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Immediate Sequential vs. Delayed Sequential Bilateral Cataract Surgery

Retrospective Comparison of Postoperative Visual Outcomes

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Objective: We conducted a retrospective comparative-effectiveness study of best-corrected visual acuity (BCVA) and refractive error (RE) after immediate sequential (ISBCS) and delayed sequential (DSBCS) bilateral cataract surgery. We tested 2 hypotheses: (1) among DSBCS patients, second-eye outcomes were no different than first-eye outcomes; (2) averaged between each patient's 2 eyes, outcomes did not differ between ISBCS and DSBCS patients.

Design: Retrospective comparative-effectiveness study.

Participants: Kaiser Permanente Northern California members who underwent noncomplex bilateral cataract surgery from January 1, 2013, through June 30, 2015.

Methods: We performed an intention-to-treat analysis comparing ISBCS to DSBCS using conditional logistic regression analysis, accounting for surgeon and patient-level factors.

Main Outcome Measures: BCVA, RE.

Results: The analysis of visual outcomes included both eyes of 13 711 DSBCS and 3561 ISBCS patients. Because of the large sample size, some statistical differences lacked clinical significance. Ocular comorbidities were slightly more prevalent in DSBCS patients. Postoperative BCVA was 20/20 or better in 48% of DSBCS first eyes, 49% of DSBCS second eyes, 53% of ISBCS right eyes, and 51% of ISBCS left eyes. The within-person difference in postoperative BCVA averaged zero (0.00) between the first and second DSBCS eyes, and between the ISBCS right and left eyes. After adjustment, average postoperative BCVA was better in ISBCS patients, although the difference was not statistically significant (compared with 20/20 or better: odds ratio for worse than 20/20 was 0.91, 95% confidence interval 0.83−1.01). Emmetropia (spherical equivalent −0.5 to 0 diopter) was achieved in 61% of first DSBCS eyes, 61% of second DSBCS eyes, 63% of ISBCS right eyes, and 63% of ISBCS left eyes. After adjustment, average postoperative RE was no different in ISBCS compared with DSBCS patients (compared with emmetropia: odds ratio for ametropia was 1.02, confidence interval 0.92−1.12). We confirmed 1 case of postoperative endophthalmitis in 10 494 ISBCS eyes (1.0 per 10 000 eyes) and 2 cases in 38 736 DSBCS eyes (0.5 per 10 000 eyes) ($P = 0.6$), and no patient had bilateral endophthalmitis.

Conclusions: Compared with DSBCS, we found no evidence that ISBCS was associated with worse postoperative BCVA or RE, or with an increased complication risk. *Ophthalmology 2017;■:1−10 © 2017 by the American Academy of Ophthalmology*

Supplementary files available at www.aaojournal.org.

We conducted a retrospective comparative-effectiveness study to assess whether immediate sequential bilateral cataract surgery (ISBCS) offers visual outcomes similar to delayed sequential bilateral cataract surgery (DSBCS). We used the community-based population and electronic health record data of Kaiser Permanente Northern California to examine postoperative best-corrected visual acuity (BCVA), refractive error (RE), and surgical complications. We hypothesized that in DSBCS patients, the outcome of the second eye would be no different than in the first eye. This hypothesis was motivated by the assertion that DSBCS offers the opportunity to improve refractive outcomes by allowing the surgeon to use the refractive outcome of the first eye to guide selection of the intraocular lens (IOL) for the second eye.[1,2] In addition, we hypothesized that visual outcomes averaged between each patient's 2 eyes did not differ between ISBCS and DSBCS patients. We also compared surgical complication rates between the 2 approaches.

Methods

The study was approved by the Kaiser Foundation Research Institute's institutional review board.

Setting

Kaiser Permanente Northern California is a community-based health care system that owns its hospitals and medical offices.

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For most patients, care is capitated (prepaid), and members receive comprehensive services. During 2013−2015, clear cornea phacoemulsification using standardized phacoemulsification machines (Alcon, Irvine, CA) and IOLs (Alcon) was performed by 152 cataract surgeons at 22 surgical centers. In 2014, medical offices switched biometry equipment from IOLMaster to Lenstar, at which time biometry information became available for research. The only systemic practice modifications during the study period were the adoption of intracameral injection of antibiotic in 2013 and the increasing adoption of ISBCS. Otherwise, surgeons practiced according to the guidelines in their own department or according to their training and continuing education.

Study Population

The study included health plan members who underwent their first noncomplex phacoemulsification for cataract (Current Procedural Terminology [CPT] code 66984; International Classification of Diseases, Ninth Revision [ICD-9] codes 13.41, 13.71) from January 1, 2013, through June 30, 2015. As with past studies,[3,4] we excluded complex phacoemulsification cases and cases performed by glaucoma, oculoplastic, or retinal specialists, as well as procedures by any surgeon combined with corneal transplant (ICD-9 code 11.6; CPT4 codes 65710−65715) or glaucoma surgery (ICD-9 codes 12.54, 12.64, 12.66, 12.69, 12.7; CPT4 codes 65850, 66170, 66172, 66180, 66185).

For the present analyses, we also excluded cases with previous endophthalmitis (ICD-9 codes 360.00, 360.01, 360.03, 360.13, 360.19, 098.42), and we required information from manifest refractions for postoperative BCVA analysis.

The study focused on 2 cohorts of patients undergoing bilateral cataract surgery: ISBCS, with surgery in the right and left eyes performed back-to-back on the same day, and DSBCS, with the 2 eyes operated on separate days, the second eye within 1 year of the first. ISBCS were identified from a procedure code used by the health plan (bilateral surgery, code 1215493) and from a laterality variable recorded into structured operative data. Second surgeries that were performed >1 year after the first were not included because most did not represent planned bilateral surgeries. To characterize each patient's history, we required at least 1 year of enrollment before cataract surgery on the first eye. We restricted the look-back to the 1 year before cataract surgery in the first eye to eliminate information bias that would have resulted had we given the DSBCS patients separate 1-year look-backs for each eye. A longer period of look-back in the DSBCS patients would have resulted in more diagnostic codes being written into the electronic medical record for mild visual complaints, including postoperative complaints recorded after the first surgery.

Data Collection

Visual Acuity and Refractive Error. Postoperative RE was calculated as the spherical equivalent (sphere + cylinder/2), measured in diopters (D), as recorded from manifest refractions performed by licensed optometrists. Best-corrected visual acuity was obtained using Snellen charts projected by standardized equipment (Nikon, Tokyo, Japan) and was converted to logarithm of the minimum angle of resolution (logMAR) equivalents. We did not include BCVA measurements from automated refractions, cycloplegic refractions, refractions obtained over contact lenses or glasses, retinoscopy, or "unaided acuity" because these represented <2% of the measurements and would have complicated the analysis.

We obtained preoperative BCVA from measurements recorded nearest the surgery date, up to 1 year before surgery. For postoperative BCVA and RE, we obtained the measurement recorded nearest the date of surgery during the interval 3 weeks to 1 year after surgery. The interval 3 weeks to 1 year was selected to optimize the completeness of postoperative data while providing time for vision to stabilize after surgery. We included refractions recorded as late as 1 year after surgery because patients with good postoperative visual acuity may not schedule an appointment for refraction for some time. We used the earliest measurement to minimize the late postoperative effects of ocular comorbidities and posterior capsular opacification.

Surgical Complications. We captured intraoperative posterior capsular rupture (PCR) and vitrectomy using natural language processing.[3,5] We identified cases with incident endophthalmitis recorded during the 120 days after the cataract surgery using ICD-9 codes (Supplemental Material, available at www.aaojournal.org) that were then confirmed by a study ophthalmologist (N.H.S.). We also captured postoperative macular edema cases during the 120 days after the first cataract surgery using ICD codes. In most patients, the second surgery was performed within 120 days of the first. We counted only 1 case of macular edema per patient because it was not possible based on coding alone to determine the laterality of the macular edema or whether the condition was unilateral or bilateral. To improve specificity,[4] we required macular edema patients to have undergone optical coherence tomography and to have filled a prescription for ophthalmic prednisolone during the 120 days after surgery.

Demographic Factors and Systemic Comorbidity. Patient age, sex, and race/ethnicity were obtained from self-reported membership information. Charlson comorbidities were calculated from diagnostic and procedure codes recorded during the year before surgery.

Ocular Comorbidity. Preexisting ocular diseases were obtained from inpatient and outpatient data using the codes detailed in the Supplemental Material (available at www.aaojournal.org).

Medications. We obtained records for dispensed glaucoma medications including prostaglandin analogues, α agonists, and carbonic anhydrase inhibitors. Because exposure of oral α-1 agonists has been associated with floppy iris syndrome, we obtained medication records for up to 10 years before surgery.[6]

Biometry. Lenstar data were available for the final 12 months of the 30-month study period. For these patients, we obtained axial length, anterior chamber depth, and lens thickness (all in millimeters).

Data Analysis

We performed intention-to-treat analyses, in which patients scheduled for ISBCS who were converted to DSBCS were nonetheless retained in the ISBCS group.

Hypothesis 1 compared visual outcome between the second and first eyes of DSBCS patients to test whether the RE after implantation of the second IOL was closer to emmetropia than the first. We examined the ISBCS cohort (left eye compared with right eye) as a negative control group. For this hypothesis, we tested whether there was a difference in the distributions of outcomes between DSBCS and ISBCS patients using a chi-square test. For these analyses, it was not appropriate to adjust for surgeon-level or patient-level factors because they did not vary within the patient.

Hypothesis 2 compared within-patient average visual outcome between the ISBCS and DSBCS cohorts. For this hypothesis, we dichotomized average postoperative BCVA as 20/20 or better compared with worse than 20/20, because half of the patients achieved BCVA of 20/20 or better. Analysis of postoperative RE excluded patients with RE −2.1 or greater myopia because most were intended for near working distance. Emmetropia was defined as spherical error of −0.5 to 0 D, whereas eyes that were more myopic or hyperopic were defined as ametropic. We estimated the adjusted odds ratio (OR) and 95% confidence interval (CI) for the