Emmetropia: Why we should do Immediately Sequential Bilateral Cataract Surgery

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PURPOSE: To research and discuss the reasoning behind the performance of immediately sequential bilateral cataract surgery (ISBCS) in the context of achieving emmetropia and visual restoration.

SETTING: York Finch Eye Associates, Toronto, Canada

METHODS: A literature review of pertinent articles and books relevant to visual function and bilateral cataract surgery. The website of the International Society of Bilateral Cataract Surgeons (ISBCS) was also reviewed.

RESULTS: The logic of human destiny and progress dictates that we will move to ISBCS to achieve better restoration of vision than achievable with delayed sequential bilateral cataract surgeries (DSBCS). ISBCS restores the visual system, whereas DSBCS can be an impediment to binocularity. Caution is required in moving to ISBCS, and reasonably strict protocols should be observed. The additional cost of performing DSBCS to a health care system is unacceptable for the miniscule additional risk of ISBCS.

DISCUSSION: As we move to ever more predictable surgical results, routinely achieving emmetropia, monovision, multifocality or pseudoaccommodation, the further enhancement of our surgeries with ISBCS is often perceived by the patient as the greatest of all recent advances in cataract surgery.

KEY WORDS: Bilateral cataract surgery, cataract surgery, immediately sequential cataract surgery, emmetropia, visual rehabilitation, visual system.

J Emmetropia 2010; 1: 000-000

INTRODUCTION

Simultaneous Bilateral Cataract Surgery (SBCS), more commonly referred to now, by most of its frequent practitioners, as Immediately Sequential Bilateral Cataract Surgery (ISBCS) (to differentiate it clearly from Delayed Sequential Bilateral Cataract Surgeries (DSBCS)), is becoming increasingly common worldwide. Among other things, ISBCS considerably facilitates planning of the patient’s post-operative refractive state, and so seems desirable in any refractive cataract surgical procedure, which today includes the vast majority of cases\(^1\). In my home province of Ontario, Canada, I was performing almost 50% of all Ontario ISBCS cases in 2003-4, which made up about 1% of all cataract cases in the province. By the 2008-9 (government fiscal year) my consistent volume had become less than 20% of ISBCS cases in Ontario, which now, however, exceeded 2.1% of all cataract cases (a 40% increase in total cataract cases occurred over the same period, to almost 140,000). Of these, 2,944 eyes underwent ISBCS (source = government of Ontario OHIP data base). The data shows that ISBCS is now increasing at a rate of 0.45% per year in Ontario (Table 1, Figure 1). We are led to believe that ISBCS is rarely performed in the US (only 0.3% of ASCRS 2008 David Leaming survey respondents admit to SBCS). However, the same survey showed that 5% of

Submitted: July, 19, 2009
Revised:
Accepted:
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Acknowledgements and Disclosure: The author has no financial interest in the contents of this paper.

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US surgeons routinely perform ISBCS in refractive lens exchange procedures, suggesting that in medicare practices ISBCS is not viable, but in patient pay refractive situations, it is. In David Leaming’s ESCRS study of 2007, 7.5% of responding ESCRS members stated that they routinely perform ISBCS. Despite the apparent surge of interest in ISBCS that this data suggests, bilateral cataract surgery has also become the subject of numerous extremely heated debates. At a time when we routinely perform bilateral LASIK, bilateral strabismus surgery, and generally bilateral «whatever needs to be done» in medicine and surgery, including ophthalmology, why is there such a fuss, and so much argument over ISBCS? What really are the issues here? Why are proponents of both sides of the argument so adamant? Are we missing something?

As in many things in life, sometimes if we try to look at a problem or issue a bit differently, from a different viewpoint, in different context, we gain new understanding. Let’s try. Why are we bothering to move to ISBCS, and why haven’t we moved faster? Hasn’t DSBCS served us well? It seems we finally have DSBCS down to a fine system with few complications. What are the problems and issues?

**METHODS**

**What we can learn from diverse sources**

Surgery, like everything else, follows the Non-zero model of progressive increasing complexity. *Nonzero: The Logic of Human Destiny* (Vintage Books, New York 2001) is a brilliant book in which Robert Wright explains how all things aggregate into progressively complex structures in our world, as long as there is some gain on both sides of merging entities, pushing them together (i.e. making the effort a positive non-zero sum venture). As soon as the first self-replicating molecule appeared, it simply had to happen eventually that replication errors would lead to mutation into a better self-replicating molecule. Over eons of time, this process led to binding to some other component, enhancing self-replication, and the unstoppable evolutionary tree, based on chemical natural selection, proceeding inevitably to ever-increasingly, but ever more functional complex structures. Chemical soup became cells, eukaryotic cells imbibed prokaryotic mitochondria, multicellularity appeared, and after a few billion years particular colonies of cells began thinking and eventually labeled themselves humans, believing anthromorphically that they were the «center of life», rather than simply «big colonies of cooperating cells» (kind of like cities), and just another step in the ladder of ever-increasing non-zero sum evolutionary complexity. Our recorded human development of last 3 millennia (a miniscule morsel of time) witnessed the evolution of villages to towns to cities to nation states, and now emerging globalization, simply a further development of non-zero sums. Should we look at all humans as cousins, as our DNA analyses suggest, or should we view ourselves as parts of an emerging larger organism – a bigger globally organized colony of cells, finally confronted with a non-moveable boundary? As we slowly surrender our individual independence to technological controls, perhaps we should try to understand what’s happening in the context of the seemingly unstoppable trend to mergers when the sum of benefits is «nonzero». The history of surgery accurately follows the non-zero model. We have seen ever-increasing complexity, and combinations of procedures, enabling us to deliver ever-greater results in single sittings. The addition of intraocular lens implantation to all cataract surgeries
is an obvious example of non-zero sum progress in cataract surgery.

Are there advantages to ISBCS that we may not have fully considered driving the non-zero process? Proponents of ISBCS claim that their patients are incredibly happy after ISBCS compared to DSBCS. Why is there such a «WOW» factor? Remember, there was a similar «WOW» factor with the first IOLs that got rid of the terrible optical effects of aphakic spectacles.

As ophthalmologists, when we hear the name Purkinje (Jan Evangelista Purkyne or Purkinje, 1787-1869), we think perhaps of seeing our own image mirrored in our first girl- or boyfriend’s pupils, but rarely of that eccentric Bohemian who experimented upon himself, observing the visual effects of spinning, and then belladonna and other drugs – the first experiments in a science that would later become physiology. En route, he discovered many things about the eye, the brain, heart and body. He established the value of fingerprinting for identification, named and described plasma and protoplasm, was the first to recognize that the vestibulo-ocular reflex exists and serves to stabilize images when we move, and discovered how we interpret moving pictures as «movies», which he was the first to make, and many more things².

Despite Purkinje’s early insights and many more added by others, the benefit of 2 eyes compared to one was not understood until well into the 20th century. Bela Julesz (1928-2003) was the first to develop random dot stereograms (1959), demonstrating the undeniable difference between true binocular stereopsis, and monocular perception of depth, using only environmental cues and parallax. Parallax is common among species, but stereopsis, the end result of normal development of the human binocular visual system, unachievable with one eye, is only present in a few lucky primate species². It seems fair to state that ophthalmologists have historically almost completely ignored the benefits of binocularity for our cataract patients. However, when we seek to achieve emmetropia, monovision, multifocality or pseudoaccommodation, we are working on the visual system and not one eye. Considerations of binocularity become important.

What we seldom perceive as ophthalmic surgeons, despite dizzyingly rapid advancements in our field, is that our concepts and behavior follow those we have inherited from our mentors, and those of our times. The statement seems trivial, but it is important to understand that we live in times where we perform what we were taught well, but must struggle to implement what we develop and work on, so that those innovations become part of the accepted practices in our children’s times.

It has long been an unchallenged dictum that cataract surgery is performed monocularly, and that the second eye is done when the first eye has recovered. I was a resident in the late 1970’s at a time when the stereoscopy work of Julesz probably had not been taught to some of my older professors. How many of my mentors had actually read the latest edition of Adler’s *Physiology of the Eye*, and how many had had their ophthalmological paradigms fixed when they were residents, before Julesz’s work became part of the ophthalmic canon? Often I was told, in those (good?) old days that to fix one eye of an older patient, possessing bilateral dense cataracts was probably sufficient for him/her to function «well enough» with cataract glasses after the proposed intracapsular procedure. Stereopsis was simply never considered. My teacher was clearly thinking of the patient’s eye, and not his vision. We are unwittingly the inheritors of this tradition. We have toiled to improve our cataract procedures, but how many of us have challenged and wrestled with the fundamental concepts of the broader paradigms we were taught.

During the same period when our understanding of stereopsis exploded, Parks, Von Noorden, and many others, were working trying to understand the developmental stages of our visual system, in order to better treat strabismic children, an investigative effort that considerably accelerated after the First World War³ We have slowly learned the details of the stepladder development of binocular vision, culminating in stereopsis, and have understood for 50 years that if we test stereopsis in a patient, and find it to be normal, the rest of the developmental steps must have been completed successfully in early childhood. But if a child fails the stereo test, we must turn to a collection of tests of intermediate steps, allowing us to pinpoint where arrested development occurred and why, and then devise treatment modalities.

And yet, we as cataract surgeons simply ignore all of the above, and continue to fix eyes monocularly, as if fixing an eye was fixing the visual system. Our collective recent quest of emmetropia, and eliminating or reducing presbyopia surely cannot continue to ignore binocularity and stereopsis, as monocular surgery does. Immediately sequential bilateral cataract surgery fixes the ocular system, in one sitting, not one of its peripheral receptors. Lundstrom et al. have shown that the improvement in visual performance observed within a few days of ISBCS is only apparent 4 months after the second eye is completed with DSBCS⁴. Tiina Leivo, of Helsinki, Finland (presented at ESCRs Sept 2008 Berlin) has shown that to prevent a single case of bilateral simultaneous endophthalmitis (BSE) after ISBCS (the repeatedly vocalized fear of performing ISBCS), by performing DSBCS instead, costs the Finnish health care system one billion USD per theoretical BSE case (none have actually occurred in Finland). Furthermore, mathematically, the same patient would still suffer
bilateral endophthalmitis after DSBCS, just at different times.

The added benefits to visual rehabilitation combined with the poor logic and ridiculous cost of avoiding ISBCS are compelling reasons to perform ISBCS. ISBCS is common in Finland, where in many hospitals half of cataract surgeries are ISBCS, in Sweden it is approaching 5%, in Spain’s Canary Islands, all patients undergo ISBCS, unless there is a good reason not to. The country with the largest membership in the iSBCS (International Society of Bilateral Cataract Surgeons) is Britain, but we do not have national data on the frequency of ISBCS there. Turkey, Poland, Canada, Austria, China, Iran and South Africa also commonly practice ISBCS, all with increasing frequency, but exact data is unavailable. Americans frequently perform ISBCS as refractive lens surgeries, but not as Medicare paid cataract surgeries.

Everywhere ISBCS is increasing. So, how does one get started with ISBCS? Well, the easiest obtainable guidance is to turn to those who have had the most experience, and see what they do. Basically, ISBCS is easy once every single step of cataract surgery has been optimized to the point that performing cataract surgery means having zero oversight or errors in sterility, anti-infective prophylaxis, IOL measurement, operating room function and reliability, incisions, capsulorhexis, phaco, I/A, IOL implantation, astigmatism correction, treatment without patching, and rapid visual rehabilitation. In my quest to achieve this in my own practice and teaching, I have begun giving a lecture called «Every complication you see, you caused.» I believe that this statement is almost true today. With study of each step of our surgery, and adjustments to make it as consistent and safe as possible, extremely low complication rates are possible. A very low complication rate is the secret that makes ISBCS safe and simple. Robert Wright’s *Logic of Human Destiny* tells us that we are headed toward repair of the visual system and not single eyes. Purkinje, Julesz, Von Noorden, and others have ascertained that we will only restore vision when we fix both eyes together, and Lundstrom has demonstrated that minimizing the time between procedures on the two eyes greatly accelerates full recovery. The time has come to shelve the older books. Our paradigms must change.

**RESULTS**

**Safe and Effective ISBCS**

The International Society of Bilateral Cataract Surgeons has recently formulated «General Principles for Excellence in ISBCS», which are posted on the Society’s website (www.isbcs.org). I have reprinted those suggestions here, as approved by iSBCS membership at our annual meeting in September 2009, in Barcelona.

**iSBCS General Principles for Excellence in ISBCS 2009**

This document was reviewed and approved by the membership at the 2nd annual meeting of iSBCS, Sept. 14, 2009.

General Principles preparation Committee 2008-9:

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1. Cataract or refractive lens surgery should be indicated in both eyes.
2. Any concomitant relevant ocular or periocular disease should be managed.
3. The complexity of the proposed ISBCS procedure should be easily within the competence of the surgeon.
4. The patient should provide suitable informed consent for ISBCS, being free to choose ISBCS or DSBCS.
5. The risk for Right-Left eye errors should be minimized by listing all surgical parameters (selected IOL, astigmatism, etc.) for both eyes on a board visible to all in the operating room (OR), at the beginning of each ISBCS case. The WHO operative checklists should also be used if possible*.
6. Intraocular lens power errors are minimized by having OR personnel familiar with the calculation methods used. The original patient charts should be available in the OR, and everybody passing the IOL to the surgical table should confirm the IOL choice. ISBCS nursing staff should be specifically trained and experienced.
7. Complete aseptic separation of the first and second eye surgeries is mandatory to minimize the risk of post-operative bilateral simultaneous endophthalmitis (BSE).
   a) Nothing in physical contact with the 1st eye surgery should be used for the 2nd.
   b) The separate instrument trays for the two eyes should go through complete and separate sterilization cycles with indicators.
   c) There should be no cross-over of instruments, drugs or devices between the two trays for the two eyes at any time before or during the surgery of either eye.

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Performing ISBCS

Changing the surgical routine to permit the successful performance of ISBCS involves a few steps:

1. Read up on ISBCS, think about your own experiences in cataract surgery, and believe that your patients will benefit from the change (consider joining iSBCS at www.iSBCS.org to keep up with current information and suggestions).

2. Review the iSBCS suggestions above and try to conform to as many as possible.

3. Review your surgical procedure in great detail. Make sure that each step is optimized. Make any necessary changes before proceeding to ISBCS.

   Reviewing your surgery, to optimize it can be a prolonged and difficult task. Everything need not be done at once, but a plan to resolve issues that prevent moving safely forward is essential. I have added here a few examples of some issues I faced as I moved to ISBCS, and how I resolved them.

1. Which eye should I do first & draping routine. When performing ISBCS, changing from the first to the second eye must be simple, consistent and easy, so that the entire team can work together, each performing their own tasks, efficiently, fully aware of where the others are going, and what they are doing. I always operate on left eyes first, simply because in my operating room, when I do the left eye, the nurse and I are further away from where we can place the tray for the right eye (which is sometimes being prepared by another nurse as we operate), than if we were to operate on the right eye first. I use simple Alcon 40x48 inch incisable drapes #8065104020, which I fold in half, so the adhesive surface catches the upper lashes, then open it onto the eye, and cut along the interpalpebral fissure, folding the upper and lower flaps under the lids (covering the lashes) with a Lieberman speculum (Katena Ki5678). I do not tape the lashes, or do any other manipulation of the lids. Removing the drape is easy – I merely roll it off temporally, and administer the topical 0.2% carbachol, prednisolone 1%, and Vigamox drops that I use routinely. I then apply 1% tetracaine drops from a sterile canula, etc. The lidocaine injection also pressurizes the eye, and I make the main phaco incision 90 degrees away, while grasping the pressurized globe using 0.12 forceps at the side port. I always inject intracameral antibiotics have been shown to dramatically reduce the risk of post-operative endophthalmitis. Their use is strongly recommended for ISBCS.

2. Incision size and architecture are critical for intraoperative control of the surgical environment, and to reduce the risk of post-operative endophthalmitis. I insist upon tight incisions, because I get much better control of the surgical environment that way. Wound leakage destroys any effort to achieve the set phaco fluidic parameters, making surgery much more difficult, and poorly sealing clear corneal incisions are the main cause of post-operative endophthalmitis. I use only diamond knives, and have designed my own Arshinoff «soft shoulder» knives, which I know create incisions that seal well. I perform the side port incision first, inject 0.1 cc of intracameral non-preserved isotonic lidocaine (Astra polyamps), use the same side port at this time if I want to use intracameral phenylephrine or dissect posterior synechiae (using the tip of the lidocaine cannula, etc. The lidocaine injection also pressurizes the eye, and I make the main phaco incision 90 degrees away, while grasping the pressurized globe using 0.12 forceps at the side port. I always inject...
3. IOL implantation and OVD removal

There are many ways to implant an IOL. I prefer using an injector and the second step of the ultimate soft shell technique. After the I/A is completed and the posterior capsule cleaned with a jet of BSS, the AC is filled about 30% with OVD, preferably a viscoadaptive, adjacent to the incision. BSS is injected through the OVD to fill the capsular bag. This filling, seen as dewrinkling of the posterior capsule and deepening of the bag is easily observed, as the BSS is trapped behind the OVD and stays in the eye. When the IOL is injected into the bag the shooter is inserted sufficiently to seal the incision, and optionally further. Careful observation is needed to watch that the leading tongue of OVD, ahead of the IOL, goes partially into the bag to lubricate the entry of the IOL. The IOL then follows easily without snagging the posterior capsule. Immediately after the IOL departs the shooter, it is exchanged for the I/A tip, which is inserted into the eye, anterior to the IOL, on continuous irrigation. The pressure of infusion forces the IOL, still closed, as it is enmeshed in OVD, backwards into the bag, where it opens, now that the haptics are surrounded by BSS instead of OVD. Simultaneously, as the lens moves backwards into the bag, aspiration is engaged, and the OVD is removed from the anterior chamber, by the I/A and incisional leakage, in a few seconds. As no OVD was placed behind the IOL, it does not need to be removed there. Occasionally a little OVD can be trapped behind the IOL, but it rapidly exits with a bit of «Rock ’n’ Roll» of the I/A tip, and going behind the IOL is rarely necessary. I use straight I/A tips with silicone sleeves, as they seal the wound better than metal I/A tips.

I give all patients one drop of topical 0.2% carbachol (easily made up by the hospital pharmacy) at the end of surgery, because cholinergics are the most effective drugs to prevent post-op IOP spikes, carbachol lasts for 24 hours, and patients appreciate the excellent vision they get with miosis immediately post-op.

DISCUSSION

From my experience, moving to immediately sequential bilateral cataract surgery has resulted in a greater increment in patient satisfaction that any other advancement in cataract surgery that occurred during my 30 year career. I find that I am obligated to discuss the patient’s desire for emmetropia or myopia, stereopsis or monovision (and if so, how much), multifocals or accommodative IOLs etc. in as much detail with each patient as I think they can understand. However, in this process, I have learned much more about my patients, and about what we are trying to do: restore vision. Vision is a cerebral perception. Our eyes are peripheral receptors. Admittedly they are very special peripheral receptors that perform a much larger part of the process integration than any other peripheral receptor, but nobody can argue that the brain’s perception is merely an unprocessed image relayed from our eyes. In the step ladder development of an infant’s vision the first step is for each eye to see clearly. Successful emmetropization of the eye with cataract surgery is similarly only the first step toward restoring normal vision. We should be proud of what we have so far achieved in cataract surgery. But we should be simultaneously humbled by the task before us and the further work necessary to restore normal vision to our patients. ISBCS is analogous to the second step of the infant’s visual development: simultaneous perception of the two clear images. In an adult patient who has already gone through normal visual development as a child, when we get them to this second step with ISBCS, the subsequent steps are extremely rapid. It is routine on post-op day 1, for my ISBCS patients to give me standing ovations as I enter my office in the morning, and for me to find that they have normal vision, currently limited only by some degree of presbyopia, depending upon the option they have chosen.

It appears complicated to learn all this. Most academic meetings permit 6-10 minute presentations. These are very useful to present a new fine point and then discuss its merits. But it is a most inefficient way to learn phaco, in the depth needed to perform ISBCS. On a number of occasions I have been invited to present a case video and discuss every single small step of phaco, and then discuss why I perform each step that way, considering alternatives with the audience, all in one lecture, or meeting. This lecture «Every complication you see, you caused» takes at least 3 hours, but is the best way to learn how to enhance your surgery to the level of precision needed for ISBCS. Sometimes, even more can be gained when 2 independent speakers do this in an all-day course, bouncing alternatives back and forth, or some similar idea. But 6-10 minutes is simply not enough.

In conclusion, cataract surgeons currently find themselves striving to achieve emmetropia. But, in reality, we are striving to more fully rehabilitate the visual systems of our patients. Whether our goal is to achieve emmetropia, monovision, multifocality or pseudoaccommodation, DSBCS sacrifices precious binocularity. Information from diverse sources supports the con-
tention that full visual rehabilitation by performing ISBCS, may achieve more for our patients than our choice of IOL and method of astigmatic repair. Whereas DSBCS may restore monocularly, ISBCS restores much more normal vision.

REFERENCES