



# Accommodative Intraocular Lenses

Felipe Soria\* and Caterina Senn

Universidad Advenista del Plata, Argentina

\*Corresponding author: Felipe Soria, Universidad Advenista del Plata, Argentina

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## Introduction

The goal in any surgery is to maximize the normal restoration of the anatomy and physiology of the organ or tissue involved. Knowing the procedure implied in cataract or presbyopia surgery this achievement seems totally impossible. The first registry found on accommodation is dated since the year 1609 when Steiner demonstrated for the first time that accommodation is an active process [1].

Many approaches in order to achieve a functional vision for all distances as if we had again 20 years old have been proposed and studied: Multifocal glasses [2] and contact lenses [3], Multifocal Intraocular Lenses [4-18], Lasik correction for presbyopia [19-28], Scleral Ciliary Surgery [29], corneal inlays [30-32], monovision [33,34] and accommodative intraocular lenses [35,36]. In this summary a description of the accommodative intraocular lenses (AIOLs) is presented.

## Normal Accommodation

Accommodation is a dynamic process in which optical changes involves modifications in the dioptric power of the eye and provides the ability to focus at different distances [37]. With the normal physiological degradation of every cell, tissue and organ, presbyopia and lens/cataract appears as something inevitable.

No system is capable to function at 100% capacity for long time. The assumption is that using only 50% of the accommodating potential will enable comfort and prolong function of the human accommodating system Donders FC [38]. In this topic, the obvious question that arises: Is there any evidence of pseudophakic accommodation available?

The capsular bag seems to be an adequate location for AIOL's due to its unavoidable decadence and fibrosis once the crystalline lens is emptied [39]. The forces generated at the zonular anterior capsule system are those to be used for AIOL's [40]. The capsular bag is a basal membrane of the lens epithelium, once the capsular bag is emptied, there are no functions and no anatomical reasons for it to exist. The development of fibrin and atrophy is unavoidable as it has no function to accomplish and no anatomy to support [40].

## Accommodative Iols Lessons from the Past

There has been a poor methodology to study near vision: Inadequate distances, non homologated near vision charts and correct artifacts in the clinical investigation. To this we can add a commercial bias, investigator's vanity in order to assure good results and poor monitorization of the investigation. The following studies that we present are examples of what was expected of AIOL and that the conclusions are determinant in terms of functionality of this type of AIOL.

- A. Comparing two AIOLs with a monofocal IOL Both IOLs restored distance visual function after cataract surgery with limitations in near visual outcomes. Eyes with the dual-optic IOL had significantly better ocular optical quality [41].
- B. Three-Dimensional Evaluation of Accommodating Intraocular Lens Shift and Alignment in vivo Quantitative 3-D anterior segment OCT allows full evaluation of the geometry of eyes Implanted with A-IOLs preoperatively and postoperatively [42].

Three basic approaches can be take in account for the implantation of an AIOL

1. Change in axial position Single or dual optic
2. Change in shape or curvature of residual anatomy after cataract surgery [40] The structural source of kinetic energy in the capsular bag is the anterior capsule The role of the posterior capsule is possibly minimal in accommodation and null in AIOL's The generated forces might be axial or at the frontal plane (centripetal and centrifugal)
3. Change in refractive index or power

## Conditions for a new AIOL

- A. Must be independent from the capsular bag
- B. Outcomes tested by homologated opt metrical standards for near (40cm) and intermediate (70 cm) vision

- C. Accommodation should be measured by subjective and objective tests
- D. Pseudo accommodation should be identified in the outcomes
- E. Outcome proved in large, multicentric series and in long term study observation

## Conclusion

Direct competitors of AIOLs are Multifocal IOLs (MFIOLs), but we must understand that multifocality is not physiological, besides this, multifocality always will disperse light between the different foci, not using the 100% of it. Other issue is that multifocal optics will always require some degree of neuroadaptation. Over the coming years, once AIOLs are developed adequately, MFIOLs will be unable to compete, as it happened with pseudophakic glasses and IOLs. Let's wait and put our maximum effort in achieving the maximum satisfaction for patients in this new challenge as it has been during the history ophthalmology.

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