Accommodative mechanisms

Accommodating IOLs in use or development primarily employ 3 strategies to accomplish the necessary power change for near vision: a change in optic position, a change in the anterior curvature of the lens, or a change in refractive index.

As discussed earlier in the Accommodating Intraocular Lenses section, one approach is a single-optic IOL that makes use of anterior axial movement of the optic position to increase refractive power. The *Crystalens* (Bausch + Lomb; the only currently FDA-approved accommodating IOL) and *TetraflexHD* (Lenstec) employ this strategy.

Some IOLs in clinical trials or in development rely on a change in anterior curvature of the implanted lens; these lenses include FluidVision (Alcon) and Juvene (LensGen). The *FluidVision* IOL is completely hollow and filled with fluid. During accommodative effort, the capsular bag compresses and squeezes the lens. Fluid moves from the annular haptics into the body of the optic, increasing the anterior curvature and power of the lens. When the ciliary body relaxes again, the fluid moves from the optic back into the haptics, flattening the lens.

The *Juvene* IOL is a 2-piece device consisting of a larger base lens within a flexible outer silicone ring that is inserted into the capsular bag, followed by a smaller fluid-filled lens placed into the ring. Accommodative effort squeezes the silicone ring, which in turn compresses the fluid-filled lens, changing the anterior curvature of the lens and increasing its near power (Video 10-3).

VIDEO 10-3 Insertion of a Juvene intraocular lens.
Courtesy of Sumit (Sam) Garg, MD.

The *NuLens* (NuLens Ltd) relies on ciliary body contraction and relaxation to change power. The IOL consists of an anterior polymethyl methacrylate (PMMA) reference lens, a silicone gel–filled chamber, and a posterior piston. During accommodative effort, haptics placed in the sulcus generate a force that drives the piston forward; this in turn compresses the gel and pushes it through a small central aperture in the anterior PMMA portion of the lens. This changes the anterior curvature of the lens and provides near power.

The *Opira* (ForSight Vision6) and *Atia* (Atia Vision) IOLs are 2-piece modular systems that make use of ciliary body contraction to initiate power changes. The Opira is unique in that the anterior dynamic portion has haptics that straddle the edge of the capsulorrhexis (bag-in-the-lens concept), while the posterior portion provides optical power.

Other approaches

The *Sapphire* IOL (Elenza) uses an electric current to physically change the lens optics. A sensor built into the lens can detect pupil constriction as part of the accommodative reflex. An electric current is passed through the lens, altering the molecular configuration of the lens material and changing the power of the lens from distance to near. A small, wireless rechargeable battery powers the lens.

The *Harmoni* IOL (Alcon) is a modular system in which the central optic is detachable from the haptic base (Fig 10-8). Theoretically, this would allow for different types of

Figure 10-8 Example of a 2-piece modular lens (Harmoni). The central optic is detachable from the haptic base for ease of IOL exchange. *(Courtesy of Malik Kahook, MD.)*

optics to be used, including monofocal, multifocal, and toric lenses. The main advantage of this type of implant would be ease of exchange if a patient cannot tolerate a multifocal lens or if there is significant postoperative ametropia (ie, the refractive target was missed) in a monofocal lens.

Another type of lens, the *Smart IOL* (Medennium) is made from a thermoplastic acrylic gel. On insertion into the eye, the gel responds to body temperature and deforms to take the shape of the capsular bag. Theoretically, compression of this pliable lens by the capsular bag allows adjustment of its effective power in a manner analogous to the way the crystalline lens adjusts. Potential problems with this approach include difficulty in predicting the lens power that results from filling the capsular bag and uncertainty about management of posterior capsule opacification.

Alió JL, Ben-nun J, Rodríguez-Prats JL, Plaza AB. Visual and accommodative outcomes 1 year after implantation of an accommodating intraocular lens based on a new concept. *J Cataract Refract Surg*. 2009;35(10):1671–1678.

Saraiva J, Neatrour K, Waring GO IV. Emerging technology in refractive cataract surgery. *J Ophthalmol.* 2016;2016:7309283.