Scientific Research Publishing

Journal of Biosciences and Medicines, 2025, 13(12), 193-209
https://www.scirp.org/journal/jbm
ISSN Online: 2327-509X
ISSN Print: 2327-5081

Progress in Visual Quality Evaluation after Cataract Surgery

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How to cite this paper: Long, Y. and Wang, J.H. (2025) Progress in Visual Quality Evaluation after Cataract Surgery. *Journal of Biosciences and Medicines*, **13**, 193-209.
https://doi.org/10.4236/jbm.2025.1312015

Received: October 28, 2025
Accepted: December 12, 2025
Published: December 15, 2025

Abstract

With cataract surgery entering the era of refractive cataract surgery, people's requirements for visual quality are getting higher and higher. From "visible" to "clear" and then to "comfortable and lasting", it is affected by many factors. This article reviews the related factors affecting visual quality, focusing on the impact of binocular visual function on visual quality.

Keywords

Visual Quality, Visual Function, Accommodative Function, Stereo Vision

1. Introduction

The recovery of cataract function has received increasing attention. From vision restoration surgery to the expectation of having full vision, including far, near, and clear vision, achieving comfortable and lasting visual quality has become the focus of discussion. Therefore, what factors affect visual quality, and what indicators can comprehensively evaluate the visual quality of cataract patients after cataract surgery? First, the classification of intraocular lens is very important. Postoperative visual quality evaluation includes visual acuity, accommodation function, fusion function, stereopsis, contrast sensitivity, visual function questionnaire, and other indicators [1] [2]. These examination items can comprehensively reflect the visual performance of patients under different lighting conditions and distances, as well as the incidence of visual interference phenomena (such as glare and halo) [3].

2. Classification of Intraocular Lenses

Since its first appearance, its application and development in ophthalmology have

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undergone significant changes. In order to better meet the needs of different patients, people classify it according to various criteria. These classification criteria cover the material characteristics of the intraocular lens, shape design, fixation position in the eye, implantation method, and division of optical functional areas [4]. Of particular interest are those lenses that meet different visual distance requirements, which can be further subdivided into the following categories based on their optical design and functional characteristics: monofocal, multifocal, accommodating, and extended depth-of-field IOLs, each optimized for specific visual needs to provide optimal vision and quality of life for patients [5] [6].

After optical action, a single-focus intraocular lens can only form a single focus on the retina, which can be divided into the following three categories: one is the spherical lens, which can only meet the basic vision restoration needs of cataract patients. When light passes through this lens, it cannot converge at one point, which can easily produce aberration, resulting in night vision being inferior to daytime vision; the other is the aspheric lens, which can focus light at one point by adjusting the optical zone of the spherical lens, thus reducing the interference of aberration; the third is the aspheric astigmatism lens, which is based on the aspheric lens and additionally adds an astigmatism correction function [7]. Although a single-focus intraocular lens can provide clear distance vision, it generally cannot achieve clear vision over the entire range covering medium and near distances. However, many patients need to improve medium and near vision when driving and using computers, mobile phones, and other devices [8]. Some researchers have proposed that the problem of presbyopia can be solved by means of the refractive state of monocular vision, that is, one eye is responsible for seeing far and the other eye is responsible for seeing near. The principle of monocular vision lies in the use of the fuzzy suppression mechanism of the brain. When the brain receives signals with inconsistent imaging clarity between the two eyes, it will actively suppress fuzzy imaging and only receive clear imaging, thus realizing functional vision in both eyes [9] [10]. However, this anisometropia will affect binocular imaging, and the damage to stereopsis is more significant [11]. In order to achieve binocular full vision, various functional intraocular lenses, including multifocal intraocular lenses and extended depth of field intraocular lenses, have emerged. According to the principle of light refraction and diffraction, multifocal intraocular lenses are divided into all-optical-surface refractive type, all-optical-surface diffractive type, and refractive-diffractive mixed type.

According to the principles of light refraction and diffraction, multifocal intraocular lenses can be divided into three types: refraction type, diffraction type, and mixed diffraction type. Refractive-diffraction hybrid type is a combination of the basic refractive power of refraction and the light energy distribution and modulation of diffraction, following two principles. Multifocal intraocular lenses can divide light into two or more focal points, following the principle of simultaneous perception, so that far and near objects can be imaged on the retina. When the refractive power difference on the retina exceeds 3.0D, the cerebral cortex will actively suppress blurred imaging and give priority to clear imaging, so that patients can obtain clear vision at different distances [12]. Multifocal IOLs split incident light so that light from different distances is focused on the same plane of the retina, allowing patients to see objects at multiple distances. For example, trifocal IOLs superimpose images from long, intermediate, and near distances on the retina and filter them with neural processing to achieve clear vision at different distances. Despite the many advantages of multifocal IOLs, residual refractive errors, light interference, etc., may increase dissatisfaction. Among them, the most common defects are glare and halo, and contrast sensitivity is reduced compared with single-focal IOLs [13] [14]. Postoperative residual refractive errors prevent patients from achieving optimal vision, and even mild astigmatism may have a serious impact on postoperative vision [15]. In addition, multifocal IOLs, especially bifocal IOLs, may lead to poor intermediate vision or visual discontinuity due to focal segment loss during spectroscopy.

Accommodative IOLs provide patients with good intermediate and near vision while maintaining good distance vision by simulating the accommodation function of human lenses [16]-[18]. The design concept of accommodating IOLs includes bioptic accommodation, deformation accommodation, and displacement accommodation. The Tetraflex accommodating intraocular lens is an early clinical accommodating intraocular lens, which is superior to single-focus intraocular lens in terms of accommodation amplitude and unaided near vision. In one study, the Tetraflex accommodating intraocular lens showed better accommodation ability and visual quality at 1 week, 1 month, and 3 months after operation compared with the AR40e single-focus posterior chamber intraocular lens. Accommodating intraocular lens has only one focal point, which has less influence on contrast sensitivity after surgery and can provide good visual quality; the ciliary muscle of presbyopia is still functional, and accommodating intraocular lens can meet the patient's demand for personalized visual quality on this basis [19]. Of course, the accommodation ability of the accommodating intraocular lens is limited. According to current technology, the lens can only restore about 20% of the accommodation amplitude. Different patients have different eye anatomy, ciliary muscle function, and postoperative recovery. The postoperative effect varies greatly. Some patients still have some complaints, such as glare, halo, and reduced contrast sensitivity. Capsular fibrosis may occur later in the implantation of an accommodating intraocular lens, affecting the accommodation of the lens [20]-[23].

Extended depth-of-field intraocular lenses are the best choice for patients who desire a continuous range of functional vision. Extended depth-of-field intraocular lens, also known as continuous vision intraocular lens, has attracted much attention in recent years by extending single focus to enhance depth-of-field, maintaining good contrast sensitivity while ensuring good distance, medium, and near vision. Postoperative glare, halo, and other phenomena are rare [24]-[26]. At present, there are few intraocular lenses that can be classified as extended depth-of-field, among which TecnisSymfonyZXR00, introduced in 2014, is more prominent. TecnisSymfonyZXR00 is designed differently from multifocal IOLs. It uses a step design to create a stepped structure. The height, spacing, and contour of the steps are optimized to expand the depth of focus. Instead of forming two or three focal points, the light passing through the IOL generates a focal line that mimics the continuous zoom function of the human eye and is closer to the visual experience of the natural human eye. The incident light is focused on an extended longitudinal plane rather than on discrete points, thus avoiding overlapping of far and near images. Extended depth-of-field IOLs perform well in providing intermediate vision, but are worse at near vision than Zeiss trifocal IOLs (AtLisatri 839 MP), and the latter performs better in near vision at 3 months postoperatively [27]. In addition, residual astigmatism can affect the quality of vision. Studies have shown that distance vision correction is better when the cylinder axis is 0˚ and 90˚, while the 0˚ axis has an advantage in near vision correction [28]. Although the higher-order aberrations of extended depth-of-field IOLs are relatively low, they may still affect visual quality in certain situations [29]-[31]. For example, in a comparative study with zonal refractive multifocal IOLs (e.g., SBL-3), although the extended depth-of-field IOL group performed better on indicators such as Objective Scattering Index (OSI) and modulation transfer function cutoff frequency (MTFcutoff), the two groups did not differ significantly in close-reading lens removal rate and night vision disturbance symptoms [32].

3. Evaluation Method of Postoperative Visual Quality

3.1. Postoperative Visual Acuity

Vision is a measure of the ability of the retina to distinguish the smallest distance, also known as visual acuity. Vision can reflect the visual resolution of the human eye in different situations. The classification of vision is more complex, including hyperopia and myopia, naked vision and corrected vision, static vision and dynamic vision, central vision and peripheral vision, etc. Myopia is characterized by parallel light rays focused in front of the retina, making distant objects difficult to see and requiring accommodation for near vision. Visual acuity is the ability to observe objects at rest, while dynamic vision refers to the ability to distinguish objects or observers in motion. Central vision focuses primarily on visual functions in the macular region of the retina, while peripheral vision focuses on visual perception in the peripheral region of the retina [33] [34].

Common eye charts include the International Standard Chart, Snellen Chart, logMAR Chart, etc. [35]. The International Standard Chart is designed to conform to international standards and is widely used to test the eyesight of various groups of people. The Snellen Chart was invented by Dutch ophthalmologist Hermann Snellen in 1862 and uses letters or symbols of different sizes to test vision. LogMAR is a scientific vision detection tool designed based on logarithmic relationships that can more accurately measure vision and quantify vision levels. In medical research, logMAR is often preferred because it better reflects subtle changes in vision and is suitable for clinical research and vision assessment [36].

3.2. Through-Focus Curve

Defocus curve is an important method to evaluate functional intraocular lenses. It can directly reflect visual quality under different focal lengths by adding lenses of different powers to the eyes to simulate vision at different distances. The defocus curve can be realized by directly changing the image distance, or indirectly changing the image distance, such as by adding positive or negative spherical lenses to the eyes of patients. The method of indirectly changing the image distance has many advantages, such as good patient acceptance and high compliance, so it is widely used in clinical work. The principle is that the lens can change the vergence (D) of light and thus simulate the vision of the patient at different distances. The negative lens diverges light, and the image focus is the inverse extension of the diverging light, which is equivalent to shortening the image distance. Since the refractive index of light in air is about 1, the actual image distance is equivalent to the reciprocal of the lens focal length, thus simulating the vision state of the human eye when viewing close objects [37]-[39]. Defocus curve helps us to better understand the performance of functional intraocular lenses, and some scholars have put forward different ideas. Gupta *et al.* [40] showed in a study of defocus curve that due to the magnification of lens method, positive lens, negative lens stimulation accommodation, pupil response, etc., the true vision at the corresponding distance may be underestimated, resulting in inaccurate results. Huang Mansha *et al.* [41] objectively measured the defocus curves of three groups of different functional IOLs with full-process visual analyzer (Binoptometer 4p), and concluded that the defocus curves of SBL-3 were relatively smooth 3 months after operation, and showed double peaks 6 months after operation. SymfonyZXR00 with extended depth of field had a wide plateau period, and diffraction ZMB00 showed obvious double peaks.

3.3. Contrast Sensitivity

Contrast sensitivity is a combination of viewing angle and contrast, which measures the ability of the human eye to distinguish images at different spatial conversion frequencies. It examines the visual quality of the entire eye, *i.e.*, the optical quality and neuropsychological factors of the eye, which are more in line with the true situation of human vision and reflect visual function more sensitively than visual acuity. Although the visual acuity of cataract patients improves after surgery, factors such as glare from multifocal intraocular lenses are likely to affect contrast sensitivity [42] [43]. Contrast sensitivity measurements are often performed with contrast sensitivity meters and contrast sensitivity test benches. Low and high-order aberrations can lead to reduced contrast sensitivity. Cataract surgery can improve contrast sensitivity to some extent by removing opaque lenses and implanting transparent intraocular lenses. Studies have shown that the improvement in contrast sensitivity after surgery varies with surgical method, intraocular lens type, and individual patient differences. Aspherical intraocular lenses can improve contrast sensitivity by reducing spherical aberration and improving light focusing ability, and have been shown to be significantly higher than the spherical intraocular lens group in contrast sensitivity, mainly in middle and high frequency space. Sandoval HP *et al.* found that aspheric IOLs had better contrast sensitivity than spherical IOLs at 1 month and 3 months after surgery, especially at intermediate spatial frequencies (3 cpd, 6 cpd, and 12 cpd) [44]. The reason is mainly that aspheric intraocular lenses can transmit light more efficiently, reducing light scattering and absorption. The choice of surgical technique also has a significant impact on the recovery of contrast sensitivity after surgery. Femtosecond Laser-Assisted Cataract Surgery (FLACS) can more accurately select the incision position, depth, and width and tear capsule than traditional phacoemulsification surgery, reducing damage to intraocular tissues. Studies have shown that contrast sensitivity after FLACS is higher than that of traditional surgery at medium spatial frequency [45]. Different types of intraocular lenses have different effects on contrast sensitivity after surgery. Hall *et al.* [46] compared contrast sensitivity between multifocal intraocular lenses and single-focal intraocular lenses, and found that the contrast sensitivity of single-focal intraocular lenses is better than that of multifocal intraocular lenses at medium spatial frequency. Studies have shown that postoperative contrast sensitivity with extended depth-of-field IOLs is better than that with multifocal IOLs [47]. Postoperative refractive status also has an important impact on contrast sensitivity. Postoperative residual refractive error (such as myopia or hyperopia) will also further reduce contrast sensitivity. For example, patients with postoperative residual myopia require greater accommodative power when looking at nearby objects, thereby increasing the accommodative burden and affecting contrast sensitivity [48]. Therefore, accurate preoperative refractive status assessment and postoperative refractive correction are essential to maintain contrast sensitivity.

3.4. Binocular Visual Function Test

Binocular vision refers to the simultaneous placement of images of objects on the retina of both eyes (fovea macularis), which are transmitted through the nervous system to the sensory system and finally integrated into a complete three-dimensional image with stereoscopic perception in the brain center [49]. Binocular vision includes primary simultaneous vision, secondary fusion function, and tertiary stereoscopic vision. The formation of binocular vision includes basic adjustment, convergence and divergence, fusion, and neuropsychology. Zhang Li *et al.* pointed out that visual reconstruction after cataract surgery can not only improve visual function, but also affect brain function and structure [50]. In clinical practice, binocular visual function examination methods are mainly divided into three categories: accommodation function, convergence and divergence function, and stereo vision function.

Adjustment function check: The key factor in maintaining normal binocular visual function is the normal function of accommodation, convergence, and dispersion. In clinical work, patients are prone to visual fatigue, eye soreness, and even double vision, but if the examination has ruled out organic lesions, then we should check the function of accommodation, convergence, and dispersion. Vergence and divergence function tests include convergence near point, convergence amplitude, positive and negative fusion vergence and divergence, and the AC/A ratio [51]. In clinical work, there are many parameters to diagnose visual dysfunction, and the most commonly used indicators are accommodation amplitude and convergence near point. Monofocal intraocular lenses can provide only one focus and lose accommodation function when looking at near distances, whereas multifocal intraocular lenses can provide multiple scattered foci. Trifocal intraocular lenses can provide accommodation function when looking at near distances, and continuous visual path intraocular lenses can provide continuous focus and also have accommodation function when looking at near distances. A study comparing 100 patients implanted with Tecnis multifocal intraocular lenses and monofocal intraocular lenses in both eyes showed that the amplitude of accommodation in the multifocal intraocular lens group was significantly higher than that in the monofocal intraocular lens group, with an average improvement of about 2.3 to 2.8 D [52]. In addition, researchers compared preoperative and postoperative binocular visual function in cataract patients, including stereoscopic vision, eye position, fusion convergence, near convergence point, and convergence insufficiency symptom survey. The study found that 4 patients with preoperative binocular visual dysfunction recovered to normal visual function after surgery. The study finally concluded that binocular visual dysfunction, especially convergence insufficiency, is common in senile cataract patients, and cataract surgery is not a risk factor for new binocular visual dysfunction. Pre-existing binocular visual dysfunction is the main risk factor for predicting postoperative binocular visual dysfunction in this population [53]. Studies have shown that the amplitude of postoperative accommodation often decreases, especially in older patients, as ciliary muscle function decreases with age and the fixed position and shape of the intraocular lens limit accommodation. A 6-month follow-up study of 100 patients after cataract surgery revealed that the average amplitude of accommodation was only about 40% of the preoperative amplitude at 3 months postoperatively [54]. The main reason for this phenomenon is that the intraocular lens cannot, like the human lens, change its shape to adjust the focal length. The recovery rate of postoperative accommodative function shows individual differences. Some patients recover accommodation within 6 months postoperatively, but the extent of recovery is limited. Age is an important factor affecting postoperative accommodative function. With age, the contractile ability of the ciliary muscle weakens, and accommodative function naturally declines. Studies have shown that patients older than 60 years of age have a significantly greater decrease in postoperative accommodation than patients younger than 40 years of age. The choice of surgical technique and type of intraocular lens also affects postoperative accommodation. For example, patients with a multifocal intraocular lens perform better than patients with a monofocal intraocular lens in terms of postoperative near vision and accommodation. Femtosecond Laser-Assisted Cataract Surgery (FLACS) has some advantages in terms of postoperative accommodative function recovery, with a higher postoperative amplitude of accommodation than conventional phacoemulsification [55]. Postoperative refractive status also has a significant impact on accommodative function, with studies showing that postoperative refractive errors (such as myopia or hyperopia) further reduce accommodative function. For example, patients with residual myopia after surgery require more accommodative power when looking at nearby objects, thus increasing the accommodative burden. Therefore, accurate preoperative assessment of refractive status and postoperative refractive correction are also of great significance for maintaining accommodative function.

Fusion function is the second-level function of binocular vision, which refers to the ability of both eyes to integrate images with slight differences into a complete and unified image, and the brain to efficiently process image information from the slightly different retinas of both eyes and fuse them into a single and stereoscopic image. Fusion function is the key factor in determining stereoscopic vision. The Worth four-light test method, by observing the patient's perception of the four light spots, determines whether there is diplopia or inhibition phenomenon and can check different distances (33 cm, 1 m, 5 m) under the fusion range, qualitatively assessing fusion function. Under normal circumstances, the patient should be able to clearly see four points of light; if there is double vision or inhibition, it may indicate that there is an obstacle to fusion function. The synoptophore inspection rule is to simulate the ability to fuse two slightly different objects into one at a distance, which can accurately measure the fusion range and ability of both eyes. After cataract surgery, some patients may develop fusion dysfunction, including diplopia, fusion difficulties, and impaired stereopsis, due to the potential impact of surgery on intraocular structures and changes in postoperative refractive status. Fusion is difficult in near vision due to the decrease of accommodation function after single-focus intraocular lens surgery; a multifocal intraocular lens has higher requirements for image fusion due to the decrease of contrast sensitivity, which may cause visual fatigue, while a continuous vision intraocular lens has a consistent and smooth binocular signal, less burden of image fusion, and faster neural adaptability. With the increase in age, fusion ability will also change. In a related study, Hashemi *et al.* [56] selected 1793 normal people aged 60 and above to investigate fusion function, and the results showed that 29.6% of the elderly had insufficient close-range assembly function. Some researchers evaluated the short-term fusion ability of monocular and binocular multifocal intraocular lens implantation patients with a synoptophore, and the results showed that there was no significant difference in fusion ability between the two groups of patients [57].

Stereopsis is an advanced form of binocular vision, which mainly judges the depth and distance of objects through binocular parallax perception. Stereopsis mainly includes the difference of images on the retina of both eyes and the processing of these differences by the brain, which is manifested in the following key aspects: 1) Parallax perception: When both eyes gaze at the same object, due to the different positions of the two eyes, there is a difference in the imaging position of the object on the retina of both eyes, namely parallax. The brain perceives this parallax to determine depth and distance. 2) Binocular fusion: The brain needs to fuse images on both retinas into a complete image. This process requires good binocular coordination and visual processing skills. 3) Depth perception: Stereopsis enables people to perceive the three-dimensional structure of objects and accurately determine the position and distance of objects in space. After cataract surgery, stereopsis may be affected to varying degrees, and the recovery varies from person to person. Patients with monocular intraocular lens implantation have difficulty focusing at near vision, and fine stereopsis. Patients with multifocal intraocular lens implantation are greatly affected by visual interference, and the quality of stereopsis is limited. Patients with continuous vision intraocular lens implantation can achieve high-quality synchronous stereopsis under continuous vision. Patients with good stereopsis function before operation are more likely to recover after operation. Patients with anisometropia or amblyopia before operation are less likely to recover stereopsis function after operation. Anisometropia and amblyopia can lead to anisometropia or unclear retinal imaging in both eyes, thus affecting the establishment of stereopsis function. Titiyal *et al.* [58] studied 50 patients (100 eyes) who were implanted with extended depth of field IOLs in both eyes for 1 year. The average distance stereo vision was 103.6 ± 49.1" and the near stereo vision was 21.1 ± 2.3". 80% of the patients had perfect near stereo vision of 20", and 82% of the patients had good stereo vision of 100" or better. Excellent stereoscopic vision was observed with extended depth-of-field intraocular lens implantation in both eyes, which correlated with good patient satisfaction and visual quality. Zhu *et al.* [59] made a comparative analysis of stereopsis after implantation of trifocal intraocular lens and trifocal and bifocal mixed group. The results showed that the average near stereopsis of bilateral group and mixed group were 49.76 ± 22.67" and 120.63 ± 90.94" respectively, and bilateral group was better than mixed group. Near stereopsis was positively correlated with visual acuity difference between two eyes.

3.5. Satisfaction Questionnaire

In addition to objective measures such as visual acuity, defocus curve, contrast sensitivity, and binocular visual function analysis, subjective measures such as satisfaction questionnaires are also important for assessing the visual quality of patients after cataract surgery. For example, after refractive cataract surgery, patients may experience some light interference phenomena such as glare and halo, which are usually subjective and difficult to measure with objective measures. In order to understand the subjective feelings of patients more comprehensively, the satisfaction questionnaire can be used to evaluate the recovery of visual function and the overall satisfaction of patients.

In clinical practice, there are a variety of satisfaction questionnaires to choose from. The VF-14 Chinese scale is specifically used to assess the subjective visual quality of patients after cataract surgery and can provide detailed information about the daily visual function of patients. The Catquest-9SF scale focuses on the assessment of visual function after cataract surgery and measures the performance of patients in different visual scenarios through a series of questions. QoV scales are more widely used, applicable to all patients after refractive surgery and eye surgery related to visual quality problems, and can assess the recovery of visual function in daily life. In addition, there are scales such as VFQ-25 and pRSIQ, which can assess patients' visual function and quality of life from different perspectives, providing clinicians with a more comprehensive assessment tool. Through the use of these scales, we can more accurately understand the true feelings of patients after surgery, which is important for us to personalize the surgical plan for patients before surgery and provide targeted recommendations for postoperative treatment and rehabilitation [60]-[62]. Thomas *et al.* [47] investigated the visual quality of EDOF IOLs using QoV scales and showed that 88% of patients had no optical interference despite some slight optical phenomena, and 63% reported no optical phenomena at all.

4. Factors Affecting Postoperative Visual Function

The main factors related to cataract surgery include the choice of surgical method, the type of intraocular lens, the accuracy of intraoperative operation, and neuroadaptability, which have significant effects on the recovery of postoperative binocular visual function. FLACS utilizes the high-precision cutting ability of the femtosecond laser to make corneal incisions, capsulorhexis, and nucleus cleavage more accurately and to reduce damage to intraocular tissues. Guo Lin *et al.* [63] studied the visual quality after femtosecond laser cataract surgery combined with TecnisSymfonyZXR00 intraocular lens, showing that the naked eye medium myopia, reading lens removal rate, and VF-14 score were significantly higher than those of the control group, and the total aberration and total high-order aberration were significantly lower than those of the control group. Jin *et al.* [64] compared conventional phacoemulsification with femtosecond laser-assisted cataract surgery and found that astigmatism changes were more predictable in the femtosecond laser-assisted cataract surgery group, internal aberrations including total RMS, tilt, and RMSOAs were lower in the femtosecond group, and patient satisfaction was higher in this group. Secondly, postoperative visual function recovery and IOL type selection also had a great impact. Monofocal intraocular lenses can provide good distance vision, but patients have difficulty with near vision after surgery. Multifocal intraocular lenses can provide patients with good distance, medium, and near vision by designing multiple focal points, which significantly improves the quality of life after surgery. It was found that postoperative stereopsis and contrast sensitivity of patients implanted with multifocal IOLs were better than those implanted with monofocal IOLs, with improved stereopsis acuity and significantly improved contrast sensitivity at intermediate spatial frequencies [65]. In addition, aspheric IOLs improved the focusing ability of light by reducing spherical aberration, thus improving postoperative contrast sensitivity [66]. Finally, the accuracy of intraoperative manipulation also affected the recovery of postoperative visual function. For example, the position of intraocular lens implantation and the accuracy of power calculation have an impact on postoperative refractive status. If the intraocular lens position is shifted or the power calculation is inaccurate, it may lead to postoperative residual refractive error, affecting accommodation function and contrast sensitivity [67]. In addition, the size and position of the corneal incision and the degree of retinal traction may affect postoperative visual function. Studies have shown that too large or improper intraoperative corneal incisions may lead to postoperative corneal astigmatism and reduce contrast sensitivity [68]. Therefore, intraoperative damage to intraocular tissues should be minimized to ensure the accuracy of surgical operations, which has an important impact on the recovery of postoperative visual function. Neuroadaptation is the process of perceptual learning and cortical reorganization of new retinal stimulation signals in the visual center. With monofocal intraocular lens implantation after cataract surgery, visual signals are similar to those before surgery, the brain can easily process them, and neural adaptation is faster, while after multifocal and continuous vision intraocular lens implantation, the neural signals received by the brain are changed, and neural adaptation is more difficult [69]. Both multifocal intraocular lenses and continuous vision intraocular lenses distribute incident light energy to multiple focal points or extended focal depth through optical design or diffraction effects, resulting in simultaneous formation of multiple overlapping object images on the retina and loss of inherent contrast sensitivity. Therefore, after intraocular lens implantation, the visual cortex of patients needs to learn to suppress blurred signals that do not match the target distance and choose to enhance the perceptual processing of clear images of targets [70]. Neuroadaptation is related to patient age, preoperative neurosensory fusion, cognitive ability, refractive error, etc., so good postoperative visual function depends on strong neuroadaptation of the brain in addition to precise optical design of the intraocular lens.

5. Conclusion

The common goal of doctors and researchers is to find a comprehensive index to evaluate the visual quality after functional intraocular lens surgery. Only in this way can we accurately evaluate the surgical effect, thus optimizing the visual function, providing better visual quality for patients, and reducing fatigue symptoms. Continuous vision intraocular lens implantation causes little visual disturbance and yields good binocular visual function recovery, which can achieve an almost natural visual experience. It is an ideal choice for more and more cataract patients.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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