

Some Consideration On Cataract Surgery With IOL Implant

Dương Diệu *

* Vice Dean of Faculty of Medicine-Nguyen Tat Thanh University, 300A Nguyen Tat Thanh street, Hochiminh City-Vietnam.
duongdieumd@ntt.edu.vn, duongdieumd@gmail.com

Abstract

Useful vision after cataract surgery and implantation of intraocular lens (IOL) depends on surgical techniques, measurement of refractive parameters as well as adaptation of the patient. (neural adaptation). Multifocal or progressive lenses, if used prior to cataract surgery, are relatively more adaptable. Results of visual acuity after IOL implantation surgery depends on surgical techniques, on setting the correct refraction first and then the quality of the IOL after, lastly on adaptation of the patient (neural adaptation). The IOL manufacturing process of different brands is not the same and it is recommended to use the same brand IOL for both eyes Identification of multifocal IOLs through bio microscopy is essential for both doctors and patients in using it. The objective of this paper is to note some characteristics of lens aberrations, types of IOL and surgical selection procedures with IOL for better vision.

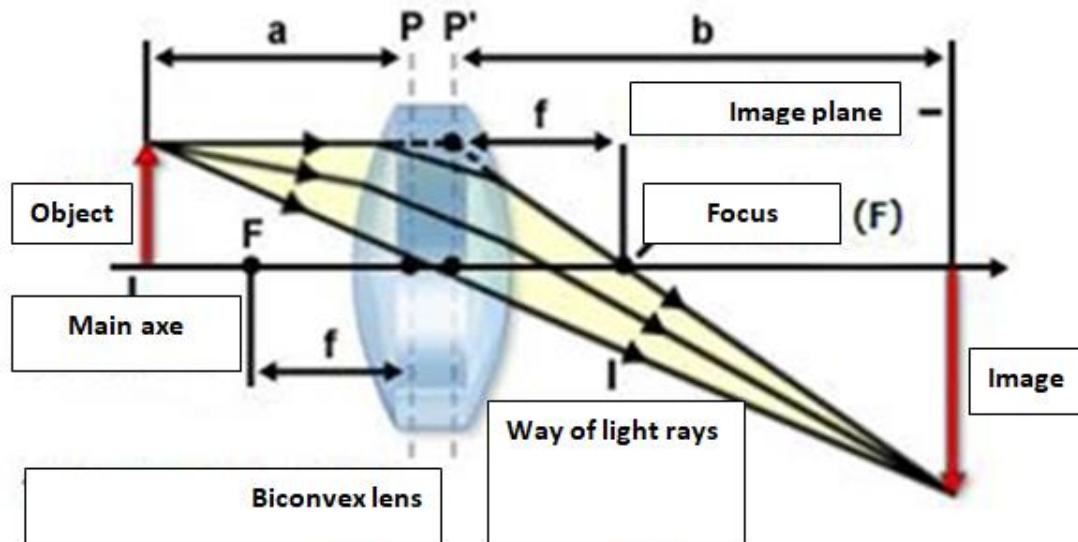
Key words: lens aberrations; implantation of intraocular lens; multifocal IOLs; vision.

Introduction:

The useful vision after cataract surgery with intraocular lens implant depends on the surgical technique, the measurement of the refractive index as well as the adaptation of the patient by accommodation. The purpose of this article is to show characterize lens aberration, types of IOL and surgical selection procedures with IOL for both doctor and patient in order to better vision.

1. Lens aberration

1.1 Overview: Optical phenomena are divided into 3 fields. Optical physics describing the wave properties of light was discovered by Christian Huygen, later developed by Young and Maxwell. Optical quantum talks about the interaction between light and matter with the wave properties given by Newton and particle nature fully explained by Planck. Geometrical optics assumes that light rays and describes images through lenses and mirrors [1]. Gauss a German mathematician and scientist hypothesized the aberration to determine optical properties of objects and images not near the axis through the lens [2]. There are many types of lenses, but can be divided into two main types: convex lenses and concave lenses. Convex lenses have a positive focal length, which means that with actual focus it magnifies the image of the subject. Intraocular lens IOL is this type. Objects and image are as follows in figure 1.



F1. Object and image by lens

Anisometropia is a phenomenon where there is a difference in refraction between the eyes, Refractive deviation (anisometropia) results in an uneven binocular image (aniseikonia). Aberration has the following manifestations: Distorsion, coma, spherical aberration, astigmatism, Petzval field curvature, chromatic aberration and defocus. Astigmatism aberration similar to coma; however, this phenomenon is insensitive to aperture size and depends heavily on the bevel of the light beam. This aberration is manifested by the off-axis image of a point object appearing as a segment or ellipse instead of as a separate point. Depending on the angle of the off-axis light beam entering the lens, the segment image can be directed in two different directions: longitude or latitude. The intensity ratio of the unit image is reduced, with clarity, detail, and contrast lost as distance to the center increases. For those with a refractive error, it is necessary to adjust the glasses so that the image size for the eye is even compared to the standard lens. Formula for the magnification adjustment glasses: $D(\text{diopter}) = [1/(1-(t/n)P)] \times [1/(1-hF)]$ Where: t = center thickness (in metres); n = index of refraction; P = anterior baseline curve; h = peak distance PD (in metres); F = posterior peak distance. If the difference between the 2 eyes is up to 3 diopters, glasses is needed. Also the difference of 3 diopter lenses will be clearly different - a lens will need to be at least 3mm thick and have a +7.5 spherical base curve. Consequences of peak distance (PD): With 12mm PD, each diopter has a corresponding magnification of 2%. The adaptability of the eye is from 2-4 diopters, respectively 4-8%. [3].

1.2 Causes: The retinal image size is determined by many factors. The size and position of objects being viewed affect the properties of the light entering the system. Corrective lenses affect these characteristics and

are commonly used to correct refractive errors. The optics of the eye includes the refractive performance and the eye axis length also plays an important role in the image size in the retina. Irregular image sizes can occur spontaneously or are caused by corrections to a refractive error, usually due to a difference in refractive error significantly between each eye or a near-monocular due to different lenses. Refractive surgery can cause many uneven images due to corneal astigmatism in the same way that it is caused by frame and contact lenses. IOL-removal surgery is responsible for significant refractive error and uneven image [3].

1.3 Image magnification: Frame lenses have a magnification of 30%, contact lenses 10% and IOL intraocular lenses (front or back room) 4- 5% With aspherical (+) lenses, magnification increases by 2% and negative lenses (-) decrease the magnification by 2% [3]

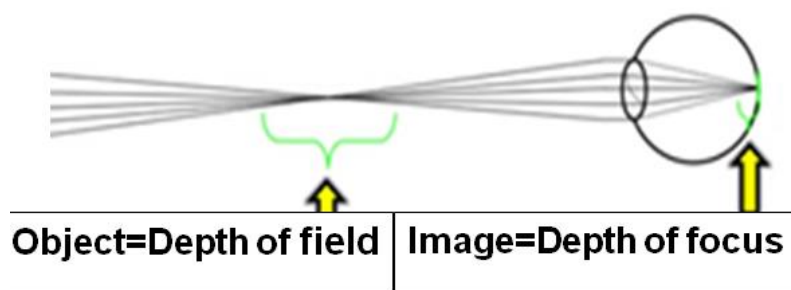
2. The intraocular lens (or IOL) [1, 4]

2.1 IOL implant: Replace the lens after removing the opaque lens. An intraocular lens (or IOL) is an artificial lens that replaces the natural lens of the eye removed during cataract surgery. The normal crystalline is transparent through light rays that enter the eye, helping to see clearly. If the crystalline lens is cloudy, the eyes will be blurred, or less colorful, especially if the eye is glared under the sunshine. Many eye conditions also cause blurred vision, so an eye doctor will be needed to determine for you. Cataract surgery removes this cloudy lens and replaces it with an IOL to improve vision. IOLs have different focus powers, like eyeglasses or contact lenses. The ophthalmologist will measure your eye length and corneal curve. These measurements are used to calculate the IOL power for each person's eye.

2.2 What is IOL made of? Most IOLs are made of silicone, acrylic or other plastic components.

They are also coated with a special material to help protect the eyes from harmful ultraviolet (UV) rays from the sun [5]. Several IOLs today take advantage with Extended Depth of Focus Lens (EDOF).

The depth of focus is the image that is clear when light enters the center of the IOL, and the image will appear blurred outside of this range. The depth of field is used for objects that are inside an area so that the image is clear and objects outside the depth of field will be blurred [1]. Figure 2



F2. Depth of focus and field

2.3 Types of IOL:

Monofocal IOLs: The most common type of lens used in cataract surgery. It has a focusing distance. It is set to focus for near, mid-range or far-range visibility. Most people place them for clear foresight. After insertion this IOL should wear eyeglasses to read or work near.

Multi-focal IOLs: These IOLs provide both near and far focusing simultaneously. This IOL with different powers in different compatible areas is housed in IOLs. These lenses allow for focusing at different distances.

Astigmatism IOLs: For people with astigmatism, there is an IOL called a toric lens. Astigmatism is a refractive error caused by the cornea or lens with an uneven curve. Toric lenses are designed to correct that refractive error according to the usual indication of turbulence > 0.75. [3]

3. Selection surgeon: Consultation in the United States-American Academy of Ophthalmology. When you plan your cataract surgery, talk with your ophthalmologist about your vision needs and expectations. Your doctor will explain the IOL options to you in more detail. Does cataract make your daily activities more difficult? Perhaps it is time to consider cataract surgery. An ophthalmologist can replace your opacity lens with an IOL. The IOL will restore the vision. Follow these steps to choose a successful, qualified eye surgeon.

[4] Talk to your ophthalmologist who regularly examines you about your health as well as eye condition included vision after cataract surgery with IOL implant. If your current ophthalmologist is an ophthalmologist surgeon, you can be operated. Or they can refer others, depending on what you need. For example, you might decide on a premium IOL instead of a traditional IOL. Ask your cataract surgeon if they have experience with these types of lenses. They can help you choose the premium lens that's right for you. Check who have had cataract surgery in your family and your friends in your area? Have they had positive experiences with their own cataract surgery? If so, they can refer their ophthalmologist. Go online to find eye surgeons in your area. Use the American Academy of Ophthalmology. Find a Doctor tool. When you see an eye surgeon, remember that you don't need to commit to them about your surgery. Consider these when you talk to your ophthalmologist about cataract surgery. Make sure you are comfortable with the eye doctor and their office staff. Have you been treated professionally and politely? Have you been given complete information about this surgery, including its benefits and risks? Have all your questions been answered? Optometrists never guarantee perfect vision after surgery. They will let you know that you may still need eyeglasses under certain conditions. In certain cases, you may be told that you may need a follow-up surgery. They call this advanced surgery. That surgery and the additional costs should be fully explained. Find out who will see you the day after your surgery to see how well you are curing. This could be a surgeon, another ophthalmologist or a refractor. Ask the surgeon if their surgical center has had an eye infection outbreak that affected many patients. If so, how many times? (This is a very rare occurrence, but it is a serious matter to be aware of.) [4]

Conclusion:

1. The production process of IOL is not the same from each other. So, it should be used the same brand IOL for 2 eyes with cataract surgery.
2. Using one eye with monofocal lens for near vision and other with far vision, it takes time for adaptation after IOL implant. Or one eye with monofocal lens for far vision and other with multifocal lens it is also need a coordinated adaptation time in accommodation from monovision to binovision [6]. In case of not well adaptation, suitable IOL will be exchanged. Rates of exchange IOL is about 1% [7] Multifocal or progressive lens if used prior to lens removal surgery will be relatively more adaptable.
3. Measurement of refractive index prior to IOL is very important for optimal vision. This issue is not that IOL price: "IOL with a lot of money is better in vision than IOL with a little money". The results of visual acuity after IOL insertion surgery depends on the correct refractive index setting first and then the quality of IOL later! [3]
4. Time to decide on 2nd eye surgery is a matter to consider to ensure safety and have to know your own country's standard of cataract surgery [4, 8].

Funding: No funding or grant support was received for this work.

Conflict of Interest: No financial disclosures

References

1. Basis and clinical science course. 2001. American Academy Ophthalmology <https://www.thriftbooks.com/series/basic-and-clinical-science-course-bcsc/122828/>
2. https://en.wikipedia.org/wiki/Carl_Friedrich_Gauss
3. Duong Dieu. Refractive Errors(2013) <https://duongdieumd.blogspot.com/2015/01/quang-sai-aberration.html>
4. <https://www.aao.org/eye-health/diseases/cataracts-iol-implants>
5. <https://duongdieumd.blogspot.com/2016/05/tai-sao-can-eo-kinh-chong-uv.html>
6. <http://duongdieumd.blogspot.com/2014/12/thi-giac-tre-em.html>
7. <https://crstoday.com/articles/2015-feb/feature-story/>
8. <https://drive.google.com/file/d/1XrNoHOJ0-ESHR-nf844cqeuwGZrMu7PY/view?usp=sharing>