Techniques of Intraocular Lens Fixation in the Absence of Capsular/Zonular Support

Essay

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Abstract

There are many techniques for IOL implantation. The two main procedures are insertion of an anterior chamber IOL (ACIOL) and insertion of a posterior chamber IOL (PCIOL). The ACIOLs can be inserted via angle-supported ACIOL or iris-fixated ACIOL techniques. Insertion of PCIOLs can be accomplished iris-supported PCIOL, or transsclerally sutured PCIOL. Anterior chamber intraocular lens has a stable track record and is the first surgical option that comes to our mind while dealing with a patient having a compromised capsule-zonular integrity.

Key word: HCL-ZONULAR-IOL-PCIOL-ECCE-ACIOL

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Dalia Mohamed fawzy Mohamed

List of contents

Table of Abbreviations

Abbreviation	Stands for
AC	Anterior chamber
ACIOL	Anterior chamber intraocular lens
ATPase	Adenosine triphosphatase
BSS	Balanced salt solution
CME	Cystoid macular edema
CTRs	Capsular tension rings
CTS	Capsular Tension Segment
ECCE	Extra capsular cataract extraction
ECD	Endothelial cell density
G- needle	Gauge needle
HCL	Hydrochloric acid
HCTR	Henderson Capsular Tension Ring
HPMC	Hydroxy propyl methyl cellulose
ICCE	Intra capsular cataract extraction
IOL	Intra ocular lens
IOP	Intra ocular pressure
m-CTRs	Modified Capsular Tension Rings
µm	Micrometer
Mm	Millimeter
Nd:YAG	Neodymium-doped yttrium aluminium garnet
OVD	Ophthalmic Viscosurgical device
PC	Posterior chamber
PCIOL	Posterior chamber intra ocular lens
PEX	Pseudoexfoliation
PMMA	Poly methyl methacrylate
UGH	Uveitis glaucoma hyphema syndrome

List of Figures

Introduction:

The lens has three main parts: the lens capsule, the lens epithelium, and the lens fibers. The elasticity of the capsule causes the lens to assume a more globular shape when not under the tension of the zonular fibers, which connect the lens capsule to the ciliary body. The capsule varies from 2-28 micrometers in thickness, being thickest near the equator and thinnest near the posterior pole **(Forrester et al., 1996).**

It is supported by the zonules which arise as multiple fine fibrils from the pars plana and also have attachment to the ciliary processes **(Blumenthal et al., 1991).**

Although the lens may be traumatized by many forces like physical, electrical, thermal or chemical, yet the main causes of compromised capsular and zonular support comes from the direct contusions or penetrating objects. Blunt trauma has been reported as a cause of posterior capsular rupture as shockwaves passing through the eye may rupture the lens capsule **(Rao et al., 1998)**.

Deformation of the eye with equatorial expansion can cause a breach in the lens capsule. Tears in such injuries have an oval or circular configuration in the central posterior capsule and similarly can stretch and cause zonular dehiscence **(Vajpayee et al., 2001).**

Penetrating injuries to the eye may cause direct capsular rupture **(Vajpayee et al., 1994).**

Fresh tears are less fibrosed than older ones which may lead to their expansion during the surgery with increased risk of vitreous loss which will make a posterior capsular intraocular lens (PCIOL) implantation difficult as there is no enough capsule to support the lens either in the capsular bag or the ciliary sulcus **(Vajpayee et al., 2001).**

Complicated Extracapsular cataract surgery may lead to a compromise in the capsular support. This may be due to the direct surgical trauma or pre-existing anomalies such as a posterior polar cataract. For example, in large incision extra capsular cataract extraction (ECCE), manual expression of the nucleus is performed by pressing the globe and increasing the intravitreal pressure. The whole lens in pushed with the zonules and in case the capsular incision is small or the nucleus is too big, this force may lead to zonular dehiscence **(Blumenthal et al., 1991).**

There are some cases with congenital weakness of the zonules and may lead to ectopia lentis such as Marfan syndrome, familial or idiopathic ectopia lentis and homocystinuria. Fortunately, these conditions have a low prevalence **(Neely and Plager, 2001).**

Other causes of weakness of lens zonules include chronic uveitis, mature cataract, infantile glaucoma with buphthalmos and high myopia **(Bleckmann et al., 1990).**

Implantation of intraocular lens has become the standard of care in aphakic state. The lens is best placed in the capsular bag, which affords stable fixation at a position closest to the nodal point of the eye. If the IOL is implanted as a secondary procedure, even in presence of capsular support, mostly sulcus fixation has to be resorted to. In absence of any capsular remnants, the options available are anterior chamber lenses, iris fixated lenses and scleral fixated posterior chamber lenses **(Por and Lavin, 2005).**

Aim of work:

The aim of this work is to describe the various methods to allow intraocular lens implantation in absence of capsular or zonular support stressing on the techniques involved, advantages, disadvantages, complications and results of each technique.

Anatomy of the lens

Position, size, and shape

The lens is a part of the anterior segment of the eye. Anterior to the lens is the iris, which regulates the amount of light entering into the eye. The lens is suspended in place by the zonular fibers, which attach to the lens near its equatorial line and connect the lens to the ciliary body. Posterior to the lens is the vitreous body, which, along with the aqueous humor on the anterior surface, bathes the lens. The lens has an ellipsoid, biconvex shape. The anterior surface is less curved than the posterior surface (Figure 1). In the adult, the lens is typically 10 mm in diameter and has an axial length of about 4 mm, though it is important to note that the size and shape can change due to accommodation and because the lens continues to grow throughout a person's lifetime **(Forester et al., 1996).**

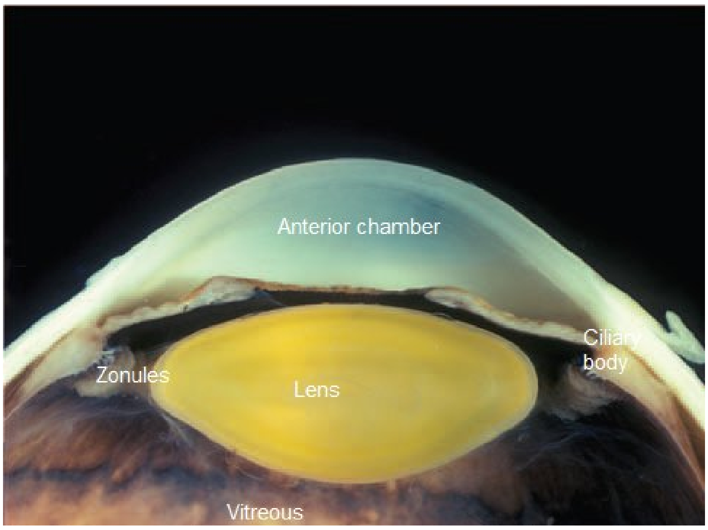


Figure 1: The anatomical features of the anterior segment are easily recognized. Note that formalin fixation leads to opacification of those tissues (cornea, lens, zonules, and vitreous) which are normally transparent **(Sehu and Weng, 2005)**.

Lens structure and function:

The lens has three main parts: the lens capsule, the lens epithelium, and the lens fibers. The lens capsule forms the outermost layer of the lens and the lens fibers form the bulk of the interior of the lens. The cells of the lens epithelium, located between the lens capsule and the outermost layer of lens fibers, are found only on the anterior side of the lens till the equators (Figure 2) **(Forester et al., 1996)**.

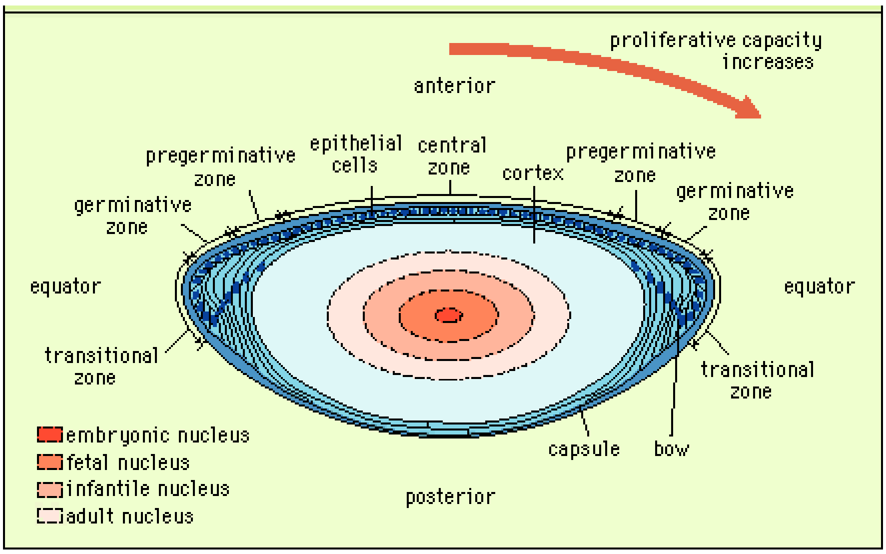


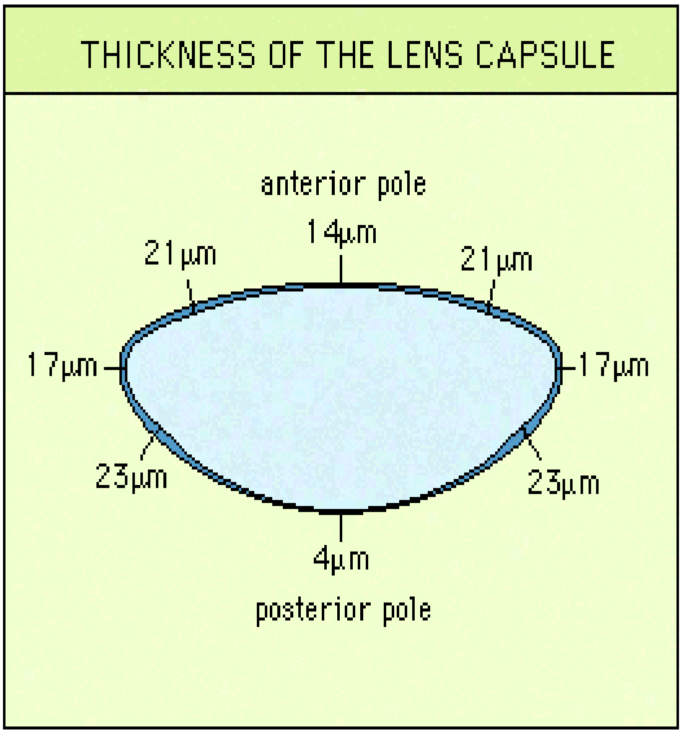
Figure 2: Gross anatomy of the adult human lens **(Forester et al., 1996).**

Lens capsule:

The lens capsule is a smooth, transparent basement membrane that completely surrounds the lens. The capsule is elastic and is composed of collagen. It is synthesized by the lens epithelium and its main components are Type IV collagen and sulfated glycosaminoglycans **(Forester et al., 1996)**.

The capsule is very elastic and so causes the lens to assume a more globular shape when not under the tension of the zonular fibers, which connect the lens capsule to the ciliary body. The capsule varies from 2-28 micrometers in thickness, being thickest near the equator and thinnest near the posterior pole **(Forester et al., 1996)**.

The capsule completely envelopes the lens and is unique in that its cells of origin are completely contained by it. The capsule is the basement membrane of the lens epithelium and is the thickest basement membrane in the body (Figure 3). It is much thicker in the front than behind and the posterior portions are thicker towards the periphery just within the attachment of the suspensory ligament than at the pole **(Bron et al., 1997)**.



Figures3: Changes in thickness of the adult lens capsule with location **(Olivero and Furcht, 1996).**

Lens epithelium:

The cells of the lens epithelium regulate most of the homeostatic functions of the lens ,As ions, nutrients, and liquid enter the lens from the aqueous humor, Na+/K+ ATPase (adenosine triphosphatase) pumps in the lens epithelial cells pump ions out of the lens to maintain appropriate lens osmolarity and volume, with equatorially positioned lens epithelium cells contributing most to this current. The activity of the Na+/K+ ATPases keeps water and current flowing through the lens from the poles and exiting through the equatorial regions **(Candia, 2004).**

The epithelium consists of single sheet of cuboidal cells spread over the front of the lens deep to the capsule and extending outward towards the equator **(Bron et al., 1997).**

Lens fibers:

The lens fibers form the bulk of the lens. They are long, thin, transparent cells, firmly packed, with diameters typically between 4-7 micrometers and lengths of up to 12 mm long **(Forester et al., 1996)**.

The lens fibers are laid down in concentric layers, the outermost of which lie in the cortex of the lens and the innermost in the core or the nucleus, the division between the cortex and the nucleus of the lens may be taken to be the junction between fetal and post natal lens fibers. The lens fibers are strap like or spindle shaped cells which arch over the lens in concentric layers from front to back **(Bron et al., 1997).**