INTERNATIONAL JOURNAL OF MEDICAL AND APPLIED SCIENCES
Earthjournals Publisher
E-ISSN:2320-3137
www.earthjournals.org

Review Article

RECENT ADVANCES IN IOL.

M.Kashinatha Shenoy[1], Gopalakrishna.K[2]

1. **Associate Professor , Malabar Medical College& Research Centre, Calicut.673319 Kerala, India.**
2. **Assistant Professor, Dept of anatomy, Malabar Medical College& Research Centre, Calicut.673319 Kerala, India**

Corresponding Author: Dr. M. Kashinatha Shenoy, M.B.B.S,D.O., DNB (Ophthalmology), Associate Professor , Malabar Medical College& Research Centre, Calicut.673319 Kerala, India. Cell Phone: +91.9448501547. Phone: +91.8762734677

Abstract :Purpose of review :To review the current management and recent changes in IOL in treatment of paradigm for cataract surgery. IOL technology has evolved dramatically during recent years due to development of injectors that insert a folded IOL into the eye through a small incision. Introduction. Cataract account for approximately five per cent of blindness in Westren Europe and almost 50% of blindness, worldwide1. Currently , the only treatment for cataract is sugery .After removing lens IOL is inserted through a small incision into one of three positions;the capsular bag,the sulcus ciliaris,or less frequently anterior chamber in front of the iris.In each case , the IOL replaces the natural lens and act as a refractive medium for the visual correction of aphakia.An intraocular lens (IOL) is a lens implanted in the eye used to treat cataracts or refractive errors. The most common type of IOL is the pseudophakic IOL. These are implanted during cataract surgery, after the cloudy crystalline lens (otherwise known as a cataract) has been removed. The pseudophakic IOL replaces the original crystalline lens, and provides the light focusing function originally undertaken by the crystalline lens. The second type of IOL, more commonly known as a phakic intraocular lens (PIOL), is a lens which is placed over the existing natural lens, and is used in refractive surgery to change the eye's optical power as a treatment for myopia or nearsightedness.3IOLs usually consist of a small plastic lens with plastic side struts, called haptics, to hold the lens in place within the capsular bag inside the eye.4 IOLs were traditionally made of an inflexible material (PMMA), although this has largely been superseded by the use of flexible materials. Most IOLs fitted today are fixed monofocal lenses matched to distance vision. However, other types are available, such as multifocal IOLs which provide the patient with multiple-focused vision at far and reading distance, and adaptive IOLs which provide the patient with limited visual accommodation. Several intraocular lens (IOL) materials and types are currently available. Polymethyl methacrylate IOLs used to be the gold standard, but the inability of folding limits theiruse to selected countries and patients.. Foldable hydrophobic acrylic is the most popular material, which is also available in yellow (blue light absorbing) models and several IOL shapes. Although have very effective and safe material, water penetration producing glistenings and some dysphotopsia has been reported with some IOL types.3 Foldable hydrophilic material is widely employed in Europe, and especially for micro incision cataract surgery lenses because of its plasticity,even if rare optics opacification and higher posterior capsular opacification rates have been reported in the past. Single-piece IOLs are the most employed in modern cataract surgery, but 3-piece IOLs are preferred for sulcus implantation and in infants. The aspheric design to correct or to control spherical aberration in implanted eyes is now the rule after the problems of centration we had before the capsulorhexis era were solved. However, the optical quality of pseudophakic eyes willdepend not only on aberration control, but also on good media transparency and low light scattering.4

Keywords; pseudophakia,multifocal IOL, acrylicIOL,.siliconeIOL,.toric IOL

INTERNATIONAL JOURNAL OF MEDICAL AND APPLIED SCIENCES
Earthjournals Publisher
E-ISSN:2320-3137
www.earthjournals.org

INTRODUCTION

History.

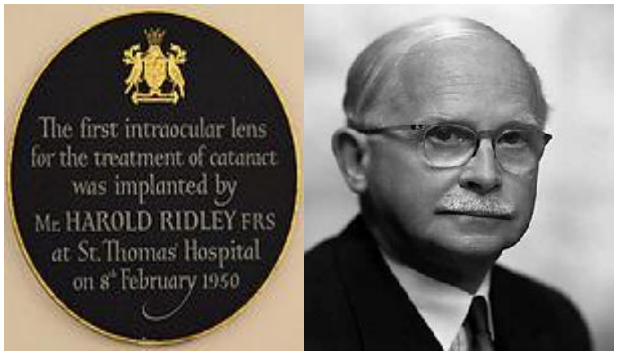


Fig No 1

Sir Harold Ridley(Fig No 1) was the first to successfully implant an intraocular lens on 29 November 1949, at St Thomas' Hospital at London. That first intraocular lens was manufactured by the Rayner company of Brighton, East Sussex, England from Perspex CQ Polymethylmethacrylate (PMMA) made by ICI (Imperial Chemical Industries). It is said the idea of implanting an intraocular lens came to him after an intern asked him why he was not replacing the lens he had removed during cataract surgery. The acrylic plastic material was chosen because Ridley noticed it was inert after seeing RAF (Royal Air Force) pilots of World War II with pieces of shattered canopies in their eyes (this acrylic resin is known by several trade names including Lucite and Plexiglas). The intraocular lens did not find widespread acceptance in cataract surgery until the 1970s, when further developments in lens design and surgical techniques had come about. By the 21st century, more than a million IOLs are implanted annually in the United States.

An intraocular lens (IOL) is a lens implanted in the eye to treat large refractive errors. IOLs usually consist of small optics with side structures, called haptics, to hold the lens in place within the capsular bag inside the eye. The most common type of IOL is inserted into the capsular bag after cataract (lens) removal and is known as ‘aphakic IOL’. The second type of IOL, more commonly known as a phakic IOL, is placed inside the eye without removing the existing natural lens, to correct large refractive errors2.

In recent years, a tendency has developed preferring foldable IOLs and especially those suitable for micro incision cataract surgery (MICS), i.e. those IOLs that can be implanted through sub-2 mm incision. These lenses are usually hydrophilic acrylic single-piece IOLs. IOL materials are defined hydrophobic or hydrophilic according to the angle a drop of water makes with respect to the material surface. The more acute this angle is, the more hydrophilic the material is defined2. Although hydrophilic lenses must be packaged immersed in normal saline, there is nothing against packaging the lenses made of hydrophobic materials wet. Every IOL is immersed in water once inside the eye.

Characteristics of an ideal IOL.

1) Provide high levels of corrected visual acuity.
2) Quickly and regain their mechanical and optical properties after injections.
3) Assume a stable position after insertion without exerting zonal stress or causing transformation of the capsular bag.
   Be associated with a relatively low risk of post operative complications such as capsule opacification and endophthalmitis.3

Classification-IOLs.

Material, Optics, Haptics, Design and Aberration3.

. Classification of IOLs

Destination= Capsular bag, ciliary sulcus, scleral fixation, iris fixation, angle supported.
Overall design= 3 piece/1 piece.
Overall length= 10–13 mm.
Optics material= Rigid (PMMA), flexible (silicone), foldable (hydrophobic acrylic, hydrophilic acrylic),Collamer.
Refraction index= 1.42–1.55.
Optics shape= Biconvex, plano-convex, meniscus.
Optics diameter= 5–7 mm.
Optics design= Spherical, aspheric, toric multifocal, multifocal toric.
Optics color =Transparent, tinted.
Haptics properties= 3 piece/1 piece (PMMA, PVDF, polyamide haptics).
Type of implantation= Injectable, not injectable.
Type of packaging= Pre-loaded, not pre-loaded.

Terminology-

1)Phakic IOLs are implanted without removal of the patient's original crystalline lens, and this is performed solely to correct refractive error in the presence of a clear crystalline lens.
2)Aphakic IOLs generally refer to lenses implanted secondarily in an eye already aphakic from previous surgery or trauma some time ago.
3)Pseudophakic IOLs refer to lenses implanted during cataract surgery, as a sequential step after removal of the cataractous lens of the patient.
Many aphakic and pseudophakic IOLs such as anterior chamber IOLs or 3 piece posterior chamber IOLs can be used interchangeably. The exception are one piece IOLs, which must be placed within the capsular bag at the time of cataract surgery and hence cannot be used as secondary implants.

MONOFOCAL LENS.

This common IOL type has been used for several decades.
Monofocals are set to provide best corrected vision at near, intermediate or far distances.Most people who choose monofocals have their IOLs set for distance vision and use reading glasses for near activities. On the other hand, a person whose IOLs were set to correct near vision would need glasses to see distant objects clearly.

Some who choose monofocals decide to have the IOL for one eye set for distance vision, and the other set for near vision, a strategy called "monovision." The brain adapts and synthesizes the information from both eyes to provide vision at intermediate distances. Often this reduces the need for reading glasses. People who regularly use computers or other digital devices may find this especially useful.

MULTIFOCAL LENSES.

These newer IOL types reduce or eliminate the need for glasses or contact lenses.
In the multifocal type, a series of focal zones or rings is designed into the IOL. Depending on where incoming light focuses through the zones, the person may be able to see both near and distant objects clearly. The ability to read and perform other tasks without glasses varies from person to person but is generally best when multifocal or accommodative IOLs are placed in both eyes3.
It usually takes 6 to 12 weeks after surgery on the second eye for the brain to adapt and vision improvement to be complete with either of these IOL types
TYPES-
1)Refractive IOL(REZOOM,AMO) are pupil dependent, with varying zones of refractive power for optical near and distance correction.The centre has an add of 3.5 D giving a additionalpower of 2.5D at the spectacle plane3,4.
2)Diffractive IOL(RESTORE, ALCON) are pupil independent with smooth anterior surface and concentric zones on the posterior surface.
Contraindication for multifocal IOL-macular degeneration,diabetic retinopathy.
Problems-glare, halos and night vision difficulties,no guarantee of freedom from spectacles.
Selection of patients-Workers requiring higher contrast, drivers, night shift workers may have problems due to poor contrast and glare. Such patients should be avoided.

Recent advances in pseudoaccommodative multifocal IOL technology offer a new alternative for those desiring vision at both distance and near. In March 2005 the ReStorapodized diffractive IOL from Alcon and the ReZoom multifocal refractive IOL from Advanced Medical Optics both received FDA approval for capsular bag implantation following cataract surgery4.

ReZoom/Re Stor Multifocal Refractive IOL

How does it work? The ReZoom IOL is a refractive, distance-dominant multifocal optic that enables good vision through a range of distances. It is an improved version of the Array multifocal IOL that received FDA approval in 1997. The ReZoom lens uses five optical zones to focus light on the retina at all pupil diameters. This enables distance-dominant vision with a near add of 3.5 D in the plane of the IOL. (A usual spectacle add is 2 to 2.5 D, but when the lens is placed closer to the retina as an IOL, it must be more powerful.) In comparison with the 4 D of near add that the ReStor IOL provides, the ReZoom IOL offers a 3.5 D near add that results in a slightly longer working distance for reading vision.
Posterior capsular opacification can disrupt the complex optical properties of both types of multifocal IOLs, and a moderate amount of opacification has the potential for causing scattering of light that could be bothersome. The ReZoom lens is made of acrylic with a sharp-edged optic design to attempt to reduce the development of capsular opacification and thus maintain proper visual acuity5.

The ReZoom IOL also attempts to reduce edge-related halos and glare, two of the more common complications of the earlier Array multifocal IOL, by using a triple-edge design. The anterior edge is rounded to reduce internal reflections, the side edge slopes to cut down on edge glare and the posterior edge is squared off to facilitate contact with the posterior capsule.

How is it used? The ReZoom is a foldable IOL designed for capsular bag placement following standard phacoemulsification cataract surgery, using a 2.8-mm posterior limbal incision centered on the axis of plus cylinder. Limbal relaxing incisions are safe, effective and predictable in the treatment of mild to moderate amounts of corneal astigmatism.

Side effects. The most common concerns for ReZoom lens recipients include distance blur and monocular diplopia, as well as glare and halos at night. Potential solutions to these side effects include correcting residual astigmatism, treating a dry eye that might be worsening these effects and using the dome light in the car during night driving. Although many patients will adapt to these effects, the occasional patient may require implant removal for severe symptoms. In order to avoid the risk of significant side effects, it is advised not to implant the ReZoom IOL in patients with significant dry eye, corneal scarring, pupil size less than 2.5 mm, a monofocal implant in the first eye, uncorrected astigmatism greater than 0.5 D or unstable capsular support6.

Patient Selection-

Proper patient selection and education is the most important factor leading to eventual success, and patients identified as potentially prone to finding negative aspects of their vision quality after surgery should be excluded.

Postsurgically, the mechanism by which both of these lenses works also makes vision degradation more apparent (than a standard IOL) when there is surface dryness, blepharitis, basement membrane dystrophy, corneal scarring, corneal edema, IOL tilt, decentration, posterior capsular opacification, macular edema, any residual refractive error or even astigmatism greater than 0.5 D.

Patient might experience with the night glare and loss of contrast, which they could perceive as reduced distance quality But second-eye surgery should be avoided until dissatisfaction with the first IOL is address.

ACCOMMODATIVE IOLs

Indications- Ideal candidates are the ones with regular astigmatism of 1.5 -2.0D.

Common IOLs being in use are by Alcon Inc and Staar Surgicals.Toric IOLs are designed to correct astigmatism.

Risks include poor vision due to the lens rotating out of position, with the possibility of further surgery to reposition or replace the IOL.The Acrysof Toric IOL has better stability , hence is the preferred.For many people, these IOL types reduce but do not eliminate the need for glasses or contact lenses. For example, a person can read without glasses, but the words appear less clear than with glasses.

Each person's success with these IOLs may depend on the size of his/her pupils and other eye health factors. People with astigmatism can go for toric IOLs and related treatments.

Side effects such as glare or halos around lights, or decreased sharpness of vision (contrast sensitivity) may occur, especially at night or in dim light. Most people adapt to and are not bothered by these effects, but those who frequently drive at night or need to focus on close-up work may be more satisfied with monofocal IOLs7.

One of the major disadvantages of conventional IOLs is that they are primarily focused for distance vision. Though patients who undergo a standard IOL implantation no longer experience clouding from cataracts, they are unable to accommodate, or change focus from near to far, far to near, and to distances in between. Accommodating IOLs interact with ciliary muscles and zonules, using hinges at both ends to "latch on" and move forward and backward inside the eye using the same mechanism as normal accommodation. These IOLs have a 4.5-mm square-edged optic and a long hinged plate design with polyimide loops at the end of the haptics. The hinges are made of an advanced silicone called BioSil that was thoroughly tested to make sure it was capable of unlimited flexing in the eye12. There are many advantages to accommodating IOLs. For instance, light comes from and is focused on a single focal point, reducing halos, glares, and other visual aberrations8. Accommodating IOLs provide excellent vision at all distances (far, intermediate, and near), project no unwanted retinal images, and produce no loss of contrast sensitivity or central system adaptation. Accommodating IOLs have the potential to eliminate or reduce the dependence on glasses after cataract surgery. For some, accommodating IOLs may be a better alternative to refractive lens exchange (RLE) and monovision13.

The FDA approved Eyeonics Inc.'s accommodating IOL, Crystalens AT-45, in November 2003. Bausch & Lomb acquired Crystalens in 2008 and introduced a newer model called Crystalens HD in 2008. Crystalens is the only FDA-approved accommodating IOL currently on the market 14and it is approved in the United States and Europe.

Intraocular lenses for correcting refractive errors.

Intraocular lenses have been used since 1999 for correcting larger errors in myopic (near-sighted), hyperopic (far-sighted), and astigmatic eyes. This type of IOL is also called phakic intraocular lens (PIOL), and the crystalline lens is not removed.

Types of PIOLs.

Phakic IOLs (PIOLs Fig No2) can be either spheric or toric. The difference is that they are placed in an eye that retains the natural human crystalline lens. As with aphakic eyes, toric PIOLs have to be aligned with the meridian of astigmatism; toric IOL misalignment or rotation can lead to residual or even greater astigmatism postoperatively4,5,8.

Depending on their placement site in the eye, PIOLs can be divided into:

1)Angle-supported PIOLs: those IOLs are placed in the anterior chamber. They are notorious for their negative impact on the corneal endothelial lining, which is vital for maintaining a healthy clear cornea.

2)Iris-supported PIOLs: this type is gaining more and more popularity. The IOL is attached by claws to the mid peripheral iris by a technique called enclavation. It is believed to have a lesser effect on corneal endothelium.

3)Sulcus-supported PIOLs: these IOLS are placed in the posterior chamber in front of the natural crystalline lens. They have special vaulting so as not to be in contact with the normal lens. The main complications with this type is their tendency to cause cataracts and/or pigment dispersion.

Two types of PIOLs have been approved by FDA. The VisianICL (Visian Implantable Collamer Lens), (FDA approved in 2004), produced by Staar Surgical Company and Artisan Myopia lens (FDA approved in 2004), produced by Ophtec USA Inc. The VisianICL is made of collamer, a biocompatible material, and the Artisan is a plastic lens.
Some of the risks that FDA have been found so far during a three-year study of the Artisan are:

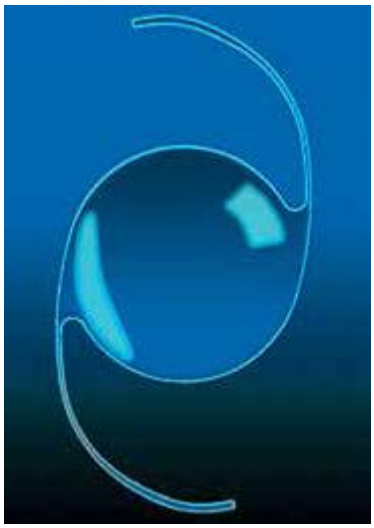
- yearly loss of 1.8% of the endothelial cells,
- 0.6% risk of retinal detachment,
- 0.6% risk of cataract (other studies have shown a risk of 0.5 – 1.0%), and
- 0.4% risk of corneal swelling.

Other risks include:

- 0.03 – 0.05% eye infection risk, which in worst case can lead to blindness. This risk exists in all eye surgery procedures, and is not unique for IOLs.
  - glaucoma.
  - astigmatism.
  - remaining near or far sightedness.
  - rotation of the lens inside the eye within one or two days after surgery.

Materials used for different IOLs.

A)Polymethyl Methacrylate
PMMA was the first material used for IOLs(Fig No3).It is a rigid, non-foldable, hydrophobic (watercontent <1%) material. The refractive index is1.49, and the usual optic diameter is 5–7 mm.PMMA IOLs are usually single piece, with fragile and low memory haptics, unless a compression molding production is employed. PMMA lenses are usually thin as the rigidity of the material balances the low refraction index8. Because of the required large incision, PMMA IOLs are seldom preferred today. They are currently used in developing countries because of the low cost, and in children given the proven long life in implanted eyes .As any material immersed in water, PMMA may be penetrated by aqueous humor some times.This will cause small vacuoles to appear within the lens optic, a phenomenon called ‘glistenings’.Glistenings are very rare with PMMA IOLs, but they have been observed, and at least on one occasion have caused optic opacification 9.



PMMA IOL of recent design.

B)Silicone(Fig No4)

Polymers of silicone and oxygen have been employe as IOL material since 1984,10 , with the purpose of implanting the IOL through an incision narrower than IOL diameter . Silicone is hydrophobic, with a contact angle with water of 99°, higher than that of hydrophobic acrylic material. Silicone IOLs must be handled dry if folder and holder forceps are employed for implantation, because it is slippery when wet. Giant cell coverage of this material is similar to that of hydrophobic acrylic IOLs. The refractive index is usually between 1.41 and 1.46, the optic diameter is 5.5–6.5 mm. Current models are 3piece, with PMMA, polyvinyl difluoride (PVDF)or polyamide haptics. Because of the low refractive index, the optics is rather thick, requiring incisions larger than 3.2 mm to implant higher powerlenses. Recently, injectors for 3-piece silicone lenses have been developed, allowing better and safer handling. However, the abrupt opening of silicone IOLs inside the anterior chamber remains a problem for surgeons. Silicone lenses have been suspected to favor bacterial adhesion, with increased risk for postoperative infection –an item never demonstrated in surgical setting11. After implantation, the anterior capsule rim opacifies quickly while the posterior capsule may remain clear for many years. Despite the low posterior capsular opacification (PCO)rate and the good resistance to Nd:YAG laser shots, silicone is less used today because it is not suitable for MICS. Recently, a two-component silicone IOL was designed, in which power can be adjusted after implantation through UV exposure. The light-adjustable lens is entering clinical practice, and the ability to correct for spherical and cylindrical errors might overcome the3.2 mm incision disadvantages12,13.We should remember that the lens capsule will never adhere to silicone, and therefore the optics will be kept in place by the haptics and by capsule coalescence. Therefore, we should refrain from implanting silicone lenses with damaged haptics,an issue unfortunately emerging only after the lens optics is inside the eye. When removing the lens, cutting the haptics will impede any extraction through small incision. Silicone can be penetrated by aqueous humor and glistenings may appear within silicone optics 14. However, the main problem with silicone IOLs is the adherence of silicone droplets in the case of silicone oil tamponade after retinal detachment repair 15. These eyes always require Nd:YAG posterior capsulotomy, and silicone droplets deposit onto the

posterior IOL surface after silicone oil removal, causing IOL explantation and exchange. For this reason, silicone material may not be preferred in highly myopic eyes that are at increased risk for posterior segment
surgery.

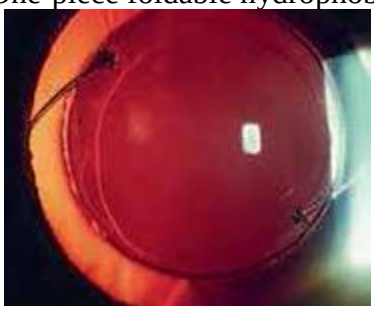
Silicone plate-haptic IOL

C)Hydrophobic Foldable Acrylic

Hydrophobic foldable acrylic materials are a series of copolymers of acrylate and methacrylate derived from rigid PMMA, with the purpose of making them foldable and durable. The typical angle of contact with water is 73°, 16. Hydrophobic foldable acrylic lenses can be folded, pushed and pulled, always regaining their original shape in a matter of seconds 17.Hydrophobic acrylic foldable lenses were introduced in 1993 with the first Acrysof 3-piecelens (Alcon, Forth Worth, Tex., USA; and have been probably the most successful IOLs there after. Hydrophobic acrylic IOLs are available in 3-piece or 1-piece designs optic diameter between 5.5 and 7.0 mm, overall length between 12 and 13 mm, transparent or yellow, with a refractive index between 1.44 and 1.55. Hydrophobic acrylic foldable lenses are easy to implant, however require at least a 2.2mmincision.Some of them can receive permanent fingerprints or scratches by implantation instruments, while others claim to be harder. As a common feature these lenses show low tendency to self-centering, and care must be taken to position them properly at implantation. In the postoperative period, they elicit low degrees of posterior capsule opacification and receive little damage from Nd:YAG laser posterior capsulotomy.

Moreover,they show little tendency to attractsiliconedropletsaftersilicone.oiltamponade,albeit hydrophilic acrylic material is still better. At the moment (2012) hydrophilic acrylic IOLs are the most popular worldwide, especially in the US because of the FDA approval. Hydrophobic foldable intraocular lenses have been associated with photopsias more frequently than other types of acrylic IOLs, an item related to low anterior curvatures and high refractive index 18,19. In addition, some of them are easily penetrated by aqueous humor, and develop glistenings in the form of water microvacuoles within the IOL optics a problem not pertaining to all hydrophobic foldable materials 20. Glistenings seem to be clinically important only when dense or with special(multifocal) design. To overcome this drawback,newmaterialshavebeenintroducedthatareprehydratedtoequilibriumandwillnotaccept furtherwater, thus avoiding the formation of glistenings. These IOLs are hydrophobic because the contact angle with water is that of hydrophobic acrylic, but are packaged in BSS to absorb the eventual 4% water content before implantation.

One-piece foldable hydrophobic acrylic IOL(Fig No4).



.

Three-piece foldable hydrophobic acrylic IOL(Fig No5).

D)Hydrophilic Foldable Acrylic

Hydrophilic acrylic materials are composed of a mixture of hydroxyl ethyl metha crylate (poly-HEMA)and hydrophilic acrylic monomer 22.Compounds specifically prepared for IOLs appeared at the end of the 1980s and under went several modifications thereafter, giving rise to a list of materials of different copolymers and water content, usually between 18 and 26%. A typical refractive index is 1.43, and some material scan be yellow tinted . Hydrophilic acrylic lenses are soft, somewhat compressible ,and have excellent biocompatibility because of their hydrophilic surface. The contact angle with water is lower than 50°. Most IOLs are single piece, and designed for capsular bag implantation with few exceptions. Hydrophilic acrylic material is the easiest to handle, with low tendency to receive scratches from instruments or damage from Nd:YAG laser shots. They can be implanted through sub-2-mm incisions and are the ideal lenses for MICS 23. . The number and shape of haptics varies widely, but these lenses are rarely found displaced if properly implanted. In the postoperative period, the induction of photopsias is low, but the PCO rate is considered to be higher than with other materials, although recent research seems to contradict this statement24.. Hydrophilic acrylic material is considered weaker than hydrophobic, with lower resistance to capsular bag contraction 25. Therefore, they may not be preferred when high contraction forces are anticipated, as in some eyes with pseudoexfoliation. The main concern with hydrophilic acrylic lenses is optic opacification due to calcium deposits,a rare event that led to IOL exchange in a number of patients . In the past, this calcification has been associated with certain IOL types and/or certain viscoelastic substances, but its mechanism is still unclear 26, 27. Hydrophilic IOLs are very popular in

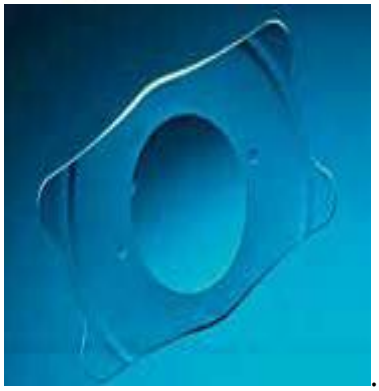
Europe because of the easy handling, the sub-2-mm implantation, the low risk for capsular bag damage during implantation, and the improving results with PCO.

Foldable hydrophilic acrylic IOL.(Fig No 6).

Foldable hydrophilic acrylic microincision IOL(Fig No 7).

E)Collamer

Collamer is the name of the material used exclusively in making STAAR®9 Fig No 8) Company phakic and aphakic lenses, including the Visian ICL..The name comes from the combination of 'collagen 'and 'polymer'. IOLs made of Collamer are highly biocompatible, and easy to implant because of the softness of the material and the gentle unfolding27. Water content is very high, at about 40%, which makes this material very soft and also suitable for aphakic IOLs. The collagen in the Collamer attracts fibronectin, a substance found naturally in the eye. A layer of fibronectin forms around the lens, inhibiting white cell adhesion to the len This coating prevents the lens from being identified as a foreign object, and the lens remains unnoticed and 'quiet in the eye' indefinitely.



FUTURE-

Blue Light- Filtering IOLs- AcrySof Natural filters both ultraviolet (UV) and high-energy blue light.Blue light,which ranges from 400nmto 500 nm in the visible spectrum, may cause retinal damage and play a role in the onset of age related macular degeneration. 3,4,5.

.

Piggyback IOLs- the option of inserting an additional lens over the the top of the one you have currently.This can improve vision and may be considered safer than removing and replacing the existing lens.4,5.

Eclipse IOL-a new photochromic IOL is a one –piece hydrophobic acrylic IOL incorporating a pigment with with photochromic propertis.This pigment is made up of two substructures connected together by a spiro-carbon bond.Upon exposure to ultraviolet light, the spiro carbon bond breaks followed by the appearance of alarge co-planer molecule that absorbs apart of the blue-coloured rays.As aresult, the lens is activated and turns yellow, with an absorption curve compareable to that of a 53 –old human crystalline lens.28.

Tele-IOL-An implantable miniature telescope(IMT) can provide useful visual function in selected patients with end stage of age- related macular degeneration.(AMD).The IMT is the most advanced medical device so far to be implanted inside the eye forAMD patients missing their central vision. Once implanted , the device magnifies images, which are projected onto the healthy area of the retina not affected by AMD. Contra indicated in active retinal disease, retinal detachment, high myopia, evidence of low endothelial count<1600cells/mm2, as well as stroke or dementia.28.

CONCLUSIONS

The development of preloaded injectors that insert a folded IOL into the eye through a small incision has led to significant improvements in the speed , reliability, reprodcibility, safety and cost – effectiveness of cataract operations, IOL should provide high level of corrected visual acuvity. More ever, they should be associated with a relatively risk of infection and postoperative complications, and have a low propensity glistenings and general deterioration over time.

New technology, which now includes presbyopia treatment at additional patient expense, will continue to raise the bar of expectation for patients as cataract surgery with IOL implantation continues to be recognized as one of the most successful surgical procedures medicine has to offer.

Acknowledgements:
All authors would like to thank the department staff and managements of their respective institutions who cooperated in the above article. Authors wish to clarify that they have not received any financial support or funding from any commercial sources.

Conflict of interest:

There is no conflict of interest to be declared.

REFERENCES;

1)World Health Organization;Global initiative for the elimination of avoidable blindnesss; action plan 2006-2011.

2)Alio, Rodriguez.Advances in microincision cataract surgery intraocular lens.Cur Opin Ophthalmol2006;17;80-93.

3)TognettoD,et all.Analysis of the optical quality of intraocular lenses.Invest Ophthalmol Vis Sci 2004;45 2682-90

4)Martinez Palmer A et all.Visual function with bilateral implantation of monofocal and multifocal intraocular lense; a prospective, randomized, controlled trial.J Refract Surg 2008;24;257-64.

5)Hutz WWet all.Intermediate vision and reading speed with arry,Tecnis and ReSTOR intraocular lenses.J Refract Surg 2008;24,251-6.

6) Güell, Jose Luis; Morral, Merce; Kook, Daniel; Kohnen, Thomas (2010). "Phakic intraocular lenses". *Journal of Cataract & Refractive Surgery* 36 (11): 1976. .

7) Sanders, Donald; Vukich, John A (2006). "Comparison of Implantable Collamer Lens (ICL) and Laser-assisted in Situ Keratomileusis (LASIK) for Low Myopia". *Cornea* 25 (10): 1139–46. .

8) Gaudet, Jodie ed. 1001 Inventions That Changed the World, page 697.

9) Barsam A, Allan BD (2012). "Excimer laser refractive surgery versus phakic intraocular lenses for the correction of moderate to high myopia". *Cochrane Database of Systematic Reviews* (1) .

10) Belluci R. An Introduction to Intraocular Lenses: Material, Optics, Haptics, Design and Aberration. In: Güell JL (ed): Cataract. ESASO Course Series. Basel, Karger, 2013, vol 3, pp 38–55.

11) Myron Yanoff, Jay S. Duker (2009). *Ophthalmology* (3rd ed. ed.). Mosby Elsevier. .

12) Slade, Stephen. "Accommodating IOLs: Design, Technique, Results." Review of Ophthalmology. 2005. 20 Mar 2009.

13) "Crystalens Accommodating IOL." USA Eyes. 2008. Council of Refractive Surgery Quality Assurance. 20 March 2009. < http://www.usaeyes.org/lasik/faq/crystalens-2.

14) Marilyn Haddrill. "Crystalens & Accommodating Intraocular Lenses for Cataract Surgery". *All About Vision*. Retrieved 2010-05-11.

15) United States Food and Drug Administration. Center for Devices and Radiological Health (CDRH). Crystalens Model AT-45 Accommodating IOL P030002. New Device Approval. CDRH Consumer Information. Updated 21 Jan 2004. http://web.archive.org/http://fda.gov/cdrh/mda/docs/p030002.html

16) Cummings et al. "Clinical evaluation of the Crystalens AT-45 accommodating interocular lens Results of the U.S. Food and Drug Administration clinical trial. J Cataract Refract Surg. 2006 May; 32(5): 812–25.

17) Pepose JS, Qazi MA, Davies J, Doane JF, Loden JC, Sivalingham V, Mahmoud AM. Visual performance of patients with bilateral vs combination Crystalens, ReZoom, and ReSTOR intraocular lens implants. Am J Ophthalmol. 2007 Sep: 144 (3) 347–357.

18) Macsai et al. Visual outcomes after accommodating intraocular lens implantation. J Cataract Refract Surg. 2006 Apr; 32(4): 628–33

19) Sanders DR, Sanders ML. Visual performance results after Tetraflex accommodating intraocular lens implantation. Ophthalmology. 2007;114:1679–1684

20)Glasser, Adrian. "Restoration of accommodation." Current Opinion in Ophthalmology. 2006 Feb;17(1):12-8.

21)Mahootchi, Ahad. "What Happens During a Crystalens Procedure?". The Eye Clinic of Florida. Retrieved 23 July 2014.

22) Paul Koch (September 2005). "An Exercise Program for Crystalens Patients: How to use word search games to help crystalens patients". *Ophthalmology Management*. Retrieved 2010-05-11.

23) Alpins, Noel; JK Ong; G Stamatelatos (2012). "New method of quantifying corneal topographic astigmatism that corresponds with manifest refractive cylinder". *Journal of cataract and refractive surgery* 38 (11): 1978–1988.

24) Ngoei, Enette (February 2013). "Refractive editor's corner of the world: CorT'ing accuracy". *EyeWorld*. Retrieved 22 April 2013.
25) Biro, A (25 November 2012). "New measurement method quantifies corneal astigmatism". *Ocular surgery news. US edition*. Retrieved 22 April 2013.
26) "Getting more from topography". *EuroTimes India*. 4 March 2013. Retrieved 22 April 2013.
27)Guell jl(ed);Cataract.ESASO Course Series. Basel Karger, 2013, vol3, pp38-55.
28).Euro Times sept2014/Vol19Issue9.