ganciclovir, but then recurred with extensive involvement in both eyes after the discontinuation of ganciclovir. Her visual acuity diminished to NLP in the right eye, and 20/100 on sweep visual-evoked potential

TABLE 1. Characteristics of patients who developed an ocular complication after organ or bone marrow transplantation

Patient	Diagnosis	Type of transplantation	Ocular complication	Time to complication (months)*	Final visual acuity
1	Aplastic anemia	Bone marrow, then renal	Posterior subcapsular cataract, OU	9.0	20/40 OD, 20/80 OS Snellen
2	Alpha-1 anti-trypsin deficiency	Liver	Posterior subcapsular cataract, OU	19.6	20/20 OD, 20/20 OS Snellen
3	Focal segmental glomerulosclerosis	Renal	Posterior subcapsular cataract, OD	49.5	20/20 OD, 20/20 OS Snellen
4	Myelodysplastic syndrome	Bone marrow	GVHD keratoconjuntivitis sicca, OU	3.5	20/20 OD, 20/25 OS Snellen
5	Acute lymphocytic leukemia	Bone marrow	GVHD keratoconjuntivitis sicca, OU	3.5	20/25 OD, 20/25 OS Snellen
6	Acute lymphocytic leukemia	Bone marrow, then stem cell	Corneal ulcer, OS; GVHD keratoconjuntivitis sicca, OU	9.3	20/40 OD, 20/25 OS Snellen
7	Biliary atresia	Liver	CMV retinitis, OU; then posterior subcapsular cataract, OU	2.3, 11.9	NLP OD, 20/250 OS Snellen
8	Congenital gastroschisis	Liver, small intestine, pancreas	CMV retinitis, OU; posterior subcapsular cataract, OU	24.7	CSM† OU
9	Hodgkin's disease	Bone marrow	Intermittent exotropia, diplopia	0.2	20/20 OD, 20/20 OS Snellen
10	Congenital gastroschisis	Liver, small intestine, pancreas	Exotropia, OD	9.4	20/30 OD, 20/30 OS VEP
11	Myelodysplasia	Bone marrow	Transient visual loss, OU	1.0	20/20 OD, 20/25 OS Snellen
12	Acute lymphocytic leukemia	Bone marrow	Allergic periorbital edema, OU	1.2	20/20 OD, 20/20 OS Snellen
13	Neuroblastoma	Stem cell	Preseptal cellulitis, OD	1.5	20/20 OD, 20/20 OS Allen
14	Reflux nephropathy	Renal	Conjunctivitis, OU	0.5	20/20 OD, 20/20 OS Snellen
15	Biliary atresia	Liver	Lymphoproliferative disorder, OU	55.2	20/25 OD, 20/20 OS Snellen

*Length of time between transplantation and diagnosis of ocular complication.
†Central, steady, maintained fixation in preverbal patient.

(VEP) testing in the left eye. She had a central island of uninvolved retina in her left eye. She subsequently developed bilateral cataracts secondary to intraocular inflammation. Lensectomy was performed in her left eye 1.7 years after transplantation surgery. Aphakic contact lens use led to a bacterial corneal ulcer 3.3 years post-transplantation, which resolved with topical fortified antibiotics. The residual central stromal scar did not appear to decrease her vision. However, during 11.6 years of follow-up, the Snellen acuity in her left eye gradually deteriorated to 20/250. Retinal fibrosis and pigment encroachment on the macula were believed to be the etiology of her worsening vision.

Patient 8 underwent a combined liver, pancreas, and small intestine transplantation for gastroschisis at 10 months of age. He had a complete eye examination, including dilated retinal examination, 2.2 months after transplantation after he was diagnosed with CMV-positive serology. No evidence of CMV retinitis or cataracts were noted at the time. He sustained hearing loss secondary to chronic aminoglycoside use, and a head computed tomography (CT) was performed 2 years after transplantation surgery for potential cochlear implantation. Multiple retinal calcifications were noted in his right globe on CT. An examination under anesthesia revealed inactive CMV retinitis bilaterally, affecting the right posterior pole and left periphery. Fibrosis and retinal calcification were noted bilaterally. Focal retinal calcification was found in the right perimacular area. He also had central posterior subcapsular cataracts bilaterally. It is unknown exactly when he had active retinitis because no eye examinations were performed since the time of the initial post-transplantation examination. He appeared to have appropriate fixation in each eye and did not have strabismus. A VEP test to assess visual acuity was not performed.

A 4-month old patient (patient 15) with biliary atresia underwent a liver transplantation. One year later, she had abdominal pain with elevated serum Epstein–Barr (EBV) virus titers. The diagnosis of PTLD was made. She appeared 4 years later with bilateral uveitis and iris nodules in her right eye. An iris biopsy was performed, which demonstrated monoclonal plasma cell proliferation consistent with PTLD. A complete blood cell count, bone marrow biopsy, and CT of her abdomen and chest were normal. A

cerebrospinal fluid analysis showed mild lymphocytosis. Her medications included oral prednisone and cyclosporine. She was treated with intravenous ganciclovir, topical and subTenon steroid, maintenance of oral prednisone, and discontinuation of oral cyclosporine. The uveitis resolved and flat iris fibrosis replaced the previous nodules. She was continued on low-dose prednisone and ganciclovir for 5 years.

An 8 year-old patient (patient 11) underwent bone marrow transplantation for myelodysplasia. A month after transplantation, she complained of headaches and blurred vision. On ophthalmologic evaluation, she had hand motion vision bilaterally with completely normal appearing fundus. The first episode lasted a few minutes, with a subsequent episode lasting 2 days. The episodes occurred within 12 hours of each other. A brain magnetic resonance imaging (MRI) revealed leptomeningitis involving the parietal and occipital lobes. She developed seizures and encephalopathy. Cerebrospinal fluid analysis revealed no infectious etiology. However, a cyclosporine level was found to be significantly elevated, and her symptoms were attributed to cyclosporine toxicity. The medication was discontinued and within 48 hours, her vision and neurologic status returned to baseline. She had no further episodes of transient visual loss.

Two patients (patient 9, 10) acquired strabismus shortly after transplantation surgery. Patient 9 developed a 35-prism diopter (PD) left exotropia within the first few weeks after surgery. There was no associated third-nerve palsy or medial rectus paresis. The exotropia remained constant over the next 13 months. It is unknown if the patient underwent strabismus surgery as no subsequent records were available. Patient 10 became diplopic and acquired a 25-PD intermittent exotropia within the first week after transplantation. The intermittent misalignment and diplopia persisted for 3 days, then completely resolved. Both patients did not have strabismus detected on pretransplantation eye examinations.

Four patients (patients 1, 6, 7, 15) underwent eye surgery for their complications, including lensectomy for cataract, tarsorrhaphy for corneal ulcer, and iris biopsy. Two patients had visually significant posterior subcapsular cataract, the first secondary to prednisone use (patient 1) and the second attributable to a combination of CMV-induced ocular inflammation and prednisone use (patient 7). They had surgery 1.7 and 2.3 years after transplantation, respectively. In both cases, lensectomy led to improved visual acuity postoperatively. Patient 1 had visual acuity improvement from 20/80 to 20/40, and patient 7 improved from 20/200 to 20/100. The final acuity in each patient was believed to be limited by a macular scar and CMV retinitis, respectively. Patient 1 had bilateral vitreous hemorrhages caused by aplastic anemia, for which she underwent a bone marrow transplantation. The vitreous hemorrhages resolved, resulting in macular fibrosis in both eyes. Patient 6 developed a sterile corneal ulcer secondary to GVHD keratoconjunctivitis sicca. She underwent a temporary tarsorrhaphy, after which the ulcer resolved. The residual corneal scar decreased her visual acuity to 20/40 from its baseline of 20/20. The procedure was performed 0.9 years after transplantation. Patient 15 underwent an iris biopsy to diagnose PTLD, 4.7 years after transplantation. She was treated successfully with subTenon kenalog injection, topical steroids, and modified immunosuppressive agents. Her visual acuity remained stable after the surgical procedure, and improved to 20/25 and 20/20 with medical therapy.

Most patients with measurable visual acuity maintained ≥20/40 acuity in both eyes, determined with VEP, Allen picture, HOTV, or Snellen letter testing. Twelve of 74 patients were too young for recognition acuity testing and did not have sweep VEP. One patient had 1/200 pre- and post-transplantation Snellen acuity due to retinitis pigmentosa. Another patient had bilateral macular fibrosis after pretransplantation vitreous hemorrhage and cataracts. Her final acuity was 20/40 after lensectomy for cataract in the right eye, and 20/80 in the left eye. Patient 7 became bilaterally blind from CMV retinitis, with final acuity of NLP in one eye and 20/250 in the other eye. The remaining 59 patients had ≥20/40 acuity in both eyes.

Fourteen patients had 3 years or more of follow up after transplantation (Table 2). The range of follow-up was 3.0 to 14.0 years. Four of 14 patients (patients 2, 3, 7, 15) had post-transplantation ocular complications. Three patients (patients 2, 3, 7) had posterior subcapsular cataracts. They were not visually significant in patients 2 and 3, who maintained 20/20 acuity in both eyes. Patient 7 had CMV retinitis and cataracts and had resultant poor visual acuity in both eyes despite lensectomy. Patient 15 had ocular PTLD, which was treated with steroids and ganciclovir. She had good final vision in both eyes. The remaining 10 patients did not develop complications over the course of their long-term follow-up and had excellent visual acuity.

DISCUSSION

This study determined the 1-year ocular complication rate to be 16.0% after organ and bone marrow transplantation surgery in a pediatric population. This rate has not been reported in the medical literature, to our knowledge. There have been a few published reports analyzing specific ocular complications after either bone marrow transplantation or organ transplantation in children. Bartosh et al[15] sent questionnaires to pediatric renal transplantation recipients who survived into adulthood. The mean age at transplantation was 12.7 years (range, 0.4–18 years) with a mean follow-up period of 13.2 years. Of the 57 adults who responded, 28% developed cataractous changes in one or both eyes. It is not known how many of the patients required lensectomy. Englund et al[16] reported minor cataract development without visual disturbance in 45% of 47 pediatric renal transplantation recipients. The patients were studied 10-20 years after transplantation. Suh et al[17]

TABLE 2. Characteristics of patients with at least 3 years of follow-up after organ or bone marrow transplantation

Patient	Diagnosis	Type of transplantation	Length of follow-up (years)	Complication, if present	Final visual acuity
16	Glioblastoma	Bone marrow	3.0	None	20/20 OD, 20/20 OS Snellen
17	Familial juvenile nephropthisis	Renal	3.3	None	20/25 OD, 20/20 OS Snellen
18	Familial juvenile nephropthisis	Renal	3.4	None	20/20 OD, 20/20 OS Snellen
19	Focal segmental glomerulosclerosis	Renal	3.4	None	20/20 OD, 20/20 OS Snellen
20	Liver failure, unknown etiology	Liver	3.5	None	20/20 OD, 20/20 OS Snellen
3	Focal segmental glomerulosclerosis	Renal	4.1	Posterior subcapsular cataract, OD	20/20 OD, 20/20 OS Snellen
21	Obstructive nephropathy	Renal	4.9	None	20/20 OD, 20/20 OS Snellen
15	Biliary atresia	Liver	9.3	Lymphoproliferative disorder, OU	20/25 OD, 20/20 OS Snellen
2	Alpha-1 anti-trypsin deficiency	Liver	9.4	Posterior subcapsular cataract, OU	20/20 OD, 20/20 OS Snellen
22	Obstructive nephropathy	Renal	10.6	None	20/20 OD, 20/20 OS Snellen
23	Biliary atresia	Liver	11.3	None	20/20 OD, 20/20 OS Snellen
7	Biliary atresia	Liver	11.6	CMV retinitis, OU; then posterior subcapsular cataract, OU	NLP OD, 20/250 OS Snellen
24	Bilat renal failure, reflux nephropathy	Renal	12.7	None	20/20 OD, 20/20 OS Snellen
25	Biliary atresia	Liver	14.0	None	20/20 OD, 20/20 OS Snellen

assessed ocular findings in 104 pediatric bone marrow recipients with an average of 2-year follow-up. Dry eye syndrome was found in 12.5%, cataract in 23%, and fundus complications in 13.5% of patients. Similar to our study, over 95% of patients had a final visual acuity of 20/40 or better.

Fifteen of 74 (20.3%) patients were found to have ocular complications in our study. The most common ocular complication was cataract. The dose-dependent relationship between systemic steroids and cataract formation has been well described, although the exact mechanism may rely on individual susceptibility, prolonged use, and longer duration after transplantation.[12,18-20] Five patients (6.8%) developed posterior subcapsular cataract, 4 bilaterally, after transplantation. The etiology of the cataract, either steroid use or CMV-induced ocular inflammation, did not affect timing of lens opacity formation. Only 1 patient with cataract was a bone marrow transplantation recipient, and the same patient was the only bone marrow recipient (n = 20) to develop a cataract. A higher percentage would have been expected, particularly in bone marrow or stem cell transplantation recipients who receive total body irradiation. Deeg et al[21] found cataracts in 20% of patients who underwent fractionated exposure total body irradiation, and in 80% of patients with single exposure total body irradiation. Fisher[4] summarized long-term complications in children and young adults undergoing hematopoietic stem cell transplantation. Cataracts were found to occur 1.5 to 5 years after transplantation. Potter et al[22] reported cataract development in 56% of renal transplantation recipients with at least 20 years of follow-up. It is very likely that a significantly higher percentage of our patients would develop cataracts with longer follow-up time.

The most devastating complication to produce severe visual loss in this study was CMV retinitis. The 2 patients with CMV retinitis were diagnosed 2 months and 2 years post-transplantation. The latter patient had a delayed diagnosis, as his ocular infection was inactive by the time a retinal examination was performed. Papanicolaou[13] determined the time from liver transplantation to diagnosis of CMV retinitis ranged from 2 to 8 months. Because the patients were adults, they complained of blurred vision which prompted funduscopic examinations. Despite current antiviral regimen for CMV infection, it is still a cause of permanent, debilitating visual loss in transplantation patients.

GVHD is a common finding after bone marrow and stem cell transplantation. It results from transplanted cells reacting immunologically against the host cells. Often, it occurs weeks to months after transplantation. Chronic GVHD occurs ≥100 days after transplantation, and many involve the eye. Ocular manifestations include keratoconjunctivitis sicca, conjunctivitis, cicatricial lagophthalmos, scleritis, and retinal microvascular disease.[23-25] Reduced tear production, secondary to lymphoid and fibroblast

infiltration of the lacrimal gland,[26] occasionally results in sterile corneal stromal ulceration, as in the patient in our study. Persistent epithelial defects predispose the patient to stromal thinning. Therapeutic management includes nonpreservative artificial lubricants, punctal plugs, topical steroid and cyclosporine, bandage soft contact lenses, tarsorrhaphy, or conjunctival flap. Permanent visual loss secondary to corneal scarring commonly follows ulceration. In the pediatric age group, corneal scarring is a major risk for amblyopia.

PTLD occurs in 3% of liver transplantation recipients. It is believed to stem from the uncontrolled proliferation of B-cells, which are usually regulated by cytotoxic T cells and natural killer cells. Because immunosuppressive therapy inhibits T-cell function, there is no mechanism to suppress B-cell growth. EBV is the cause of the majority of PTLD.[27] Iris immunohistochemical staining revealed predominantly monoclonal plasma cells, consistent with PTLD. Ganciclovir is recommended for its anti-EBV properties. Reports of ocular PTLD include various initial presentations such as iris masses,[28,29] vitritis,[30,31] and orbital mass.[32] Prognosis depends on the extent of tumor involvement. Multiorgan spread of PTLD and death have been reported.[33]

Cyclosporine toxicity has been reported to cause transient visual loss associated with MRI white matter abnormalities.[34,35] The MRI lesions occur primarily in the occipital lobes, and are believed to result from ischemia or edema. Similar findings from vasospasm occur in hypertensive encephalopathy. Encephalopathy and seizures often accompany the visual symptoms. Visual and neurologic recovery is common once the dose of cyclosporine is reduced or discontinued.

All 14 patients with 3 or more years of follow-up had good visual results overall. Follow-up ranged from 3 to 14 years after transplantation, and mean follow-up in this group was 7.7 years. All but 1 patient underwent organ transplantation. Four of 14 patients (28.6%) had an ocular complication. Three patients developed cataracts. The cataracts were diagnosed between 11.9 to 49.5 months after transplantation, and only 1 was visually significant. A fourth patient developed PTLD 55.2 months after transplantation. All except one (patient 7) had excellent vision, at 20/25 or better.

There were 20.3% and 28.6% of patients who developed an ocular complication overall and with ≥3 years of follow-up in this study, respectively, suggesting a trend of higher complication rates with longer follow-up. Cataract and chronic ocular GVHD frequently occur after the first year of transplantation. Ocular surgery did not lead to vision loss, regardless of the complication. The patients in this study had good final acuity overall, with only 1 patient becoming bilaterally blind.

The major weakness of our study was the short follow-up duration with a mean of 2.3 years. Although 61 patients had at least one year of follow-up, several patients returned to their local eye care provider for annual eye examinations. Future studies with longer follow-up are needed to assess the long-term risk of ocular complications in a pediatric organ or bone marrow transplantation population.

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An Eye on the Arts – The Arts on the Eye

To get to his office, I have to walk through a waiting room jammed with eye patients, a sea of them, and I'm made conscious that my left eye, once askew in its socket, the muscles incapable of movement, can now swivel and focus as well or better than my right. From what Dr. Kurtz told me, what Dr. Della Rocca did was extraordinary; he was the best.

He's not in his office when I arrive, but he enters shortly thereafter, a stocky, white-haired man, apologizing for his lateness—he has just finished his third operation of the day (it is 3:15 PM) and is running behind schedule. He hugs me then runs a hand over the scar beside my eye with the gentleness of a mother caressing her baby.

We sit facing one another. He tells me that Dr. Kurtz called him in for a consultation two weeks after the attack, but since I was still in such bad physical shape, he decided to postpone an operation rather than risk the further battering that surgery would require, despite enormous pressure from the press and second-guessing doctors who urged him to do it right away. By May 17, though, I was strong enough, and Dr. Della Rocca, along with Dr. Craig Foster, a plastic surgeon, and other doctors, set to work.

Dr. Kurtz had told me that Dr. Della Rocca made an incision around the eye and teased the eyeball out of its trapped position, then resurfaced the floor of the orbit he took from the outer table of my skull to form a bone graft. He put that graft under my eyeball and moved it back up so it could be pulled back and forth, as it is supposed to be, by the muscles.

"I hate to use the phrase *cutting edge*," Dr. Della Rocca says, "but it was certainly surgery as updated as you're going to get. It's difficult when you work on the bones around the eye, repositioning the eye. You've got to support the eye so it takes off some of the pressure from the optic nerve. We had to not only stabilize the tissue around the eye, but you had some forehead bones that Craig Foster fixed, and I think there was a nasal fracture. It took around five hours. We had to go through the internal tissue, both through the mouth and also through the areas that tend to make a scar more obscure—underneath the eye, above the teeth, going in from the side a little bit so you limit the scarring. And then we put a little implant under your eye too, bone from the skull with metal on the rims.

—Trisha Meili (from *I Am the Central Park Jogger*, Scribner)