IOL Surprise - What to do?

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The last decade has seen the emergence of refractive cataract surgery. This is defined as cataract surgery, which not only restores the transparency of the ocular media but also attempts to correct any refractive aberrations of the eye, with the objective of achieving the best possible uncorrected visual acuity. This reduces the spectacle dependence of patients with consequent quality of life and economic benefits.

Despite numerous advances in surgical techniques, IOL materials, IOL designs, biometry and IOL power calculation formulas; patients can still be left with significant residual refractive errors after cataract surgery. The success of refractive cataract surgery depends on achieving a predictable refractive outcome for spherical equivalent and astigmatism. Refractive surprises can seriously compromise patient satisfaction and also give rise to potential problems of anisometropia, dominance switch, in which the dominant eye ends up with the weaker uncorrected vision and, above all, give rise a sense of failure in patients expecting good uncorrected visual acuity. This article focuses on the detection, management and prevention of refractive surprises in cataract surgery.

Identification of the IOL Surprise

- During immediate post operative period
- At the time of prescription of glasses

Causes
In 1992 prior to the advent of optical biometry, Olsen reported that

- 54% of refractive surprises were due to errors in axial length measurement,
- 38% were due to errors in predicting the post operative IOL position and
- 8% were due to errors in keratometry measurements.

After the advent of optical biometry, improvement in the accuracy and consistency of axial length measurements was seen to such a degree that a similar study by Norrby in 2008 showed the commonest source of error to be

- Prediction of post operative IOL position (36%),
- Errors in post operative refraction (27%),
- Axial length measurement (17%),
- Keratometry (10%),
- Pupil size (8%),
- Variation in refraction across the pupil and IOL power (1%).

Patients at significant risk of refractive surprises

- Small hyperopic eyes
- Large myopic eyes
- Eyes with very steep or flat corneas
- Shallow anterior chamber depths
- Prior history of refractive surgery
- Vitrectomized eyes
- Corneal ectasia
- Peripheral corneal melt syndromes and
- Contact lens use (when measured without an adequate contact lens holiday)
It is important to warn these patients of the increased risk of refractive surprise as part of the informed consent process and prepare the patients for a second stage enhancement procedure.

**Clinical Assessment of Refractive Surprise**

A methodical approach is critical in identifying the cause of a refractive surprise. This consists of the following:

1. **Refraction:** Inaccurate refraction is the second most common cause of refractive surprise after cataract surgery. An accurate subjective refraction is essential. Auto-refractor measurements while repeatable are not consistent with subjective assessments. A repeatable and consistent strategy to refract postoperative patients is essential in order to reduce errors as well customize lens constants. The post-operative refraction also forms the basis for calculating the correction needed in a secondary enhancement procedure.

2. **Repeat Biometry Measurements:** Optical biometry makes it easy to measure the axial length and keratometry in pseudophakic eyes. This will identify any measurement errors in the original biometry.

3. **Calculating IOL power with the new measurements:** It allows for a comparison with the previous calculation. The difference in IOL power between the original and recalculated should be consistent with the magnitude of the refractive surprise. If the full magnitude of the refractive surprise cannot be explained by the difference between the original and recalculated IOL power than other factors apart from measurement error like prediction of postoperative IOL position or a lens power error may be significant contributors to the refractive surprise. The cause of a refractive surprise can influence the method chosen to correct the refractive surprise.

**Management**

Options for correcting unexpected refractive errors in cataract surgery—

- Prescription of glasses
- Contact lens use
- Repositioning in cases of Toric IOLs
- IOL exchange
- Piggyback IOL implantation and
- Laser refractive surgery

It is our job to choose the most appropriate solution according to the amount and type of refractive error and the time between the two surgeries. When we treat these patients, it is important to remember that tolerance of minor refractive errors has decreased with the widespread use of premium IOLs, specifically toric and multifocal lenses.

**Correction of Refractive Surprise: Pearls**

- Identifying the cause of a refractive surprise is critical in picking the correct refractive enhancement procedure.
- Not all surprises need to be corrected.
- Prior to any such enhancement it is important to identify and demonstrate the benefits as well as the potential risks a patient may expect from an enhancement procedure.
- It is important to keep in mind the trade-offs a patient may have to accept by carrying out an enhancement procedure.
- Patients who end up myopic in their non-dominant eye may well prefer the accidental monovision.
- Similarly patients with multifocal lenses may well prefer a longer working distance attained by a small hyperopic surprise.

Laser vision correction, Secondary Piggyback IOLs, IOL Exchange and IOL repositioning are the common methods for correcting refractive surprises.

**Laser vision correction:** It is important to demonstrate a stable refraction before attempting a correction. Laser vision correction using PRK, LASIK or LASEK will give the most predictable refractive outcome. Smaller errors are preferred for this modality and are done after 1 to 3 months of primary surgery.

**Secondary Piggyback IOLs:** These are IOLs placed in the ciliary sulcus and a simple procedure within the comfort zone of most cataract surgeons. The trauma and risks of removing an IOL is avoided and piggybacking covers for an IOL power error. Spherical errors are relatively easy to correct but spherocylindrical errors can also be treated with Toric piggyback lenses. The calculations for choosing the power of these lenses is based on the refraction using a vertexing formula like the Refractive Vvergence formula.

**IOL Exchange:** This is a method of first resort in high errors and is done within 1 month of primary surgery to facilitate ease of explantation and as a last resort in cases when all other corrective options have been considered and discarded. Removing an IOL from an eye can be a technical challenge depending on the lens design and the time period the lens has been in the eye. Removing lenses months or years after primary surgery can be fraught with the danger of rupturing the capsule. The replacement IOL calculations use the same method as used for the primary IOL. IOL exchange is not a good method to correct refractive surprise due to an error in predicting the postoperative IOL position or an error in the actual IOL power.

**IOL repositioning:** This method is most commonly used in toric implantations where the misalignment of the IOL lead to a refractive surprise. Anterior optic capture can
also correct a refractive surprise of less than one diopter if needed.

**Prevention**

Percival et al using ultrasound measurements and customised lens constants reported 97% of eyes achieving a refractive outcome within 1 diopter of target. Gale et al suggested a benchmark for NHS cataract surgery is to achieve 85% results within 1 diopter. These figures have to be viewed within the perspective of the normal distribution of refractive error in the population with 66% of eyes within 1 diopter of emmetropia. It follows that if one is to use a standard power IOL within the population without any biometry, 66% of eyes would fall within 1 diopter of target.

An essential tool for improving the accuracy of IOL power calculation is Optical biometry. In patients with dense cataract where optical biometry is not feasible, immersion ultrasound biometry provides similar levels of accuracy. There are various protocols available to improve the accuracy of measurements and all of them are based on rechecking the measurements when the probability of these occurring in the population is very low. These protocols are implemented within the newer versions of software for optical biometry machines. Although these protocols alert the operator to unusual measurements they do not identify errors, which do not appear to be unusual in patients with unusual eyes. It is thus critical to not only use these protocols but to supplement them with a strategy of reconciling the IOL power measurements with the patient’s refractive history prior to the development of cataracts.

A crude rule of thumb is to expect a difference of 3 diopters in the IOL power between eyes with a difference in pre-cataract refraction of 2 diopters. Reducing the risk of refractive surprise requires a consistent approach to measuring eyes, reconciling the measurements with the patient’s refractive history, using a modern theoretical formula like the SRK-T, Haigis or the Holladay 2 and customizing formula constants for surgeons as well as different lenses.

**Summary**

Prevention of refractive surprise requires a consistent method of biometry. Refractive surprises after cataract surgery are a common cause of patient dissatisfaction. A methodical assessment with repeat measurement is needed to identify the cause. Combined effect of multiple small factors must be considered. A risk benefit assessment is critical to establish the need for a refractive enhancement. All surprises need not require surgical correction. Laser vision correction and secondary piggyback IOLs carry lower risk and are more predictable methods for correcting refractive surprises.

**References**