

Monovision Revisited

One of The Ophthalmologist's most-read articles of the past five years was called "The Misnomer of Monovision." Here, I present an update on binocular spectacle-free vision for 2021.

By Raymond Radford



In the optically auspicious year of 2020, when the ophthalmology world planned to reach worldwide goals in vision, eye care, and patient outcomes, suddenly – like the punchline in a Greek myth – almost all routine ophthalmology stopped. However, time gifted by adversity has allowed us to reflect on our practice – and, in my case, revisit the topic of monovision (1).

Cataract removal and lens replacement remains the most common operation, with demand increasing, and waiting times for surgery being extended by six months and more. When patients eventually get their surgery, what is the best outcome we can achieve for them? For those who are not in love with their glasses, for reasons of habit or image, the option of spectacle-free vision exists with binocular spectacle-free vision (BSFV) – otherwise poorly labeled as “monovision.” If only every patient could achieve monocular 6/6 and N6 in each eye with a standard monofocal implant (true monovision perhaps)! Some patients have unpredictably gifted natural optics – for everyone else, you might want to consider BSFV.

“For those who are not in love with their glasses, for reasons of habit or image, the option of spectacle-free vision exists with BSFV.”

What do we already know about BSFV

- It works in 70–94 percent of cases – dependent on appropriate management, case selection and expectations (2).
- It takes time to explain to patients.
- It depends – like all lens replacement surgery – on biometry accuracy (but to a lesser degree than other types).
- It does not bring direct financial reward to the surgeon.
- It has been used successfully for decades in contact lens use and laser refractive surgery.
- Scientific studies support its use.
- It occurs naturally in some patients with much appreciated positive benefit.
- It sometimes happens accidentally to patients of all cataract surgeons (biometry error range).
- A small number of patients don't tolerate any difference in refraction (whether it is a psychological or an optical issue).
- Even with “premium presbyopia correcting lenses” mini-monovision is advocated by refractive surgeons to improve satisfaction and reduce spectacle dependence.

The five-year trend: 2015–2020

On the final summary day at the ESRCS in Barcelona in 2015, a colleague made the observation that all modern technologies in refractive surgery are using monovision some of the time or use it to optimize outcomes for spectacle freedom. Lens manufacturers have spent considerable sums marketing and advocating their premium lens designs, yet uptake remains less than 5 percent of all surgeries. Why is this? Surgeons want happy patients free from aberrations, glare, “vaseline vision,” positive and negative dysphotopsia. Concern about these effects and the frequency with which they occur has led to redesigned and refined multifocals: bifocals and trifocals, including removable lenses, such as “piggy back” trifocals.

How common is explanation? Accurate data on explanation rates is hard to find, and the data that exist are likely underreported. Lens marketing doesn't communicate the message: “Try it out and see if aberrations occur; if it is a problem,

we can remove the lens.” If this scenario happens, the surgeon is likely to incur the cost unless risk of removal is “priced into” the costs of the surgery, spread among all patients. The extended depth of focus (EDOF) lens has been promoted by some as never requiring removal because it is aberration-free and “not like multifocals, almost a monofocal.” However, I have met patients who experienced removal of EDOF lenses because of intolerable dysphotopsia. A recent study showed that 30 percent of EDOF patients experience significant photic phenomena (3). Reports on EDOF lenses consistently show less near vision without a complimentary monovision strategy (4, 5).

Aware of the popularity of monovision (80 percent of all surgeons use it, as audited in ESRCS annual reports) and the low uptake of “premium technology,” manufacturers are now offering “enhanced monofocal” lenses to “increase monovision effectiveness.” We are yet to see independent studies

Cortical processing and summation

Spherical aberration results in a blur focus, which may be used to give an increased depth of focus with reduced contrast sensitivity. Combining two maximally focused images, distance in one eye and near in the other, allows cortical processing to sort the blending without additional compromise to optics of the retinal image. In the competition of evolution versus engineering, one has a few billion years' head start.

A key aspect of the success in cataract surgery is the greater improvement experienced when both eyes have been operated on. Clear retinal images in both eyes allows the higher visual centers to achieve the best levels of stereoscopic and cortical processing, allowing summation. Typically, patients with 1.5 D disparity between eyes achieve a better line improvement for distance and near measurement binocularly than they do unocularly. This improvement is a positive cortical phenomenon, not a depth of focus elongation, with reduction in contrast sensitivity process of retinal image associated with "premium lenses."

that will show patient experience of unwanted optical effects of these new options. What we know already is that with spherical aberration induced, the known optical effect is reduction in contrast sensitivity. And that is most likely to manifest itself as issues with

reading in low light, such as studying restaurant menus, or driving at night.

The surgeon's reality

Happy patients make for a happy, content, and well-rewarded surgeon. Any patient who has the above frequently-reported problems with "premium lenses" is likely to require six months or more of discussions, repeat visits, negative emotions, and concern from the surgeon as to whether they can rectify the patient's disappointment and avoid further problems. Patient disappointment results from the failure of the "experts' recommendation" and the additional financial costs incurred to "benefit" from a premium lens.

Of course, the majority of premium lens insertions are reported as successful, with fully satisfied patients. However, it is important to consider all the data available, including the relatively high percentage (compared with monovision patients) of unhappy dysphotopsia patients.

Words of advice

If you decide to go down the monovision route, how should you discuss the chance of spectacle free-vision with BSFV? Firstly, outline the options available:

- Two eyes with best distance focus, with glasses for reading (just like most people over the age of 45-50 your patients may know: "safety in the herd"). Expect 6/6 good distance (equivalent to preop pinhole) and N24 or less.
- Two eyes with reading vision, with distance glasses or contact lenses; aiming for -2.0 to -3.0 D.
- Having the dominant eye with the best distance focus and non-dominant eye with near focus.
- Compromise and have -0.5 to -1.0 D in both eyes (as we used to do prior to 1999, usually without discussion).

Important advice incoming: resist the temptation to tell the patient what to do or what not to do. Most patients instinctively make a decision. And, if they are confident, they don't try to change their mind. If they ask for clarity, be patient with them and explain again. Be clear that there is time to make the final decision before surgery.

My important advice with regards to point 2 is: show the patient what -0.5, -1.0, -1.5 and -2.0 D near aim looks like in terms of working distance and expected font size. Everyone has their own preferences, interests, and regular activities – ask the patient about theirs.

My very important advice with regards to point 3 is that you make it very clear that the outcome depends (as for premium lenses) on accuracy of biometry and individual optical properties of each eye. The outcome is not certain. Doing the myopic eye first gives you some room for the dominant distance lens power choice (which rarely has a radically different outcome to the first eye). Even the latest biometry clinical studies show that about 70–80 percent of biometry is accurate to within 0.5 D of aim for all formulae (6). Usually, the contralateral eye will have a similar error to the first eye, but not always. Doing the myopic eye first can be advantageous, especially when reading ability is considered a bonus, but distance is deemed to be most important by the patient.

How much myopia?

Be guided by the patient's reading, working distance, and font size expectations. Looking at their occupation and hobbies, you should be able to decide together what to aim for. For the majority of patients, -1.5 D is the most required and the maximum amount of anisometropia. However, for myopes over -3.0 D and those who have existing myopic anisometropia greater than -2.0 D, there is room for postop



anisometropia of higher levels to help achieve the desired myopic near point patients are adjusted to.

My most important advice remains – as ever – to under promise and over deliver. Total BSFV with -1.5 D disparity is a likely outcome, but not guaranteed. Based on studies, satisfaction is typically reported at 85 percent overall. Reduced spectacle dependence is very likely with any amount of near focus achieved. For many patients, especially those with -1.0 D or less reading result or N8 or less outcome, off-the-shelf reading glasses of +2.0 or +2.5 D will provide increased magnification and will allow easy and comfortable reading for prolonged periods in good light.

Variability

Depending on individual characteristics, there is a range of possible outcomes for a particular aim. Therefore, -0.75 D aim results in N12 vision in one patient, and N6 in another. Similarly, a -1.5 D aim

Astigmatism

The majority of patients have astigmatism of less than 2 D. In non-private cataract surgery and in keeping with the maxim of "doing the best we can with the resources and time we have," this astigmatism can often be reduced quickly and efficiently with paired clear corneal incisions, with the main incision initially placed along the steepest axis. This initial incision is enlarged at the end of surgery to 4-6 mm internally and

4-5 mm externally using the keratome in a sweeping fashion. This is paired with a similar opposite incision. While performing these incisions, the anterior chamber can be kept watertight after re-inflation via the side port. This technique maximizes the clarity of the uncorrected image, especially in the distance-focused eye. Some astigmatism is better tolerated in the myopic eye. Where possible, toric lenses can be used to correct high degrees of astigmatism and achieve excellent BSFV using 1.5 D spherical disparity between eyes.

typically ensures N6 or better, but in a few patients only N9 might be achieved. This is independent of the variability of biometry accuracy, ending up with a more myopic result than planned (7).

Words of caution

Don't convince a patient they should choose monovision or a premium lens. Monofocal lenses have 1 percent incidence of dysphotopsia. The disturbing "blinkers



BSFV by default and missed opportunities

Some patients present fully aware of the benefits of their “monovision” (BSFV). They have experienced it naturally, have developed it through asymmetrical nuclear cataract myopic shift or have it through contact lens wear or past laser refractive surgery. Another, even more common situation is the patient who finds – between first and second eye surgery – that they are suddenly

not requiring glasses because of second-eye existing myopia or first-eye biometric myopic error with an emmetropic second eye due to surgery. Many of these “accidental” monovision patients are not sure how this glasses-free vision has happened and think it is the planned result of their marvelous surgery.

In both groups, standard practice would often appear to correct the second eye to emmetropia, with an explanation to the patient, who now needs reading glasses, that this was expected from the beginning. This is a missed opportunity for the patient. In the previously successful monovision patient, a complaint (or worse) is likely.

effect” of negative dysphotopsia is usually temporary, thankfully. The most introspective, detail-focused patients may not be the best candidates for monovision. Patients with a history of diplopia, strabismus, and use of prisms in glasses are best avoided. Patients with macular diseases need to clearly understand that disease progression would result in the loss of focus. If a patient presents to you with a fixed idea of what option they want, cover the options available, but do not attempt to convince them to choose a different plan. If a patient has successfully worn contact lens providing monovision, they will likely be delighted with IOL monovision, and upset if they don't receive this. For non-contact lens wearers with significant cataracts, a contact lens trial is unlikely to help preoperatively (8). For a patient who asks, “What do most people do?” safety in the herd might be the answer, so ask which herd they want to be in: the one with glasses or the one free of them. In the UK, patients

don't get offered the chance of BSFV as often, or are sometimes advised against it, whereas in Europe monovision is a very common practice.

To sum up...

Monovision remains a confusing label, which patients can find hard to understand. Vision – in the absence of marked amblyopia, suppression or uncorrected diplopia – is a stereoscopic experience. BSFV explains the aim of using a different target in each eye in a more easily-understood language. The brain's visual system has developed over many billions of years using visual memory, spatial frequency, color correction, natural aberration correction, and neural processing to give us the best version of reality it can. We can let the brain work out the best binocular image from the least aberration-inducing monofocal artificial lens with BSFV and attain 6/6 N6 (or even better) unaided or we can present the optical system with an artificial aberrated “premium lens”

and hope the visual system accepts it – which it does 70 percent of the time. The first option can result in more satisfied patients and a very low explantation rate. True monovision should be used to represent those patients with 6/6 and N6 unioocular. Binocular spectacle-free (reduced wear) vision best explains the shared two-eye strategy.

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