6 Multifocal Intraocular Lenses: Considerations in Special Cases

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Multifocal intraocular lenses may open new horizons of treatment in patients who have special problems. The possibility of gaining good vision in different distances without the need of spectacles or contact lenses might be a solution for many challenging clinical situations. On the other hand, implanting multifocal intraocular lenses in certain situations might be useless and even causing reduction in visual function. Knowing the multifocal intraocular lens advantages and limitations is a necessity while treating patients who have special clinical situations and needs. In this chapter, we will deal with the most common special cases one might deal with and suggest some guidelines of how to use, or not use, multifocal intraocular lenses. However, the reader should be cautious about the following conditions as they are to be considered as at the limit of the indication/contraindication clinical balance according to today's level of evidence in such borderline indications of multifocal IOLs.

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6.1 Multifocal Intraocular Lenses in Children

Children who need to have a cataract surgery are prone to develop amblyopia unless they are vigorously treated in order to avoid it. Treatment for amblyopia in these children demands corporation and usually is difficult. The main reasons for developing amblyopia in these children are the change in refractive power during the two first decades of life and the lack of multifocality due to the loss of accommodation after surgery. Allegedly the entrance of multifocal lenses to the market opened new options to tackle this problem; however, there are still some unclear issues while considering multifocal intraocular lens implant in children. The first issue is the ongoing growth of the child resulting in a change of the refractive power of the eye, hence raising the question of how to calculate the power of the implanted lens and when exactly does the eye become "adult eye"? Is the multifocal intraocular lens the best solution in children? What kind or type of multifocal intraocular lens should we implant in children? [1].

There are just a few publications on this subject, and implanting multifocal intraocular lenses in children is still in dispute. Advantages of using multifocal intraocular lenses are as follows:

- Rapid rehabilitation of far, intermediate, and near vision
- Improved chance of binocularity
- Reduced risk of amblyopia

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- No need for bifocals
- Better self-estimation of the child

While there is no doubt that these advantages are important, there are still some concerns. While implanting multifocal intraocular lenses, we might reduce contrast sensitivity and intermediate vision and exacerbate amblyopia [2]. While the visual world of a young child is primarily at arm's length, growing his visual daily tasks become distant than that and the implanted lens might not pit any more [3]. The growth of the eye between the ages of 10 and 20 may lead to a change of 4.0 diopters [4].

Cristobal et al. presented in 2010 their experience in multifocal intraocular lens implant in five children and reported good postoperative visual acuity but less good results in postoperative stereoacuity [5]. Though their study was of limited number of patients and with no control group, their results do encourage the use of multifocal intraocular lenses in children. Can and his colleagues presented a successful scleral-fixated single-piece multifocal intraocular lens and summarized that this might be a good technique to use in children where there is no capsular support to implant of intraocular lens [6]. As multifocal intraocular lenses continue to improve and surgeon's experience of implanting these lenses developed, there is a great promise for improving visual outcome and life quality of the pediatric cataract patient, especially in children 8–10 years of the age. Abouzahide et al. evaluated the outcome of 34 eyes of 26 children that had a cataract surgery with multifocal intraocular lens implant and concluded that best far vision, best near vision, and stereopsis were significantly improved especially in bilateral cases [7]. In 2014, Ram et al. published a study of a follow-up of 21 children (42 eyes) that had cataract surgery and multifocal intraocular lens implant. They concluded that multifocal IOL implantation is a viable option in children above 5 years of age with bilateral cataract [8].

6.2 Multifocal Intraocular Lenses in Glaucoma Patients

The use of multifocal intraocular lenses in glaucoma patients is yet another subject that is relatively little discussed in the literature. Patients with glaucoma have a certain degree of contrast sensitivity reduction and mesopic visual function loss. Multifocal intraocular lenses reduce contrast sensitivity and mesopic visual function as well, and therefore multifocal intraocular lenses implant might cause significant vision disturbances in these patients [9, 10]. Another consideration in glaucoma patients is small pupil and zonular weakness especially in pseudoexploitative glaucoma patients. In patients who are candidates for combined operation (cataract and glaucoma), surgeons should take into consideration, while calculating the lens power, the axial length of the eye and anterior chamber length change after the operation [11].

Glaucoma patients who have an intraocular multifocal lens will have difficulties in visual field tests due to the small pupil, reduction of contrast sensitivity, and defocus to near and intermediate distance. These undesired effects should be remembered and considered while evaluating visual fields results in these patients [12, 13].

Farid and colleagues studied the impact of multifocal intraocular lens implant on the mean deviation as tested in visual fields of glaucoma patients and concluded that multifocal IOL implants cause significant nonspecific reduction in mean deviation values on Humphrey Visual Field 10–2 testing that does not improve with time or neuroadaptation and that multifocal intraocular lens implants may be inadvisable in patients where central visual field reduction may not be tolerated, such as macular degeneration, retinal pigment epithelium changes, and glaucoma [14].

On the other hand in a study published in 2015 by Ouchi and Kinoshita, patients with existing ocular pathology, among them four glaucoma patients who had a cataract and refractive surgery with a multifocal intraocular lens, showed no deterioration in their visual field results [15].

Ocular hypertension Perce is not a contraindication for implanting multifocal intraocular lenses. Glaucoma patients, with no or slight visual field damage and controlled intraocular tension, are proper candidates for multifocal intraocular lens implant; however, patients with advanced glaucoma, significant visual field

defects, or uncontrolled intraocular tension as well as patients with a glaucomatous damage in the other eye are not good candidates for this operation and will not benefit from multifocal intraocular lens implant, and in these patients glaucoma is a contraindication for such a surgery.

6.3 Multifocal Intraocular Lenses in Patients with Maculopathy

There is no doubt that patients who suffer from diabetic maculopathy or from age-related macular degeneration may benefit from cataract surgery and intraocular lens implant. Though patients who suffer from maculopathy already have contrast sensitivity reduction which is adaptive to the contrast sensitivity reduction from the implanted lens, the overall result is beneficial to the patient. Most multifocal pseudophakes without an active retinal disease are satisfied from being free from spectacles and with trading some of their contrast sensitivity for it. Patients with maculopathy and some visual loss are more tolerant to image defocus and might adapt more rapidly; however, in some of these patients, contrast sensitivity is an important measure of their reading ability. Therefore, patients who suffer from maculopathy should be carefully selected and preoperatively assessed for multifocal intraocular lens implant [16].

Patients with maculopathy should be tested carefully in order to determine the maximal visual potential preoperatively and to be informed of the possible predicted visual outcome. These patients should be treated for the retinal disease, if needed and possible before the cataract surgery. If that is done and the patient's expectations correlate with the real predicted outcome, a multifocal intraocular lens implant will be of benefit for the patient.

Multifocal intraocular lenses were found to serve as an important visual aid in patients who suffer from age-related macular degeneration. In an article published in 2012, by Gayton, Mackool et al. reported their experience in implanting multifocal intraocular lenses in patients with age-related macular degeneration and concluded that for cataractous eyes with age-related macular degeneration, the multifocal lens serves as a low vision aid. Targeting the implanted lens for a spherical equivalent of about −2.00 diopters yielded a + 5.20 near addition. Replacing the crystalline lens with this myopia-targeted multifocal intraocular lens improved or maintained near vision without severely compromising distance vision [17]. Patsoura and Georgaras published in 2012 that multifocal intraocular lenses may serve as a visual aid in cases of maculopathy [18]. However, the use of multifocal intraocular lenses for this purpose is not accepted as a standard procedure yet.

6.4 Multifocal Intraocular Lenses in Patients with Amblyopia

Though implanting multifocal intraocular lenses reduces contrast sensitivity and intermediate vision, in adult patients, it does not exacerbate amblyopia. There are only two studies reporting multifocal intraocular lens implant in the current literature. In both studies, multifocal intraocular lenses were implanted in both eyes—the amblyopic eye and the non-amblyopic eye—and both studies reported good results in far and near vision outcome, as well as slight improvement of binocularity in some of the patients [19, 20]. In the last 6 years, there were no new studies on this subject, and the benefit of multifocal intraocular lenses in adults and in youngsters should be investigated and determined.

6.5 Multifocal Intraocular Lenses and Dry Eye

A healthy ocular surface is a key factor in achieving a successful result in multifocal intraocular lenses implant. Since the corneal tear film is actually the first refractive plane of the eye, its healthiness and integrity is important in reaching the aim of having the light rays uninterrupted focusing on the retina. A successful cataract operation with a multifocal intraocular lens implant but

with interference in the tear film will result in an unfavorable refractive result and an unhappy patient. We use in daily practice the term dry eye but actually the right term is inadequate tear film which might be due to small amount of tear production (dry eyes) or due to production of a proper amount but of poor quality tears. No matter what the reason is, the result is a disruption of the ocular surface causing a disturbance in vision and interference with quality of life.

About 15% of unsatisfied multifocal intraocular patients suffer from dry eyes reporting blurred vision, photic phenomena in addition to irritation redness, and excessive tearing [21]. The assessment of ocular surface problems such as dry eye is therefore essential as well as a thorough ophthalmic and systemic evaluation in order to diagnose, treat and prevent dry eye syndrome. Dry eye signs include

- Conjunctival erythema
- Decreased tear film strip test
- Decreased breakup time test
- Punctate epithelial staining

Categorization the dry eye into aqueous deficiency state or to poor tear quality is helpful in choosing the treatment strategy though frequently dry eye is a combination of the two [22].

Treatment of dry eye includes lubrication–hydration with tear supplements, lid hygiene, and in advanced cases punctal plug installation. The use of topical cyclosporine 0.05% twice daily was found as an efficient treatment—reducing dry eye signs and improving visual quality—after multifocal intraocular lens implantation in patients who suffered from dry eye [23].

Though one of the complications of multifocal intraocular lens implant and one of the causes of dissatisfaction of patients is dry eye, it should be remembered that exacerbation of dry eye symptoms is not due to the multifocal lens implant but rather due to the cataract surgery itself and might happen in monofocal lens implant as well.

Dry eye should be diagnosed and treated preoperatively but should not prevent multifocal intraocular lens implant and the patients to benefit from it.

6.6 Multifocal Intraocular Lenses and Ocular Surface Diseases

As mentioned before, a healthy and integrated ocular surface is critical for cataract surgery to succeed; however, scholarly it is often overlooked at the preoperative examination. Proper mechanical lid function enables an equal and persistent tear spread all over the cornea, thus preventing dry eye syndrome. In addition, one should look for the presence of any anterior or posterior blepharitis since this condition does not only disturbs vision but is of a potential risk for postoperative inflammation and even of infection.

Blepharitis increases the risk of antibiotic-resistant bacteria existence on the ocular surface and even of postoperative endophthalmitis [24]. Other diseases of the ocular surface such as seborrheic anterior blepharitis and meibomianitis should be diagnosed and treated since they are too a risk factor for postoperative infection and inflammation [25, 26].

Treatment of blepharitis includes:

- Lid hygiene
- Systemic doxycycline
- Antibiotic or steroid ointment (sometimes combined therapy needed)
- Cyclosporine 0/05%—topical
- Metronidazole cream
- Ketoconazole shampoo
- Omega 3 fatty acid supplementation—found to favorably alter Meibomian gland secretions [27]

In addition to blepharitis and Meibomian gland diseases, other surface conditions are important to diagnose and treat, such as anterior basement membrane dystrophy pterygia and Salzmann nodules which may cause significant astigmatism. In any case, preoperative corneal topography should be obtained in order to ensure that there is no astigmatism induced by these conditions.

Careful preoperative assessment and aggressive treatment of surface diseases combined with postoperative treatment for ocular surface diseases are obligatory and a must in order to ensure positive results from cataract surgery and multifocal intraocular lens implant.

6.7 Monocular Multifocal Intraocular Lens

As multifocal intraocular lenses reduce contrast sensitivity, in cases where only one eye is operated, the amount of light finally reaching the retina might be less compared to the unoperated eye. A difference in the image in each eye might cause inconvenience and might take time to get used to. Neuroadaptation to this difference is a time-consuming procedure, but eventually the brain neuroadapts and the perceived image from both eyes is clear and integrated into the vast majority of patients. Opponents to multifocal intraocular lenses warren from monocular suppression [28], however numerous reports are suggesting that multifocal intraocular lenses should be implanted in unilateral cataract patients and the overall outcome is satisfactory in these cases.

In order to help the process of neuroadaptation and overcome the difference in retinal image between the two eyes, it is recommended to perform cataract extraction and multifocal intraocular lens implant in two eyes. Nevertheless, some patients do have cataract only in one eye. Several reports on monocular multifocal lenses suggest that results in these cases are good and multifocal intraocular lenses in one eye provide better stereopsis, higher spectacle independence rate, and satisfactory functional vision compared to monofocal lens implant in unilateral cataract patients [29]. Although bilateral multifocal intraocular lenses implant is favorable, unilateral implantation of multifocal lenses also provided patients with high levels of spectacle freedom and good visual acuity without compromising contrast sensitivity. In a recent study, comparing monofocal intraocular lens implant to multifocal intraocular lens implant in patients with unilateral cataract, the multifocal lenses provided better binocular near and intermediate vision and spectacles independence than the monofocal lenses, although distance contrast sensitivity was worse with the multifocal intraocular lenses [30].

Though bilateral multifocal intraocular lens implant is favorable, in cases of unilateral cataract, patients gain more from these lenses compared to monofocal lenses, overcoming the reduction in contrast sensitivity. Though neuroadaptation might be more difficult or take longer even in unilateral cases, multifocal intraocular lens implant is favorable.

6.8 Other Considerations

It is almost impossible to include the whole variety of preoperative considerations in one chapter; hence, there is no doubt that a thorough patient ophthalmic examination should be performed prior to cataract surgery and that issues mentioned as well as others should be addressed and if needed treated prior to the cataract surgery as well as the patients general health and well-being.

Implanting multifocal intraocular lenses requires a personalized attitude since often patients present with multiple ocular, systemic, and psychological conditions that differ one from the other. As many factors affect the final results, the surgeon must adopt a “wide angle” approach and be aware of the various conditions that eventually have an impact on it. If an unfavorable factor is diagnosed preoperatively, it should be treated and not ignored or postponed.

There is no doubt that in order to achieve the best possible results in multifocal intraocular lens implant cataract surgery, there is a need to know the different factors that affect the final result, and this knowledge helps to cough with them, targeting and achieving the aim of having a postoperative happy patient free of the need to use spectacles or contact lenses. Planning ahead the surgery in view of these influencing factors is an essential step to perform a safe and fruitful surgery for the benefit of the patient and the surgeon as well. In multifocal intraocular lens implant operations, the “tailor-made” approach, which means personal specific lens and surgery adaption, should be taken especially in cases that are of treating challenge as described in this chapter. It is beyond the scope of any text to handle with the entire possible clinical situation; however, the reasonable surgeon can adapt the existing knowledge and the main considerations described here and imply it to the special clinical situation he deals with.

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