



Immediately sequential bilateral cataract surgery

Ali Nowrouzi^a and Jorge L. Alió^{b,c}

Purpose of review

This review aims to clarify the advantages and disadvantages of immediately sequential bilateral cataract surgery (ISBCS) based on recent studies, illustrate the safety of this approach, the cost-effectiveness, and present the importance of inclusion protocols for the best results.

Recent findings

In recent studies, the authors found no evidence of an increased risk of bilateral devastating complications such as endophthalmitis with ISBCS based on descriptive evidence compared to delayed sequential bilateral cataract surgery (DSBCS). Furthermore, recent studies on cost analyses showed that ISBCS resulted in fewer costs and significant cost savings to third-party payers, patients, and society compared to DSBCS.

Summary

The ISBCS surgical approach decreases hospital visits, reduces costs, and provides rapid visual rehabilitation and neuro adaptation. The risk of bilateral simultaneous complications is now recognized to be very rare with intracameral antibiotics and compliance with correct protocols. With new generations of optical biometry and lens calculation formulas, refractive surprises are occasional for normal eyes. However, refractive surprise is controversial, especially in the implantation of presbyopia correction intra-ocular lenses, which must be evaluated carefully in the ISBCS approach.

Keywords

bilateral simultaneous postoperative endophthalmitis, immediately sequential bilateral cataract surgery, simultaneous bilateral cataract surgery

INTRODUCTION

Background

Cataract surgery is one of the most frequently performed surgeries worldwide, and the number of demands for this surgery has increased rapidly over the years. Most patients suffer from bilateral cataracts, up to 71% of all cataract population. Studies have shown that Immediate sequential bilateral cataract surgery (ISBCS) leads to well documented potential advantages for patients and the healthcare system, decreases follow-up visits, and reduces costs, as well as more rapid visual rehabilitation and improved efficiency [1–3].

Nowadays, most patients undergo cataract surgery in both eyes on separate days, with a delay of 1–2 weeks and, in some centers, up to 1–3 months (delayed sequential bilateral cataract surgery, DSBCS). However, ISBCS has been documented as a safe approach to perform in both eyes on the same day during a single operating session. This review aims to clarify the advantages and disadvantages of ISBCS based on recent studies.

TEXT OF REVIEW

Methods

In this review study, the PubMed platform and the Cochrane Central database search were performed from the year 2000 till the end of June of 2023, using the following keywords: bilateral cataract surgery, simultaneous bilateral cataract surgery, sequential bilateral cataract surgery, same-day cataract surgery, bilateral cataract extraction, and ISBCS. We found 66 articles and analyzed just 45 of them. Four articles

^aCornea, Cataract and Refractive Surgery Unit, Department of Ophthalmology, Hospital Quironsalud Marbella, Marbella, ^bResearch and Development Department, and Refractive Surgery Department, VISSUM, VISSUM Instituto Oftalmológico de Alicante, Grupo Miranza and ^cDepartment of Ophthalmology, Universidad Miguel Hernández, Alicante, Spain

Correspondence to Prof. Jorge L. Alió, MD, PhD, FEBO, Calle Cabañal 1, 03016 Alicante, Spain.

E-mail: jlalio@vissum.com

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KEY POINTS

- In immediately sequential bilateral cataract surgery (ISBCS), treating each eye surgery as an independent procedure with strict aseptic separation and administration of intracameral antibiotics significantly reduces the risk of developing endophthalmitis.
- For 'normal' eyes, optical biometry and using the newest generation formula for intra-ocular lens calculation are so predictable that the risk of refractive surprise is more theoretical than any real clinical relevance.
- More complete and faster visual rehabilitation might be the most significant medical advantage of ISBCS.
- ISBCS resulted in fewer costs and significant savings to third-party payers, patients, and society than delayed sequential bilateral cataract surgery. The patient's financial advantages include a faster return to work and fewer hospital visits.

were classified as randomized clinical trials with a level of evidence of 1. And the other 39 articles were classified as nonrandomized clinical trials with an evidence level of 2, and we included One Cochrane review and one Meta-analysis as well. English and Spanish languages were preferred, at least for abstracts.

Qualification and protocol

In the ISBCS approach, the fundamental and overriding principle is to prevent complications and to treat each eye surgery as an independent procedure with strict aseptic separation between each eye, as recommended by the International Society of Bilateral Cataract Surgeons (i SBCS) (www.isbcs.org). Each eye requires an absolute change of covering, instruments, and staff gloves and gowns [4–6]. If any significant surgical complication happens in the first eye in some special situations, changing the ISBCS approach to DSBCS should be considered [7,8].

Serious doubts about the risk of complications against the ISBCS include the risk of potential bilateral vision impairment as a result of bilateral complications [9] such as Endophthalmitis, Toxic Anterior Segment Syndrome (TASS), and Cystoid Macular Edema (CME). The most severe of these is endophthalmitis; however, there are other risks of choroidal hemorrhage, corneal decompensation, and retinal detachment [10–12]. Some authors classify complications into 'catastrophic' and 'noncatastrophic'. The first one includes endophthalmitis, whereas noncatastrophic complications include cystoid macular edema and corneal decompensation

[13,14] uveitis, ocular hypertension (HTO), hyphema, capsular bag distension syndrome, striate keratopathy, incisional leakage, ciliary block, glaucoma, and intra-ocular lenses (IOL) decentration [15]. Several epidemiologic studies have reported that the administration of intracameral antibiotics significantly reduces the risk of developing endophthalmitis compared to other prophylactic measures, such as topical antibiotics [16,17]. More recent studies on incidences of endophthalmitis after administration of intracameral antibiotics show unilateral endophthalmitis rates of 0.039% (in Spain) [18] and 0.029% (in Sweden) [19] compared to an overall higher rate of 0.056% based on IRIS registry in the United States where mainly do not use intracameral antibiotics [20]. In the prospective study by Friling *et al.*, they identified 422 cases of endophthalmitis in 1 457 172 cataract extractions from 2002 to 2017. DSBCS's rate was 0.0299%, whereas ISBCS's was 0.0152%. Based on ISBCS's exclusion criteria protocols, independent risk factors for endophthalmitis, such as capsule complication and ocular comorbidities, were less common in the ISBCS group as they were automatically excluded from this protocol, and it might be the reason for less incidence of endophthalmitis in this study. In this study, nonuse of intracameral antibiotics, age older than 85 years of perioperative communication with vitreous, procedures other than phacoemulsification, and procedures with no IOL implantation were identified as decisive risk factors for the developing postoperative endophthalmitis [19]. The older age of 85 was also confirmed as a risk factor for postoperative endophthalmitis in other studies [20], and it might be recommended as a new exclusion criterion. A possible explanation for older than 85 as a risk factor might be higher quantities of pathogenic bacteria in their conjunctivas [21,22]. In the study of Lacy *et al.*, based on intelligent research in sight registry, the endophthalmitis rates in either surgery eye between the two surgery groups were similar (0.059% in the ISBCS group vs. 0.056% in the DSBCS). Seven cases of bilateral endophthalmitis with supporting clinical data in the DSBCS group and no cases in the ISBCS group were identified in this study [23]. In the other research done by Malwankar *et al.*, no significant difference was found in endophthalmitis rates within 42 days between ISBCS (1.74 per 1000 ISBCS procedures) and DSBCS (1.01 per 1000 DSBCS procedures) [24]. Bilateral simultaneous postoperative endophthalmitis (BSPOE) is the most devastating complication of ISBCS. Since 1970, nine cases of BSPOE after ISBCS have been reported over the last 50 years. Strict adherence to the i SBCS General Protocols of Excellence in ISBCS 2009 surgical protocol and care with operating room construction seem to diminish the risk of BSPOE [25]. Acute

endophthalmitis will most likely occur within the first two weeks after surgery. When this happens, cataract surgeons may decide to abstain from second-eye surgery. However, in many centers, the separation time between two eyes in the DSBCS approach is less than two weeks, so the allegation of ISBCS from surgeons who prefer the DSCBS approach with less than two weeks of separation does not seem to be safer for the risk of bilateral acute endophthalmitis. In the ESCRS prophylactic intracameral studies (cephalosporin), the incidence of postoperative endophthalmitis after unilateral cataract surgery was up to 0.3% without prophylactic intracameral antibiotics and decreased to 0.05% with prophylactic intracameral antibiotics, whereas studies in the United States using only topical antibiotics reported infection rates as low as 0.028%. No bilateral simultaneous endophthalmitis occurred in the 95 606 ISBCS cases collected. The overall rate of postoperative endophthalmitis after ISBCS was 1 in 5759. Intracameral antibiotics significantly reduced the infection rate to 1 in 14 352 patients [26]. It is essential to consider another type of endophthalmitis: delayed-onset postoperative endophthalmitis. The onset of this kind of endophthalmitis has been defined as greater than six weeks after the surgery. In some studies, the mean time between surgery and the diagnosis of endophthalmitis was nine days (range: 1–39) [27]. As the separation time between two eyes in the DSBCS approach is between 7 days to 30 days, it would not be a conclusion to prefer DSBCS over the ISBCS approach as a safer surgery for this late-onset of endophthalmitis. However, late-onset endophthalmitis is not reported in any cases in previous randomized controlled trials (RCTs) [28–30] and other noncomparative studies [26,31–38].

In a recent Cochrane study including 14 studies, two RCTs, seven nonrandomized studies (NRSs), and six economic evaluations on 276 260 participants (7384 for ISBCS and 268 876 for DSBCS), the authors found a very low risk of endophthalmitis in both ISBCS (1/14 076 participants) and DSBCS (55/556 246 participants) groups and the authors did not find any evidence of an increased risk of endophthalmitis with ISBCS based on descriptive evidence and somewhat weak statistical evidence in this study [39^{***}].

One more devastating complication is toxic anterior segment syndrome (TASS), a sterile inflammatory reaction [40,41]. Of all previous studies, no reported cases of bilateral TASS [42^{*}]. RCTs [28,29,30] and other noncomparative studies [26,31–38] found no significant differences in terms of (severe) complication rates in both ISBCS and DSBCS approaches.

Other possible complications mainly classified as noncatastrophic include high intraocular pressure < 30 mmHg, intraocular pressure >30 mmHg

on in the first postoperative day, corneal edema, iritis, vitreous detachment, posterior capsule opacification, capsule tears, vitreous loss, sutures in the wound, wound leak, incorrect IOL power calculation, IOL decentration or displacement, anterior chamber flare, central macular edema (CME), iris prolapse, Irrigation misdirection, zonular rupture with vitreous loss, choroidal hemorrhage, Aqueous misdirection, and foreign body sensation, and dry eyes. In a meta-analysis study of RCTs, There was a tendency toward fewer complications in the groups randomized to ISBCS. However, the quality of the evidence was rated as very low in this study [25].

Regarding the CME in the study of Malvankar *et al.*, there was no significant cumulative difference between CME rates in ISBCS (1.79 per 100 ISBCS procedures) and DSBCS (1.96 per 100 DSBCS procedures). It is important to emphasize that based on the exclusion criteria recommended by i SBCS, patients with ocular pathologies which induce the risk of postoperative CME, such as glaucoma, macular degeneration, and the macular hole or epiretinal membrane, were less likely to undergo ISBCS than those without [24].

Concerning refractive outcomes, delaying second-eye surgery enables cataract surgeons to evaluate the result of the first eye at a very early postop time and, if necessary, adjust their plans for second-eye surgery [43]. The standard for success in cataract surgery is postoperative refraction within 1.0 diopter of the target refraction [44]. However, the better result is postoperative refraction within 0.50 diopter of the target refraction. Based on previous studies, one randomized study and one nonrandomized comparative study [45], report data on refractive outcomes for ISBCS compared to DSBCS showed similar refractive outcomes, indicating that by careful patient selection, refractive surprises may be prevented [25,31,38,46]. Proponents of ISBCS note that refraction advancement in the second eye is modest except in rare cases, that patient's eyes may be too different to compare, and that recent improvements in biometric technology are well on their way to eliminating any difference in outcomes between ISBCS and DSBCS.

However, the number of patients in these previous studies might be a limitation factor for the conclusion [44]. In contrast to previous studies, other studies have reported VA improvement in the second eye using first-eye results [47–49]. A review of 110 patients who underwent ISBCS revealed that only 6 had refractive outcomes that could have been improved by delaying the second surgery [50]. Owen *et al.*, in a cohort study of 1824 196 patients from the Intelligent Research in Sight Registry, found that ISBCS was associated with worse

outcomes than DSBCS. The study found that the ISBCS group had statistically significantly worse UCVA (2.8 fewer letters in the first eyes and 1.7 fewer letters in the second eyes) than the DSBCS group, despite having better presurgical BCVA [51¹¹]. A refractive error has been reported to stabilize in healthy eyes approximately one week postoperatively [52,53]. The adjustment might have impacted the second eye outcome since most DSBCS groups had more than seven days between operations [52,54]. They are suggesting that a longer waiting period may be unnecessary. Previous studies have compared refractive outcomes after ISBCS and DSBCS but were limited by small sample sizes [31,45]. One of the critical differences in Owen's study compared to the previous research is that they did not exclude patients with comorbid ophthalmic disease and eyes with high and low axial length in contrast to other previous studies in which they had excluded patients at risk for poor visual outcomes because of factors such as extreme axial length or other sight-threatening diseases, which might be the reason of this difference compared to previous studies. Undertaking specific eligibility criteria and careful patient selection may solve this problem. However, for 'normal' eyes, optical biometry and using the newest generation formula for IOL calculation are so predictable that this disadvantage is more theoretical than any real clinical relevance. Recently, light adjustable IOL(LAL) will allow patients to postoperatively test and elect a different refractive target. Ophthalmologists can achieve them better, especially if there are any intolerable residual refractive errors in the bilateral simultaneous cataract surgery approach [55].

Regarding contrast sensitivity and quality of life, one randomized clinical trial in Sweden (in 88 eyes) found that binocular contrast sensitivity and quality of life were more significant in the ISBCS group at two months compared with the DSBCS group. However, at four months they did not find any significant differences between these two groups [27].

The patient's more complete and faster visual rehabilitation might be the most significant medical advantage of ISBCS [48]. Single eye surgery causes a reduction in our visual system from two receptors to one without the same function and similar refraction conditions. Second eye surgery restores a normal balanced visual system for the patient. (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5161806/-b0070>) [32,60]. Serrano *et al.* confirmed this faster complete visual rehabilitation by Self-perceived changes in visual function assessed with the VF-14 questionnaire. Differences between groups were observed one month after surgery. Patients in the ISBCS group had significantly better

visual function scores than those in the DSBCS group after the first eye was treated. At the 1-year follow-up, group differences disappeared [29]. Lundström *et al.* also reported that ISBCS patients had more rapid rehabilitation than DSBCS patients concerning [30]. Nasiri *et al.* also utilized the VF-14 questionnaire, and they found it to be the only outcome measure that remained significantly higher postoperatively in the ISBCS group compared to the DSCBS group up to 4 months after the first operation [47]. Furthermore, ISBCS is an ideal solution for patients who require general anesthesia because it lowers the risk of a second anesthetic with associated risks [41,61,62].

Based on available studies on cost analyses showed that ISBCS resulted in fewer costs and significant cost savings to third-party payers, patients, and society compared to DSBCS [55–60]. The patient's financial advantages include a faster return to work and fewer hospital visits [62–64]. We can illustrate the potential cost savings in 1 year in the Netherlands as published in the BICAT-NL study by Spekrijse; 37 million euros for the healthcare perspective and around 64 million euros for social perspectives [14].

A study from Sweden found that delayed sequential bilateral cataract surgery, surgery on both eyes but on separate dates, was 14% more expensive than ISBCS [65]. A Finnish study considering the direct costs of the surgery and transportation and time costs for the patient found that delayed sequential bilateral surgery was 849 Euros more expensive than ISBCS [66]. Surprisingly, the calculation has been carried out that there is a potentially higher risk of death in a traffic accident by undergoing extra visits for unilateral sequential cataract surgery in those suitable for ISBCS [67].

CONCLUSION

Based on recent clinical evidence, immediate sequential bilateral cataract surgery offers some advantages in saving health resources and faster optical rehabilitation.

The risk for postoperative bilateral complications such as endophthalmitis appears to be as low as and possibly lower than published rates for unilateral surgery, particularly when recommended precautions are taken completely, like Intracameral antibiotics.

The ISBCS surgical approach is considered a safe procedure without further risk of other complications compared to the DSCBS approach. The risk of refractive surprise in 'normal' eyes with optical biometry and using the newest generation formula for IOL calculation is much lower than any real clinical relevance. However, The adjustment of the second

eye based on the first eye result might have impacted the second eye outcome in the DSBCS approach. ophthalmic surgeries are faster and have a lower risk of complications, shorter hospitalization time, and fewer visits. Available studies on cost analyses showed that ISBCS resulted in significant cost savings to third-party payers, patients, and society compared to DSBCS. ISBCS may be beneficial to patients under certain circumstances. Patients must travel great distances for surgery, those requiring general anesthesia, and those with limited social support systems. With these advantages, we gain the courage to cross new boundaries, and one of them is the adoption of ISBCS. With careful and correct patient selection and strict adherence to i-SBCS protocol, this is an accepted method. All this adds up to the fact that the operational risk for ISBCS is the same or even smaller than DSBCS. We believe that soon it could become a standard in many clinics.

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The manuscript has been read and approved by all the authors, and each author believes that the manuscript represents honest work.

Conflicts of interest

There are no conflicts of interest.

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