28 Accommodative Intraocular Lenses

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28.1 Introduction

One of the major challenges for ophthalmologists is the correction of presbyopia [1]. The multifactorial basis for the development of presbyopia makes it difficult to be managed adequately [1]. Till date, all surgical techniques that have been proposed for its correction are based on the induction of pseudoaccommodation in the presbyopic eye, including multifocality. While corneal procedures for presbyopia are still under a serious debate regarding their long-term outcomes and success rate, current surgical options mostly include refractive lens exchange by either monofocal IOLs for monovision or multifocal IOLs. However, none of them could achieve a complete restoration of accommodation, and multifocal lenses are frequently associated to visual symptoms that may decrease patient satisfaction. Therefore, presbyopic surgery is one of the most difficult targets that a refractive surgeon will have to deal with today and in the coming years. The real restoration of accommodation is complex, and it has been tried by the use of different, so called, "accommodative" pseudophakic intraocular lenses (AIOL). Overall, the reported results with these lenses by independent authors have been modest in relation to the restoration of the accommodative power of the eye, and these modest benefits are usually lost with time due to the long-term changes in the capsular bag.

In the current chapter, we will update the modern refractive surgeon about the fundamentals and provide updated information about the outcomes of AIOLs, by reviewing the technologies that have been tried and the ones that are proposed for the near future.

28.2 What Is an Accommodative IOL

An accommodative IOL (AIOL) is the one that is designed to simulate the mechanism of action of the human crystalline lens, which is capable of changing the dioptric power by modifying its shape after contraction of the ciliary muscle, thus provid-

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ing functional vision at different distances. In this way, an AIOL will restore the vision at difference distance in a presbyopic patient. The current options in intraocular lenses (IOL) that exist today, in order to restore the visual function in subjects with presbyopia, include several models of diffractive and refractive optics, as well as optics capable of modifying the depth of focus to provide a wide range of vision. Nevertheless, most of these optics induce photics phenomena—as halos and glare—which, in some cases, might represent a serious limitation in the quality of life of the patient or the IOL—does not provide enough vision at different distances. Therefore, an AIOL will overcome these limitations, as in theory it should have a plane optic without significant alterations in its geometry and also should provide an optimal visual acuity at different distances. Several investigators have worked in the development of an AIOL with the aforementioned characteristics; however, till date, this ideal AIOL does not exist. Different types of approaches have been tested, but unfortunately, due to poor methodology in the near vision assessment, non-independent monitorization, commercial bias, etc., the efficacy of this AIOL has not been totally approved by the scientific community.

Currently, the mechanism of action of the different types of AIOL that we have today are based on the following principles:

- Change in axial position
- Change in shape or curvature
- Change in refractive index or power

Nowadays, a controversial topic is whether an AIOL should be placed inside or outside the capsular bag [2]. The capsular bag is the basal membrane of the lens epithelium and, once it is emptied, its fibrosis and atrophy are unavoidable as it has no function to accomplish and no anatomic structure to support. Thus, the capsular bag cannot function in the long term, when it is emptied [2]. This fact has been demonstrated by a recent study performed by our group. We observed, in a primate model, that following phacoemulsification with insertion of a force/movement gauge simulating an accommodating intraocular lens, capsular fibrosis causes the disappearance of the mechanical forces detected by the in-the-bag gauges. However, the on-the-bag gauges placed at the sulcus detected stronger active forces lasting at least 5 years, although, in the long term, the contracting capsule pressure compromises its compliance [2]. Thus, considering the unavoidable atrophy of the capsular bag, which seems to be a wrong destination for an AIOL, as it has already been demonstrated by the constant failures of the AIOL models tested to date, the best suitable place for accommodative lenses should be the ciliary sulcus, where active forces from the ciliary muscle generate a movement of the IOL [2].

28.3 Types of Accommodative Intraocular Lenses

28.3.1 Crystalens

Eyeonics Crystalens (Eyeonics, Inc., Aliso Viejo, CA, USA) is manufactured from high-refractive-index silicone material containing an ultraviolet (UV) filter. To decrease the resistance of the optic to forward motion, the lens incorporates hinges

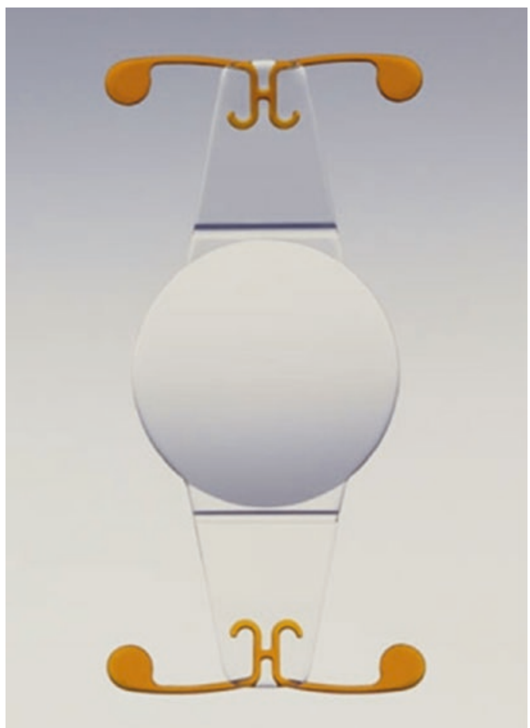

Fig. 28.1 Crystalens AIOL

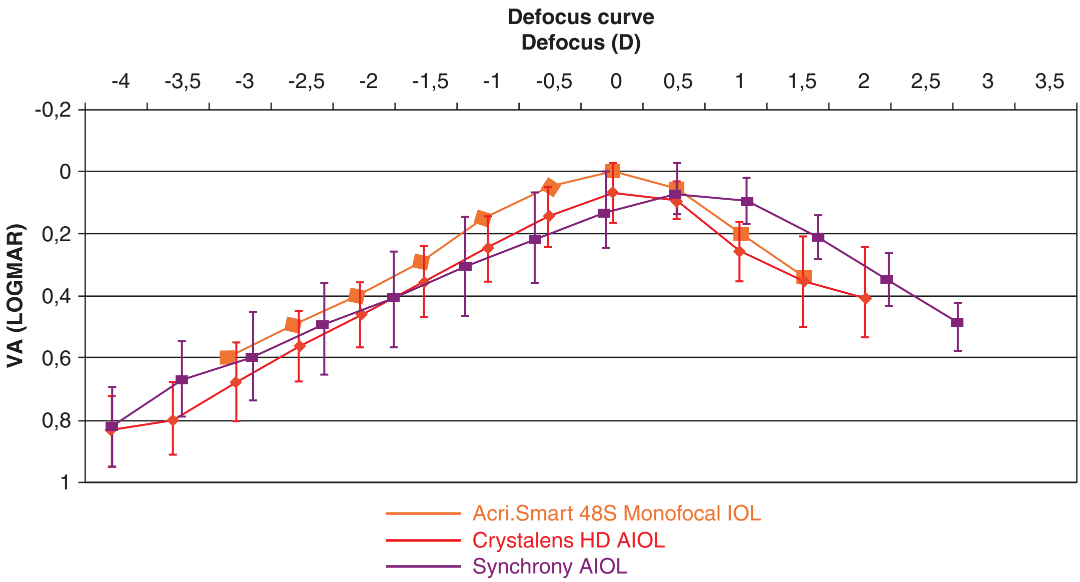

Fig. 28.2 Median defocus curve by group. The error bars represent the range associated with each median value (*VA* visual acuity, *IOL* intraocular lens, *AIOL* accommodative intraocular lens)

adjacent to the optic across the plates (Fig. 28.1). Fixation within the capsular bag is ensured by the presence of small, Tshaped haptics at the end of the plates.

There seems to be an agreement among authors that distance visual acuity results with Crystalens AIOLs do not differ from those obtained with monofocal IOLs. However, contradictory data can be found regarding intermediate and near visual acuities. Despite some authors still reporting significantly improved intermediate and near visual results in comparison with monofocal IOLs [3], the majority of them report very poor results [4–9]. Vilupuru et al. reported poor distance-corrected near visual acuity (DCNVA) results in comparison with Restor +3 D multifocal IOL (mean logMAR: 0.360 versus −0.042, respectively), obtaining slightly better results for distance-corrected intermediate visual acuity (DCIVA) (mean logMAR: 0.186) [4]. The accommodative response measured objectively using laser ray-tracing aberrometry has been reported to be lower than 0.4 D with this lens [5]. In this study, the authors also observed changes in astigmatism, spherical aberration, trefoil, and coma with accommodation in the Crystalens AIOL group, which should arise from geometrical and alignment changes in the lens with accommodative demand. Therefore, pseudoaccommodation from increased depth of focus may justify the moderate benefits for DCIVA and mild reported changes in DCNVA [6, 7]. Our group has also demonstrated in different papers the poor defocus curve shown by this type of AIOL (Fig. 28.2), whereas a multifocal IOL (Lentis-Mplus) showed significantly better visual acuities at several defocus levels. On the other hand, the Crystalens group showed better contrast sensitivity under photopic conditions at all spatial frequencies [7, 8].

28.3.2 AG Akkommodative 1CU Lens

The Akkommodative lCU lens (HumanOptics AG, Erlangen, Germany) is made of a hydrophilic acrylic material. The principle action of this lens is based on the anterior movement of the optic secondary to the ciliary muscle contraction. The haptics of the lens are modified with transmission elements at their fusion with the optic (Fig. 28.3).

The accommodative properties of this lens are very dependent on the flexibility of the capsular

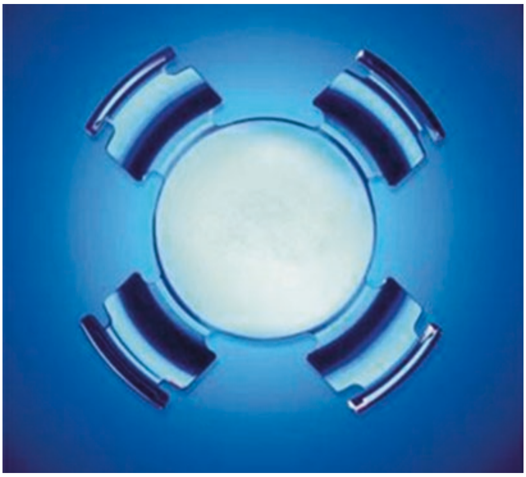

Fig. 28.3 1CU AIOL

bag, which was what made this lens fail in the long term due to the unavoidable contraction of the capsule [10]. Mastropasqua et al. reported a complete loss of the 1CU AIOL accommodative properties within 2 years (DCNVA of 8.1 Jaeger at 1 year postop) because of the high incidence and degree of anterior and posterior capsule opacification (100% of patients after 1 year), probably induced by the lens material and design themselves [10]. Other authors have found a minor improvement in the near visual function compared with monofocal lenses, but have not found any evidence of measured accommodative amplitude. Therefore, these changes are likely to be explained by pseudophakic pseudoaccommodation in a fashion similar to the Crystalens AIOL [11–14].

28.3.3 Kellen Tetraflex Accommodating Lens

The Tetraflex KH-3500 (Lenstec Inc., FL, USA) is a one-piece highly flexible hydroxyethylmethacrylate (HEMA) lens. The lens haptic was designed to take advantage of how the crystalline lens moves during accommodation according to the Helmholtz theory. It is not based on a hinge principle but rather on a haptic configuration to allow the lens to move with the entire capsular bag (Fig. 28.4).

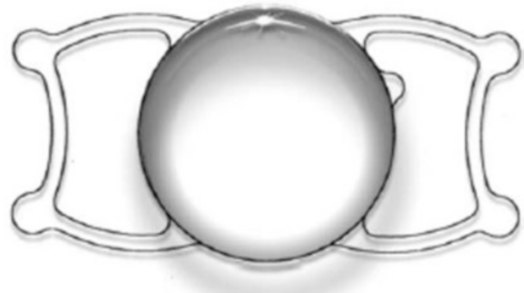

Fig. 28.4 Tetraflex AIOL

The initial sponsored publications reported good results with 75% of patients with at least 2 D of accommodative amplitude 6 months after surgery and a better near-visual function compared with the Crystalens AIOL [14, 15]. There seems to be an agreement that Tetraflex enhances near-visual function compared with monofocal IOLs, but it has been demonstrated that the Tetraflex AIOL actually is relatively fixed in position within the eye. Therefore, some of these reported benefits appear to be in relation with changes in the optical aberrations because of the flexure of the IOL on accommodative effort rather than forward movement of the lens within the capsular bag [16, 17]. Nevertheless, the results are still far from those obtained with multifocal pseudoaccommodative IOLs, and independent studies were not able to demonstrate significant differences in near and intermediate vision compared with mini-monovision with monofocal lenses or even Crystalens AIOL [18, 19]. A final concern raised with this lens was its vulnerability to the contraction of the capsular bag due to its highly flexible hydrophilic acrylic material, with a subsequent anterior flexing of the lens haptic component, requiring the exchange of the AIOL in many cases according to the authors of this report, personal experience and isolated reported case reports [20].

28.3.4 Synchrony Dual Optics IOL

Synchrony AIOL (Visiogen, Inc.) is a dual-optic silicone lens. It has two main components (anterior and posterior): each component has the gen-

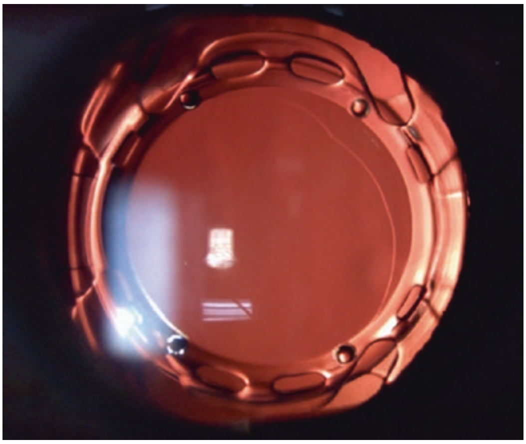

Fig. 28.5 Synchrony AIOL

eral design of a plate haptic silicone IOL, with a bridge between them with a spring function connecting the two components (Fig. 28.5). The anterior IOL component has a high plus power beyond that is required to produce emmetropia. The posterior IOL component has a minus power to return the eye to emmetropia. Once the IOL is in the capsular bag, the tension of the bag compresses the optics. During accommodation, the contraction of the ciliary body causes zonular relaxation, which releases the tension on the capsular bag and, in consequence, releases the spring that increases the interoptical distance and also the IOL power. The posterior lens is designed with a significant large area to reduce the tendency toward posterior axial excursion and to maintain stability and centration within the capsular bag at all times.

Very little evidence regarding the long-term outcomes of this AIOL by independent authors is currently available. Our group already demonstrated that although Synchrony showed significantly better visual acuities at several levels of defocus compared with Crystalens, as well or better optical quality and near visual outcomes were still limited [9].

A controversial topic is whether an AIOL should be placed inside (the classic approach) or outside the capsular bag [2]. Recently, our research team demonstrated that the capsular bag cannot function in the long term when it is empty [2]. On the other hand, the ciliary body is still active even in advanced senility, and centripetal and centrifugal forces have been demonstrated to exist in the zonular-capsular bag complex following phacoemulsification [21, 22]. In this scenario, the forces generated at the zonular-anterior capsule system are probably those to be used by AIOLs, and the sulcus location may be the ideal one for such purpose. Pallikaris et al. reported, incidentally, better near vision results in a small group of eyes (n = 3), where a Crystalens AIOL was implanted in the sulcus, after a posterior capsule rupture, compared with the fellow eye containing this AIOL within the capsular bag. This incidental finding would be justified by the optimized forces present in the sulcus [23].

28.3.5 Lumina AIOL

Lumina AIOL (AkkoLens International, Breda, The Netherlands) is designed by two optical elements, which move one over the other, aiming to change the dioptric power of the system while they change their position (Fig. 28.6). This IOL, is implanted in the ciliary sulcus, is manufactured with acrylic hydrophilic polymer material. The anterior optic provides 5 D while the posterior provides between 10 and 25 D, depending on the dioptric power needed for the patient after surgery. Each one of the optics has an internal aspheric surface, where its power increases linearly when the lens changes its position. Therefore, when the eye accommodates and the ciliary muscle contracts, the optics of the lens

Fig. 28.6 Lumina AIOL

change their longitudinal position, passing one over the other, thereby resulting in an increase of the dioptric power of the lens, focusing the light for the near distance and providing accommodation to the patient.

The IOL sizing is optimized in every patient by measuring the sulcus-to-sulcus measurement. For IOL implantation, a standard phacoemulsification cataract procedure is performed with the only difference that in this case the IOL is placed in the ciliary sulcus. The IOL can be implanted through a corneal incision between 2.8 and 3.0 mm.

Regarding the clinical outcomes with the Lumina AIOL, in a recent investigation conducted by our investigation team, a total of 61 cases were evaluated and followed during a period of 1 year in what was the first reported clinical outcomes with this type of AIOL [24]. A significant improvement was observed in both distance and near vision after AIOL implantation. In addition, when compared with a monofocal IOL, the Lumina AIOL also showed significantly better results in terms of uncorrected near and distance corrected near visual acuity . It was also found that more than 90% of those patients implanted with the Lumina AIOL showed a distance corrected near visual acuity of 0.8 in the decimal scale. Additionally, around 70% of the patients were within 1 diopter (D) of spherical equivalent. Table 28.1 summarizes the visual and refractive results found in the study.

In the aforementioned investigation, the defocus curve of the Lumina IOL group provides significantly better vision for the defocus stimulus, ranging from −4.5 D to 0.5 D than the one provided by the monofocal IOL [24].

Additionally, the level of objective accommodation evaluated with the open field autorefractor WAM-5500 (Grand Seiko, Japan) [25] for the Lumina group was statistically significantly better than the monofocal IOL group for the stimulus corresponding to −2.50, −3.00, −3.50, and −4.00 D [24].

In relation to the analysis of the contrast sensitivity function, there were no statistically significant differences ($p > 0.05$), when comparing the results from the Lumina accommodative and monofocal IOL in any of the spatial frequencies analyzed in that study [24].

Table 28.1 Comparative table showing the postoperative data of patients included in the Lumina intraocular lens group and the monofocal control group

Mean (SD) range	Lumina	Monofocal control	*P*-value
LogMAR UDVA	0.24 (0.36) −0.08 to 1.40	0.06 (0.11) −0.08 to 0.30	0.21
Sphere (D)	−0.27 (1.10) −4.75 to +2.00	+0.52 (0.81) −1.25 to +1.50	<0.01
Cylinder (D)	−1.39 (0.79) −4.25 to −0.25	−1.02 (0.60) −2.00 to 0.00	0.17
LogMAR CDVA	0.05 (0.26) −0.08 to 1.40	0.00 (0.06) −0.08 to 0.10	0.73
LogRAD UNVA	0.13 (0.14) 0.00 to 0.52	0.35 (0.16) 0.00 to 0.52	<0.01
LogRAD CDNVA	0.12 (0.20) −0.08 to 1.00	0.37 (0.18) 0.10 to 0.52	<0.01
LogRAD CNVA	0.02 (0.08) −0.08 to 0.30	0.06 (0.13) −0.08 to 0.40	0.51

SD standard deviation, *D* diopters, *UDVA* uncorrected distance visual acuity, *CDVA* corrected distance visual acuity, *UNVA* uncorrected near visual acuity, *CDNVA* corrected-distance near visual acuity, *CNVA* corrected near visual acuity, *N* number of cases

28.3.6 NuLens AIOL

The NuLens AIOL (NuLens, Ltd., Herzliya Pituah, Israel) is a complex intraocular lens that is built of the following parts: first, a polymethyl methacrylate (PMMA) haptics designed to be implanted in the ciliary sulcus; second, a PMMA anterior reference lens surface that provides correction at distance vision; third, a small chamber containing a solid silicone gel; and, lastly, a posterior piston with an aperture in the center (Fig. 28.7) [26].

The mechanism of action of the IOL works when the ciliary muscle contracts and the forces are transmitted to the piston that induces the gel

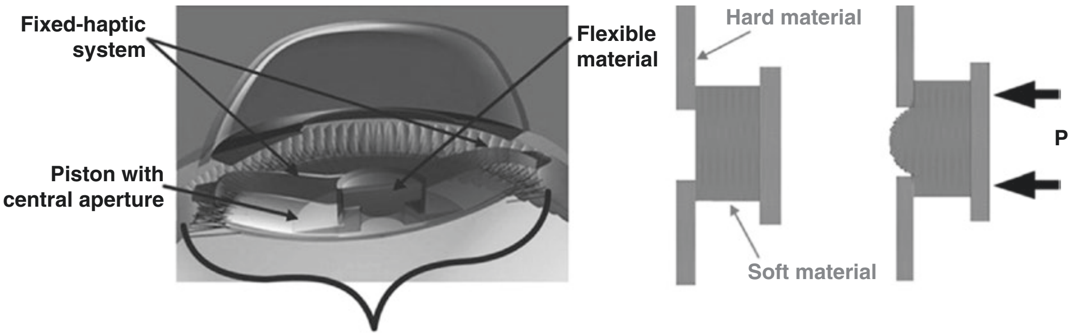

Fig. 28.7 Schematic view of the Nulens AIOL

component to bulge. The optical power of the IOL will increase depending on the magnitude of the silicone bulge due to the contraction of the ciliary muscle (Fig. 28.7) [26].

Regarding the surgical procedure, this AIOL should be implanted through a limbal incision of approximately 9 mm in length.

In relation to the clinical results after NuLens AIOL implantation, in a clinical study in which 10 patients were implanted with this lens and followed during a period of 12 months, the following outcomes were reported. It has to be noticed that in that study, all the patients were diagnosed with cataract and age macular degeneration; thus an adequate assessment of the visual acuity was limited because of the macular disease [26]. Nevertheless, regarding the uncorrected near vision, a significant increase in the mean number of Jaeger rows that the patient could read increased from preoperatively 1 line to postoperatively 3.8 lines. The mean corrected near vision also showed a slight improvement with a mean gain of 0.7 Jaeger lines [26].

In that study, movement of the IOL was assessed by means of ultrasound biomicroscopy (UBM). Specifically, cross-section movement of the IOL before and after instillation of pilocarpine was evaluated. After contraction of the ciliary muscle induced by the pilocarpine, a bulge of 200 microns in the lens was observed in comparison with the relaxed state 3 months after implantation of the IOL.

It is also worth noting that there were 2 serious adverse events observed during the follow up of this clinical trial: one posterior synechiae and a capsulorhexis edge capture by the haptic. Both adverse events were solved after a minor intervention. A large reduction of the endothelial cell count was also found at 3 months after IOL implantation that steadily stabilized over time with no significant change from the 6 to 12 months' follow-up period. Finally, there was a 60% rate of posterior capsular opacification during the follow-up period, which were successfully treated with Nd: YAG laser capsulotomy [26].

28.3.7 WIOL-CF AIOL

The Wichterle intraocular continuous focus lens (WIOL-CF) (Medicem, Kamenné Žehrovice, Czech Republic) has a polyfocal optic that could change shape during the accommodation process [27]. The mechanisms of action of these intraocular lens in order to provide vision at different distances are the following: (1) polyfocality, which gives depth of focus due to a design with a hyperbolic optic; (2) pseudoaccommodation, which provides by combining polyfocality and pupillary dynamics; and (3) accommodation, given by a change in the morphology of the lens due to ciliary body contraction that induces an increase on the thickness and a reduction of both anterior and posterior radii of the lens. The lens is built with a negatively charged hydrogel from a methacrylic copolymer with a water content of 42%. The lens has a large diameter optic of 8.6–8.9 mm with a posterior hyperbolic surface that mimics the human lens. Another feature of this AIOL is that it is designed without haptics. The

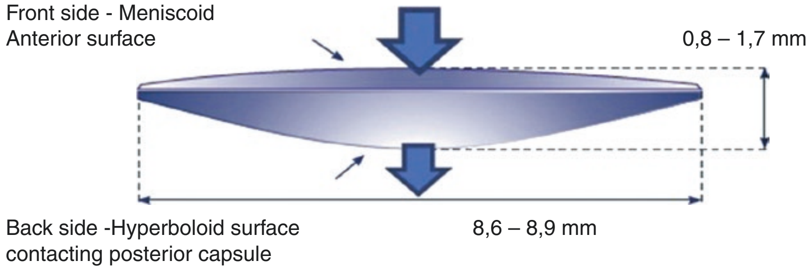

Fig. 28.8 Schematic view of the WIOL-CF AIOL

Table 28.2 Reported visual results following WIOL-CF implantation

LogMAR scale	*N*	Mean	SD
Monocular UDVA	96	0.074	0.10
Binocular UDVA	48	0.022	0.05
Monocular CDVA	96	0.047	0.12
Binocular CDVA	48	0.008	0.02
Monocular UNVA	96	0.328	0.14
Binocular UNVA	48	0.24	0.12
Monocular DCNVA	96	0.33	0.13
Binocular DCNVA	48	0.26	0.12

UDVA uncorrected distance visual acuity, *CDVA* corrected distance visual acuity, *UNVA* uncorrected near visual acuity, *DCNVA* distance corrected near visual acuity, *N* number of cases

refractive power of the lens decreases from the center to the periphery (Fig. 28.8).

Regarding the implantation during the surgical procedure, this lens can be implanted through a 2.5–2.8 mm corneal incision after standard phacoemulsification cataract surgery.

In relation to the clinical outcomes obtained with this type of AIOL in a recent multicentric study, the clinical results of patients implanted with the WIOL were evaluated during a follow-up period of 6 months [27]. In that study, 48 patients with mean age of 65 years old and bilaterally implanted with the WIOL-CF after cataract surgery were assessed.

Table 28.2 summarizes the mean uncorrected, distance corrected, and near visual acuity of patients analyzed in the aforementioned clinical investigation.

Questionnaire of satisfaction was also analyzed in that study in order to evaluate how patients developed their daily activities after being implanted with the WIOL-CF. It was found that more than 90% of the patients answered satisfied, while 8.3% of the patients were unsatisfied. With regard to the wearing of reading glasses, almost half of the population in the study, specifically 47.9% of the patients, did not use reading glasses. On the other hand, 39.6% of the patients used reading glasses occasionally, and 12.5% used reading glasses regularly. In relation to photic phenomena, 50% of the patients did not refer to any light phenomena, while 42.9% experienced either halo or glare, but were not severe. Three patients (6.2%) refer to having severe and disturbing photic phenomena [27].

28.3.8 FluidVision AIOL

This new type of AIOL (PowerVision, Inc., Belmont, CA) follows a completely new design and mechanism of action. It is composed of an acrylic hydrophobic shell filled with silicone oil (around 30 μL, depending on the desired lens power). This fluid moves between the haptic and the optic components in relation with the capsule contraction or expansion secondary to the accommodative effort, subsequently inducing a change in the curvature of the IOL optic and so a change in the optical power of the lens, theoretically leading to a real accommodation (Fig. 28.9). Thus, during accommodative effort, the capsule pushes the fluid from the haptics to the optic and in the opposite direction during disaccommodation.

Considering this mechanism of action, we can expect that this AIOL will be very vulnerable to lens capsule dynamics and capsular fibrosis. In order to minimize this problem, the haptic component of FluidVision AIOL is oversized with the objective of expanding the bag and separating the anterior and posterior capsules in order to reduce the incidence of posterior capsular opacification. One experimental study in rabbits with up to 6

Fig. 28.9 Schematic view of the FluidVision AIOL

months follow-up demonstrated not only the uveal biocompatibility of this IOL but also a significantly reduced incidence of posterior capsule opacification (PCO) compared with a hydrophobic acrylic control IOL [28].

To the best of our knowledge, there is no human clinical data published till date with this type of AIOL. On a recent review by Pepose et al., the authors state that a fifth generation of the FluidVision AIOL has recently entered multicenter clinical trials, reporting excellent corrected distance vision of around 20/20, distance-corrected intermediate vision around 20/32, and distance-corrected near vision averaging around 20/40, with an objective measurement of accommodation ranging between 1.81 D and 2.17 D (unpublished data) [29].

28.3.9 Juvene AIOL

This 2-component AIOL (LensGen, Irvine, CA) theoretically achieves accommodation using as well a mechanism based on the curvature change of a fluid-based optic in relation with the capsular forces during accommodation. This fluid optic IOL is inserted into a fixed lens with a 360° haptic and a base optic (similar to an aspheric monofocal IOL) (Fig. 28.10). In a similar fashion to FluidVision, Juvene AIOL oversized haptic tries to fill the entire volume of the capsular bag in order to minimize the incidence of PCO.

Again, to the best of our knowledge, no clinical studies have been published with this type of

Fig. 28.10 Schematic view of the Juvene AIOL

AIOL. As stated in Pepose's recent review, a pilot study with six subjects was conducted, with all patients achieving a best-corrected vision of 20/25 or better and a mean objective accommodation of 1.2 D [29].

28.3.10 Lens-Filling Accommodating IOL Techniques

Over the last years, several investigations have tried to develop a surgical technique aiming to evacuate the content of the human crystalline lens and fill it with a synthetic material that is able to compensate for the refractive error, as well as keeping the ability of changing its morphology in order to provide functional vision at different distances. Even though it seems to be a promising technology, there has been some limitations mainly related to the high incidence of posterior capsular opacification, extrusion of the material away from the capsular bag, homogenous volume of the filling material, poor quality, and poor definition of the images provided by the existing materials, among others.

Nishi et al. reported in their investigation that posterior capsular opacification can be avoided by performing a posterior circular capsulorhexis during the phacoemulsification procedure [29]. Then, a foldable disc-shaped silicone IOL with sharp edges is placed posteriorly in the capsular bag. Afterwards, a lens with accommodating capabilities is placed in an anterior position regarding the previous one. Then, a polymer of silicon is injected, which will be polymerized in around 2 hours (Fig. 28.11). Even when the characteristics of the lens and the surgical procedure seem to present some complexity, authors have shown in an animal investigation that some degree of accommodation might be achieved in primates and, therefore, the possibilities of this procedure to be used in the clinical practice.

Nowadays, the works conducted by Nishi et al. are within the few investigations that have gone deeper into the lens-filling accommodating techniques mainly because of the complexity and the limitations of the procedure. Nevertheless, it seems to be one of the more promising techniques once advance in technology and in materials design allows to overcome the aforementioned limitations and refine the surgical procedure.

28.3.11 LiquiLens

The LiquiLens (Vision Solutions Technologies, Inc., Rockville, MD) is composed of an optic which contains inside two different solutions of a specific refractive index and different density. This way, the IOL has the ability of changing the refractive power of the eye depending on the gravity and the position of the eyeglobe [29]. Therefore, when the patient is in primary position of the gaze the solution that is present in the visual axis provides a focus that allows the patient see in the distance vision. On the other hand, when the patient moves the eye to the down gaze position, the second liquid is present in the visual axis, thus allowing the patient to see in the near distance (Fig. 28.12).

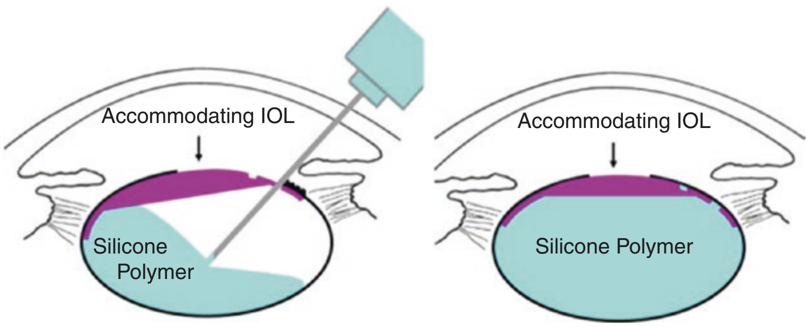

Fig. 28.11 Schematic view of the Lens Filling procedure

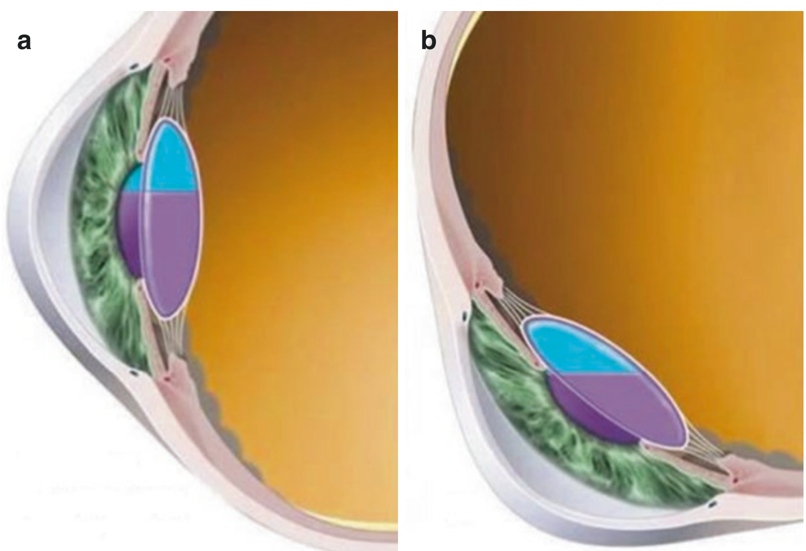

Fig. 28.12 Schematic view of the Liquilens AIOL. (**a**) Position of the lens when the patient is in primary position of the gaze. (**b**) Position of the lens when the patient is in down gaze position

Till date, this IOL is under investigation, and there is no clinical data of patients implanted with this type of AIOL.

28.3.12 Electroadaptive Accommodating IOL

The electroadaptive intraocular lens (Elenza Inc., Roanoke, VA) consists of an IOL that can be inserted through an incision between 3 and 3.5mm [30]. It contains automatic sensors that are able to respond to minimal contractions in the ciliary muscle and activate a liquid crystal plate that is located in the optic and that is responsible for changing the dioptric power of the eye (Fig. 28.13). This electroadaptive IOL has lithium ion power cells (rechargeable batteries) that may last for even 50 years. The mechanism of action of this AIOL which is independent of movement allows it to work independently of the potential limitations such as capsular contraction that can be seen with other deigns of accommodative intraocular lens [29]. Till date, this AIOL is currently under investigation and there are no clinical outcomes reported in the scientific literature.

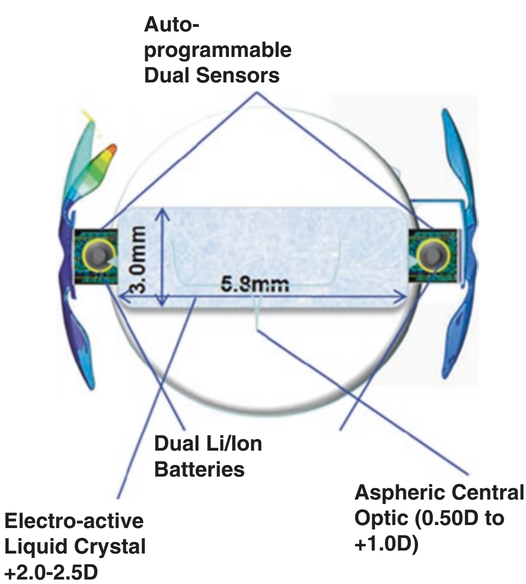

Fig. 28.13 Schematic view of the Electroadaptive IOL

28.4 Conclusions

In conclusion, we can say that even when there are several designs in accommodative intraocular lenses, most of them are still in the development process and with some contradictory clinical data regarding their efficacy. In terms of location within the eye, it seems that due to the potential limitations related to the in the bag placement of the IOL, the best scenario might be considering the ciliary sulcus plane as the best location for the lens where dynamics from the ciliary body will induce further movements of the IOL.

There are new and promising designs and technologies that will certainly find the way to achieve one of the most expected goal in ophthalmology as it is restoring accommodation.

Compliance with Ethical Requirements Alfredo Vega-Estrada, Jorge L. Alió del Barrio, and Jorge L. Alió declare that they have no conflict of interest. No human or animal studies were carried out by the authors for this article.

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