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Cost of Intraocular Lens vs Contact Lens Treatment after Unilateral Congenital Cataract Surgery: Retrospective Analysis at Age 1 Year

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Abstract

Purpose—To describe the differences in treatment costs for infants randomized to contact lens correction versus primary intraocular lens (IOL) implantation after unilateral cataract surgery in The Infant Aphakia Treatment Study.

Design—Retrospective cost analysis of a prospective, randomized clinical trial based on Georgia Medicaid data and the actual costs of supplies used.

Participants—The Infant Aphakia Treatment Study (IATS) is a randomized, multicenter (n=12) clinical trial comparing treatment of aphakia with a primary IOL or contact lens in 114 infants with unilateral congenital cataract.

Intervention—Infants underwent cataract surgery with or without placement of an IOL.

Main Outcome Measures—The mean cost of cataract surgery, and all additional surgeries, examinations, and supplies used up to 12 months of age.

Results—The mean cost of treatment for a unilateral congenital cataract with primary IOL implantation was $14,752 versus $10,726 with contact lens correction. The initial cataract surgery accounted for approximately 50% of the treatment costs for both groups. Contact lens costs accounted for 15% ($1,600/patient) in the aphakic group whereas glasses costs only represented 4% ($535/patient) in the IOL group. The increased costs in the IOL group were primarily due to the higher cost of cataract surgery in this group ($7,302 vs. $5,357) and the cost of additional operations.

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*The Infant Aphakia Treatment Study Group (see Appendix 1, available at http://aaojournal.org)
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Conclusions—For IATS patients up to 12 months of age, cataract surgery coupled with IOL implantation and spectacle correction was 37.5% (about $4000) more expensive than cataract surgery coupled with contact lens correction.

The Infant Aphakia Treatment Study (IATS) is a multi-center longitudinal study that evaluated the clinical outcomes of two treatments for aphakia following early surgery for unilateral congenital cataract. Study patients between 1 and 6 months of age underwent cataract surgery and were randomly assigned to one of two treatment groups. The first group was left aphakic and treated with a contact lens; the second group had intraocular lens (IOL) implantation at the time of cataract extraction. At 12 months of age grating visual acuity was tested by a traveling examiner; no significant difference was found between the median visual acuity in the treated eyes of children in the two treatment groups.[1,2]

Even though there was no significant difference in the visual outcome of the two treatments at one year which would demonstrate that one treatment had a clear advantage over the other, it is important that resource utilization considerations also be evaluated. The extent of the differences in resource use provides important data where there is no clear clinical advantage by helping policymakers to make an informed decision that will promote value for the patient, providers, payers, and society.[3,4,5] As such, treatment costs may include many factors such as dollars expended, time spent, emotional burden, productivity lost, and medications used; all of these can play a key role in influencing which treatment is, in the end, the best value.[6] It is especially important to understand the resource costs for any major treatment involving children given that the cost burden will be incurred over a much longer time-period.[7]

Despite the fact that an economic evaluation is an important step when evaluating any clinical treatment, collecting comparable and unbiased economic data can be a challenging task. Differences in the level of payments for services and procedures across different providers and geographic regions have the potential to limit the value of economic data from multi-site randomized clinical trials (RCTs). That is, patients for RCTs are typically randomized based on clinical and patient characteristics rather than third-party payers or treatment setting. Since there can be vast differences in the costs for the same surgical procedure or examination across payers and/or geographic regions this can limit the generalizability of these results. For example, in the IATS, our preliminary data analysis showed a 66% payment difference for cataract surgery between payers at two study sites. Such differences in payment are well documented in the literature.[8,9]

Consequently, to avert any bias due to these issues, we retrospectively estimated the monetary costs incurred by the IATS at one year based on the preoperative, hospital, surgical, and postoperative costs incurred at each study site modeled on the payment structure of a single third-party payer--Georgia Medicaid. We then combined these costs with the actual costs incurred by the IATS for postoperative optical rehabilitation services and patching therapy. We use Georgia Medicaid payment data because, while nationwide Medicaid pays for only one-third of all births in the United States and provides health coverage for only one-fourth of American children, in Georgia Medicaid pays for 61 percent of all births.[10,11] Furthermore, in Georgia Medicaid covers all medical services for up to one year of age for a child covered at birth by Medicaid.[12]

PATIENTS and METHODS

The IATS was approved by the Institutional Review Board of all participating institutions and was in compliance with the Health Insurance Portability and Accountability Act (HIPAA). The IATS is registered with clinicaltrials.gov and this research adhered to the

tenets of the Declaration of Helsinki. The primary inclusion criteria were the presence of a visually significant congenital cataract in only one eye, and an age at surgery of four weeks to less than seven months. Other inclusion and exclusion criteria, as well as general information about the design and clinical measures, are available in previously published IATS articles.[1,2] Data used in this analysis included total incurred costs up to one year of age.

Initially, cost data from subjects up to one year of age was gathered from multiple sites involved in the IATS. However, as noted above, patients were insured by a wide range of third-party payers (public, private, and managed care) and were from different regions of the country which resulted in markedly different costs at the different clinics and hospitals participating in the IATS. We concluded that it would be more representative and consistent with patient resource use and provider costs if we applied the costs of a single payer to the procedures performed and treatments rendered. We considered using private payer payments but studies have shown that private-sector payment rates for hospital and physician services have greater geographical variability in payment rates.[8,9] Because of the difficulty we encountered collecting cost data for hospital services at the different IATS clinical sites and then finding that the costs were largely incongruent, it was determined that Georgia Medicaid data was the most readily available and consistent mode of calculating the costs for all hospital and surgical treatments. The postoperative rehabilitation expenses (contact lenses, spectacles, and occlusive patches) used in this analysis were the actual costs incurred because the IATS paid for these costs directly.

Several steps were taken to estimate patient care costs. First, we divided the costs into three costs groups: (1) those that occurred before cataract surgery (pre-procedure), (2) hospital based procedures, and (3) office based follow-up. Next, for each of the major procedure cost categories and the examination-under-anesthesia (EUA) costs, we split these costs into three components: hospital, surgeon, and anesthesia. Surgical procedures that were performed only once or twice were lumped together under “additional intraocular surgeries.” Finally, among the follow-up costs for procedures, we included the cost of clinical examinations and supplies. These costs were based on the number of office visits mandated by the study rather than the actual number of office visits performed. The cost of supplies were based on the mean cost of these supplies for each treatment group (e.g. contact lenses, glasses and patches).

Hospital-Based Procedure Costs

The cost of hospital procedures was based on Georgia Medicaid payments for each of the procedures to Children’s Healthcare of Atlanta. Surgeon costs were collected by current procedural terminology (CPT) code from the July 2009 Georgia Medicaid Fee Schedule. Anesthesia costs were calculated based on the 2009 Georgia anesthesia fee schedule which includes base units for each procedure plus the average time units for each procedure plus an age modifier-- of one additional unit-- because the infants were less than one year old. These units are summed and multiplied by a Medicaid anesthesia conversion factor which in 2009 was $22.80. For full details on what was included in our analysis, with the associated CPT codes where applicable, see Tables 1 and 2.

The CPT codes 66840 (removal of lens material using aspiration technique) and 67010 (planned subtotal removal of vitreous with mechanical vitrectomy) were used to calculate the physician associated cost of cataract surgery for the cataract extraction-contract lens (CE-CL) group; the CPT codes 66982 (extracapsular cataract removal with insertion of intraocular lens prosthesis performed on patients in the amblyogenic developmental stage) and 67010 for the CE-IOL group. We based our calculations on the assumption that the primary cataract surgery code was paid at 100% and the secondary anterior vitrectomy code

at 50% of the Medicaid fee schedule consistent with Georgia's Medicaid payment policy. We included the cost of a biometry evaluation for the patients in the cataract extraction-intraocular lens (CE-IOL) group. CPT codes were also used to calculate the surgeon costs for a membranectomy, strabismus surgery, and glaucoma surgery. There were two additional intraocular surgeries included in the CE-CL arm-- retinal detachment (n=2) and laser treatment of lattice degeneration. There were four additional intraocular surgeries in the CE-IOL arm for which CPT codes were used-- wound dehiscence, IOL exchange, sclera patch graft, and lysis of vitreous wick. We included a cost of $50 for eye drops for each procedure and pooled this cost with the hospital costs even though eye drops are sometimes prescribed in an outpatient setting.

Office-Based Costs

We used the office-based CPT code 92004 to calculate the cost of the initial office exam. We did not include any payments for office visits during the 90 day postoperative global period after cataract surgery because they are included by Georgia Medicaid as part of the payment package for the surgery. After the postoperative global period, we used the CPT code 92012 for 3 mandated postoperative office visits for infants enrolled in the study between 4–6 weeks of age and 2 postoperative office visits for infants enrolled in the study after 6 weeks of age. The cost of the initial CL fitting and one additional visit to dispense the CL was based on the actual payment from the IATS to the Emory Clinic for this service since it was not covered by Georgia Medicaid at the time of this study. We then included the actual payments to the Emory Clinic for 5 additional examinations by the contact lens professional (1, 3, 6, 9 and 12 months after cataract surgery).

For the CE-IOL group, we included the mean cost of spectacles, which was based on the mean cost of spectacles for each patient in this treatment group, based on the study's financial records. For the CE-CL arm, we based the cost of replacement contact lenses on the mean number of contact lenses used by each patient in the CL treatment group times the retail cost per lens (80% Silsoft (Bausch & Lomb, Rochester, NY) lenses and 20% gas permeable contact lenses). The mean cost of patches was also included.

Once all data were extrapolated from the above listed sources, calculations were made to determine total patient costs for each treatment arm. The mean of these numbers was used to determine the average cost for a single patient within each treatment arm. The maximum and minimum costs for a single patient within each treatment were also estimated in to clarify the range of costs for an individual patient.

RESULTS

A total of 114 patients were enrolled in the study; 57 were randomized to each treatment group. One patient randomized to the IOL group was left aphakic but was analyzed with the IOL group based on the intent-to-treat. No patients were lost to follow up during the first 12 months after surgery and all patients had their vision tested by a traveling tester to determine their visual acuity at one year of age.[1]

Mean Costs

Procedure categories and their associated costs and percentages are shown in Tables 1 and 2. Data calculations reveal that the mean cost in the first year for CL patients was $10,726, whereas the corresponding mean cost for patients treated with an IOL was $14,752, indicating that overall IOL treatment is 37.5% more expensive than CL treatment. The factor accounting for the greatest difference between the two treatment groups was the increased number of membranectomies in the IOL arm (IOL, n=34; CL, n=6). Membranectomy costs

were more than five times greater in the IOL arm than the CL arm. The next largest difference was the cost of contact lenses versus glasses in the IOL group (CLs, $1,600; glasses, $535)--a three-fold difference.

Maximum and Minimum Costs

The highest and lowest costs for a patient in each group are reported in Tables 1 and 2. The patient with the highest costs in the IOL group had a total of 4 additional surgeries--membranectomy, glaucoma surgery, and two other ocular surgeries (wound dehiscence repair and sclera patch graft). The total cost for this one patient was $50,437 which was significantly higher than the mean cost. The patient with the highest costs in the CL group had a total of 3 additional intraocular surgeries--a membranectomy, glaucoma surgery, and retinal detachment repair. The total costs for this patient was $27,506 which was significantly higher than the mean cost for the CL group. The highest cost patient in the IOL treatment had costs approximately 85% higher than the highest cost patient in the CL group.

The cost for the lowest patient in the CE_IOL treatment group included the costs for: a preoperative visit, biometry, cataract surgery, one EUA, one set of glasses, eye patches, and two follow-up visits. For the lowest cost patient in the CE_CL group, the cost was based on: a preoperative visit, cataract surgery, an initial CL examination, one EUA, contact lens, eye patches, and three follow-up visits. The lowest cost patient in the CL treatment group would have incurred costs of $8,805, whereas the lowest cost patient in the IOL treatment group would have incurred costs of $9,412. These two costs are much more similar, with the IOL treatment approximately 9% higher.

DISCUSSION

The present analysis found that the cost of treating an infant with a unilateral congenital cataract during the first year of life was on average 37.5% more expensive if the child had an intraocular lens implanted compared to the child being left aphakic and then optically correcting the eye with a contact lens. The higher costs associated with primary IOL implantation were primarily due to the increased number of additional intraocular surgeries that were required compared in the CL treatment group. These cost differences were more than offset by the higher cost of contact lens wear in the CL group compared to spectacle wear in the IOL group. If we look at the minimum cost that could have been incurred, when no additional surgeries were required, the difference in cost becomes negligible, with the patients in the IOL group only costing 9% more.

The cost analysis of these treatments is complicated by payment policies for different insurance companies. While most insurance companies cover the cost of IOL implantation, many do not cover the costs associated with contact lens wear. On average it cost $1,600 to provide contact lenses for an aphakic infant until age 12 months. Thus, while societal costs of IOL implantation may have been higher, the costs to a patient's family may be lower with IOL implantation if contact lenses costs are not covered by their medical insurance. Our study provided contact lenses at no charge to participants, so that the cost of contact lens wear was not a factor affecting the visual outcome. However, if parents would have had to pay for the fitting and replacement costs of contact lenses, the visual outcomes may have been negatively impacted for patients in the CE-CL group. Also, if contact lens treatment is successful, the child will need bifocal spectacles to wear over the contact lens in order to provide optical correction for both distance and near vision. This further increases the non-surgical cost of contact lens treatment, although patients in the CE-IOL group will also need to change to a more expensive bifocal lens by 2 years of age.

It is important to consider that the costs of procedures were calculated using Georgia Medicaid payment schedules. Since private insurers typically have higher payment rates for hospital, physician, and anesthesia services, our Georgia Medicaid averages are likely significantly lower than private insurance costs. Additionally, regional differences in insurance payments may also influence the overall costs of treatment. However, the overall percent differences between the two treatment groups would likely be similar if costs were calculated using a different insurance provider. The issues related to payers and geographic differences in payment are areas of investigation that would benefit from additional study.

We used the CPT codes 66840 (removal of lens material; aspiration technique) and 67010 (subtotal removal of vitreous with mechanical vitrectomy) with the modifier 59 (distinct procedural service) to calculate the cost of cataract surgery for the contact lens group and 66982 (extracapsular cataract removal with insertion of IOL performed on patient in the amblyogenic developmental stage) and 67010 with the modifier 59 to calculate the cost of cataract surgery for the IOL group. Some surgeons use the CPT code 66850 (removal of lens material, phacofragmentation technique with aspiration) when billing for a lensectomy, which has a slightly higher reimbursement rate than 66840. When performing cataract surgery and IOL implantation coupled with a pars plana posterior capsulotomy and anterior vitrectomy in children, some surgeons bill for a pars plana vitrecomy (67036) with the 52 modifier for a reduced service. The costs of cataract surgery would have been higher for both treatment groups if these other codes had been used in the analysis. If there were specific CPT codes for pediatric cataract surgery, there would be greater uniformity of coding for these procedures.

One limitation of our study is that we only studied direct provider costs. Undoubtedly significant indirect costs were incurred by families in both treatment arms that we did not assess. These indirect costs included the cost of traveling to physician appointments, lost wages due to time away from work to bring a child to the hospital for additional surgeries and for postoperative visits, and changes in the parent's lifestyle necessitated by their child's treatment. For example, some parents of children in the contact lens group may have chosen not to work because of concerns that a child-care provider would not be able to manage their child's contact lens.

In 2009 Stager and coworkers calculated the costs associated with the treatment and care of a congenital unilateral cataract based on a hypothetical scenario of basic care for an infant undergoing cataract extraction, with follow up to 12 years of age.[13] Common complications were also considered to create a fairly comprehensive "cost-utility framework." The present study differs from Stager and colleagues' cost analysis in several important respects. First, their study was based on the hypothetical scenario of an infant undergoing a lensectomy and wearing a contact lens until secondary IOL implantation was performed at 6 years of age. They then calculated the costs of treating this child until age 12 years. In contrast, we compared the costs of an infant undergoing unilateral cataract surgery in the first six months of life and then being treated with a contact lenses or primary IOL implantation until age 12 months. Second, the Stager study extrapolated costs for various secondary surgeries based on their incidence in the literature. We based our costs on the actual procedures performed in the IATS. Because our study only analyzed the outcomes of 114 patients, certain procedures may have been overrepresented (e.g. retinal detachment) in our study which could have been avoided by analyzing data from a larger group of patients. Third, we used Georgia Medicaid rather than Medicare payment data in determining the costs of treatment. Finally, we used different CPT codes for estimating costs. For example, we used CPT code 66982, which is the code for cataract surgery during the amblyogenic developmental stage, whereas Stager and coworkers used CPT code 66940, which is the code for a routine cataract surgery. Their study provides a broad understanding of the costs for one treatment

option for a unilateral congenital cataract over an extended period of time, whereas our study provides more detailed information regarding the costs of treating an infant with a unilateral congenital cataract during the first year of life. Our study also provides valuable information comparing the costs of two treatment options.

The primary focus of the IATS is visual outcome. While the visual outcomes were similar in the two treatment arms of the study at 12 months of age, longer follow-up visual outcome data may show a difference between the two treatment modalities. Such a difference may provide a more compelling reason to choose one treatment over the other. It is also important to realize that the costs evaluated in this analysis were only up until age 12 months. Additional costs may arise in both treatment groups as these children become older which may make the cost of one treatment more expensive than the other. These costs include treating complications which may develop after the first year of life such as glaucoma or additional surgeries such as the implantation of secondary IOLs in the CL group or IOL exchanges in the IOL group. The IATS is continuing to evaluate the visual outcome and additional surgeries and complications in these children to age 5 years.

In conclusion, cost is one of many factors that should be considered when choosing a treatment option for an infant with a unilateral congenital cataract. At one year, costs are higher for patients who received the IOL treatment due to differences in the costs of the initial surgical procedure as well as the increased frequency of additional necessary surgeries. On an individual level, costs may also differ between patients based on the type of medical insurance they have and unforeseen factors such as the child's tolerance of contact lens wear. Additional follow-up will be necessary to determine the long-term direct and indirect costs of each treatment.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Georgia Medicaid Costs for Cataract Extraction and Primary Intraocular Lens Implantation

IATS Study Patient's Costs		CE with IOL						
	CPT Codes*	Hospital	Surgeon	Anesthesia	Mean CEw/IOL Costs	# of Times	Total for IOL	% of Total
Pre-Procedure Costs								
Pre Op Visit	92004				$91	57	$5,187	0.6%
Biometry	76519				$152	57	$8,664	1.0%
Hospital Based Procedure Costs								
Cataract Surgery	66982, 67010	$6,090	$984	$228	$7,302	57	$416,214	49.5%
Membranectomy	66830	$4,037	$420	$228	$4,685	34	$159,290	18.9%
Glaucoma Surgery	65850, 66625, 65865	$3,331	$632	$251	$4,214	5	$21,070	2.5%
Strabismus Surgery	67312	$5,932	$433	$228	$6,593	10	$65,930	7.8%
Additional Intraocular Surgeries	66250, 66985, 66255, 67030	$11,469	$521	$274	$12,264	4	$49,056	5.8%
Office Based Follow-Up Costs								
Initial CL Evaluation								
Examination under anesthesia (EUA)		$728	$68	$209	$1,005	66	$66,330	7.9%
Glasses					$535	57	$30,495	3.6%
Eye Patches					$162	57	$9,234	1.1%
Follow-Up Visits	92012				$165	57	$9,405	1.1%
Total Patient Costs							$840,875	100%
Mean Medicaid Costs per Patient							$14,752	
Maximum patient cost							$50,437	
Minimum patient cost							$9,412	

*Current Procedure Terminology 4th Edition (CPT-4), CL=contact lens, IOL=intraocular lens, CE=cataract extraction with the surgical and anesthesia procedures used

Table 2

Georgia Medicaid Costs for Cataract Extraction and Contact Lens Correction

IATS Study Patient's Costs		CE with CL						
	CPT Codes*	Hospital	Surgeon	Anesthesia	Mean CEw/CL Costs	# of Times	Total for CL	% of Total
Pre-Procedure Costs								
Pre Op Visit	92004				$91	57	$5,187	0.8%
Hospital Based Procedure Costs								
Cataract Surgery	66840, 67010	$4,344	$785	$228	$5,357	57	$305,349	49.9%
Membranectomy	66830	$4,037	$420	$228	$4,685	6	$28,110	4.6%
Glaucoma Surgery	65850, 66625, 65865	$3,331	$632	$251	$4,214	2	$8,428	1.4%
Strabismus Surgery	67312	$5,932	$433	$228	$6,593	6	$39,558	6.5%
Additional Intraocular Surgeries	67145, 67145	$8,002	$521	$274	$8,797	3	$26,391	4.3%
Office Based Follow-Up Costs								
Initial CL Evaluation					$150	57	$8,550	1.4%
Examination under anesthesia (EUA)		$728	$68	$209	$1,005	64	$64,320	10.5%
Contact Lenses					$1,600	57	$91,200	14.9%
Eye Patches					$162	57	$9,234	1.5%
Follow-Up Visits	92012				$165	57	$9,405	1.5%
Contact Lens Follow-Up Visit					$275	57	$15,675	2.6%
Total Patient Costs							$611,407	100%
Mean Medicaid Costs per Patient							$10,726	
Maximum patient cost							$27,506	
Minimum patient cost							$8,805	

*CPT= Current Procedure Terminology 4th Edition (CPT-4), CL=contact lens, IOL=intraocular lens, CE=cataract extraction