Complications During and After Cataract Surgery

A Guide to Surgical Management

Ulrich Spandau
Gabor Scharioth

Springer

Complications During and After Cataract Surgery

Ulrich Spandau • Gabor Scharioth

Complications During and After Cataract Surgery

A Guide to Surgical Management

Springer

Ulrich Spandau
Department of Ophthalmology
Uppsala University Hospital
Uppsala
Sweden

Gabor Scharioth
Aurelios Augenzentrum
Recklinghausen
Germany

Department of Ophthalmology
University of Szeged
Korányi
Szeged
Germany

Videos to this book can be accessed at http://www.springerimages.com/videos/978-3-642-54448-4

ISBN 978-3-642-54448-4 ISBN 978-3-642-54449-1 (eBook)
DOI 10.1007/978-3-642-54449-1
Springer Heidelberg New York Dordrecht London

Library of Congress Control Number: 2014943915

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

How to manage a posterior capsule rupture? How to operate a dropped nucleus? What to do with a subluxated IOL? If you are seeking answers to these questions, then you found the right book. In this book, these questions and many, many more will be answered.

Here, the operations are described like in a cookbook – first the ingredients and then the step-by-step preparations. These steps are illustrated with many pictures and drawings, followed by several surgical videos.

In my opinion, there are three parameters that make a good surgeon. They are surgical skill, experience, and mastery of different surgical techniques.

The outstanding quality of the modern phaco and vitrectomy machines is a blessing and curse at the same time – blessing because these machines manage over 90 % of all cases and curse because you rely too much on the machines and too little on your hands. As a complete cataract surgeon, you need to be able to perform an ECCE in case of zonular lysis or a rock-hard nucleus, implant an iris-fixated or intrascleral-fixated IOL, or manage a posterior capsule defect without trauma and function loss.

The book is divided into two main parts. The first part describes complication management with the use of a phacoemulsification machine, and the second part describes complication management requiring a vitrectomy machine. We try to solve as many complications as possible with the phaco machine. We will in addition demonstrate a trocar technique which increases the surgical spectrum of a cataract surgeon immensely.

Every surgeon is afraid of complications. This book takes the cataract surgeon's fear of complications by giving him a clear scheme in his hand after which he must proceed. Complications cannot be avoided, but you can learn to master them. And at the same time, you will also become a better surgeon.

I wish you much fun in the OR!

Uppsala, Sweden — Ulrich Spandau
Recklinghausen, Germany — Gabor Scharioth

Abbreviations

ECCE	Extracapsular cataract extraction
G	Gauge
I/A	Irrigation and aspiration
ICCE	Intracapsular cataract extraction
IOL	Intraocular lens
PCO	Posterior capsular opacification
PFCL	Perfluorocarbon liquid
PPV	Pars plana vitrectomy
PVD	Posterior vitreous detachment
SICS	Small incision cataract surgery

Contents

Part I

Complication Management Using a Phacoemulsification Machine

Basics

1

Contents

U. Spandau, G. Scharioth, *Complications During and After Cataract Surgery*,
DOI 10.1007/978-3-642-54449-1_1, © Springer-Verlag Berlin Heidelberg 2014

1.1 Difficulty of Cataract Surgery in Relation to Density of Nucleus

The difficulty of a cataract surgery depends on several factors. One important factor is the density of the nucleus.

A soft nucleus (Fig. 1.1) consists of an almost homogeneous soft nucleus and epinucleus. The cataract is approximately 50 years old. A typical indication is a refractive lens exchange. The surgery is rather difficult. The nucleus is difficult to crack because it is so soft.

A medium hard nucleus (Fig. 1.2) consists of a hard nucleus and a soft epinucleus. The age of the patient is approximately 70 years. This cataract is rather easy to operate because the nucleus is easy to crack and the soft epinucleus serves as a scaffold for the posterior capsule.

A hard nucleus (Fig. 1.3) consists of a hard nucleus and hard epinucleus. The lens is completely mature, i.e. nucleus and epinucleus are one hard mass and cannot be separated from each other. The cataract is approximately 90 years old. The difficulty of this surgery is very high. The hard nucleus requires a high phacoemulsification energy, which may cause damage to the endothelium. Grooving is difficult because the red reflex is weak and because the epinucleus is as hard as the nucleus. Cracking is difficult because you need to crack the nucleus and the epinucleus. Removal of the quadrants is difficult because the soft epinucleus as scaffold is missing. In addition, the floppy posterior capsule may easily be aspirated into the phaco tip and be damaged.

1.2 Difficulty of Cataract Surgery in Relation to Other Factors

Patient Selection: There are difficult patients with easy eyes, and there are easy patients with difficult eyes. It is impossible to say, which is worse.

What is a *difficult patient*? Spinal deformities, mental and motor restlessness and especially claustrophobia.

What is a *difficult eye*? Deep set eye, prominent brow, nystagmus, corneal opacities, small pupil, hard nucleus and especially phacodonesis due to zonular lysis.

An *easy patient* is relaxed, normal weight and approximately 70 years old. An *easy eye* is exophthalmic with a deep anterior chamber and a moderate cataract.

Try to select in the beginning *easy patients with easy eyes*.

1.3 Anatomy of Different IOL Implantation Sites

It is difficult for a beginning ophthalmologist to know and see the difference between an in-the-bag and a sulcus implantation. In the bag is the space between anterior capsule and posterior capsule. Sulcus is the space between iris and anterior capsule. The IOL is always implanted in the bag. But if a posterior capsular rent is present, the IOL is implanted into the sulcus.

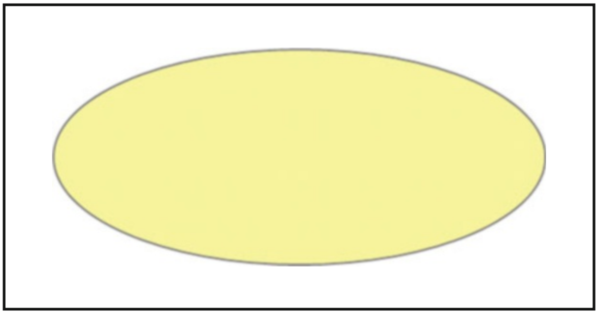


Fig. 1.1 A soft nucleus. Nucleus and epinucleus are homogeneously soft. Not too easy to operate

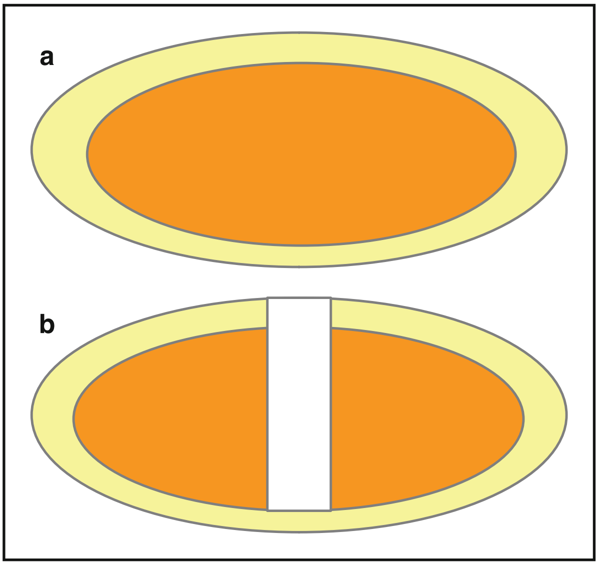


Fig. 1.2 Medium hard nucleus. (**a**) The nucleus is hard but the epinucleus is soft. (**b**) After cracking of the hard nucleus, the soft epinucleus remains as a scaffold for the posterior capsule. Good eye for a beginner

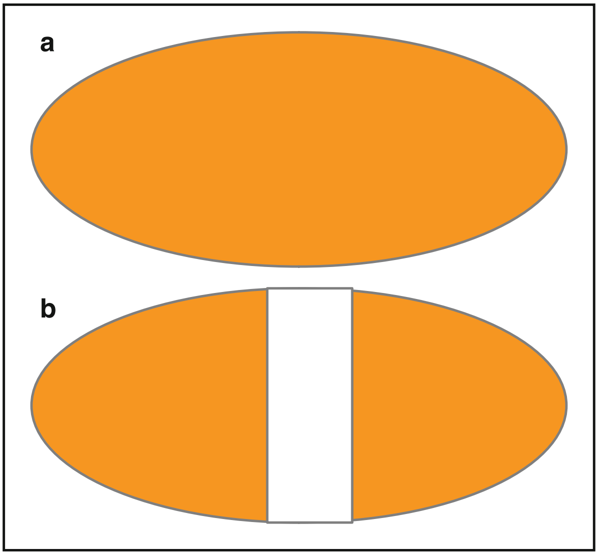


Fig. 1.3 Hard nucleus. (**a**) Nucleus and epinucleus are homogeneously hard. An epinucleus is practically not existent. (**b**) After cracking of the nucleus and epinucleus, the risk to damage the posterior capsule is high. There is no epinucleus left to protect the posterior capsule. Difficult to operate

The anterior lens capsule undergoes a fibrosis and phimosis reaction after a cataract operation (Fig. 1.4). During the contractive reaction of the phimosis, the optic may move before the edge of the rhexis. The reason for this is the rhexis size. If the rhexis has a regular size, then the optic will not move out of the rhexis. If the rhexis is too large, then the optic can flip before the rhexis. In most cases only one part of the optic flips before the rhexis. The haptics however do not flip out of the capsular bag. Exceptions are special lenses with unusual haptics.

Examine an operated eye for these features. Observe the capsular fibrosis of the rhexis and check if it is located anterior or posterior to the optic edge (Fig. 1.4). The anterior capsular fibrosis may be completely (360°) located before the IOL (Fig. 1.4) or only partially (Fig. 1.5). The latter can be often seen. In this case, the right side of the rhexis flipped behind the IOL under the phimosis reaction of the anterior capsule. In case of a posterior capsule rupture, the lens is implanted in the sulcus. In this case the anterior capsule is located behind the IOL (Fig. 1.6). If the IOL is implanted in the sulcus, it is possible to flip or buttonhole the optic behind the rhexis edge (lens capture) (Fig. 1.7). The lens is now centred and a stable IOL-lens capsule diaphragm is obtained.

If the IOL is decentred (subluxated), then observe if the lens capsule is also subluxated or not (Figs. 1.8 and 1.9). If the IOL was implanted into the sulcus, then it may happen that the IOL is decentred and the (anterior) lens capsule is centred (Fig. 1.8). If the IOL was implanted into the lens capsule, it may occur that the lens capsule with the IOL subluxated later due to zonular lysis (Fig. 1.9).

What Anatomic Requirements Are There for an IOL Implantation?

1. In-the-bag implantation (Fig. 1.10)
   Requirement: Intact (posterior) capsular bag and intact zonules. A rift in the anterior capsule is acceptable. A rift in the posterior capsule is not acceptable. A round rhexis in the posterior capsule is however no problem.
2. In the sulcus implantation (Fig. 1.11)
   The sulcus is located between the iris and the anterior capsule. Requirement: Intact *anterior* capsule and intact zonules. A rift in the anterior capsule is not acceptable (with a few exceptions).
3. Scleral fixation (Fig. 1.12)
   Requirement: No capsular bag required.
4. Iris fixation (Figs. 1.13, 1.14 and 1.15)
   Requirement: Intact iris tissue, no capsular bag required.

The decisive anatomic tissue for secondary IOL implantations is the lens capsule and especially the anterior capsule. From this perspective, there are two IOL implantation groups:

1. Intact lens capsule: In-the-bag or sulcus implantation.
   Defect posterior capsule but intact anterior capsule: Sulcus implantation.
2. No lens capsule: Anterior chamber IOL, scleral-fixated IOL, iris-fixated IOL implantation.

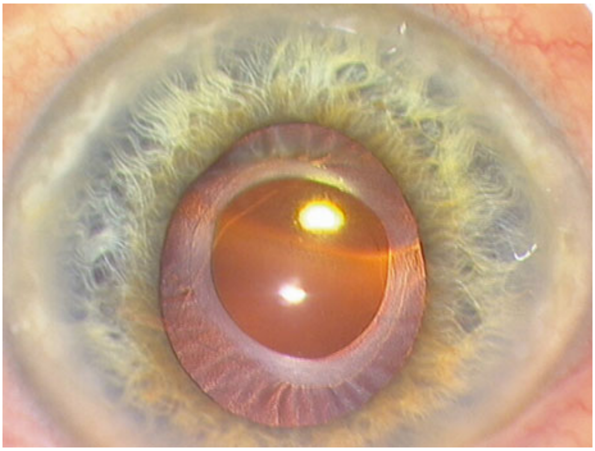


Fig. 1.4 A regular in-the-bag implantation. The anterior capsule underwent a fibrosis and a phimosis. The anterior capsule is located 360° anterior to the IOL

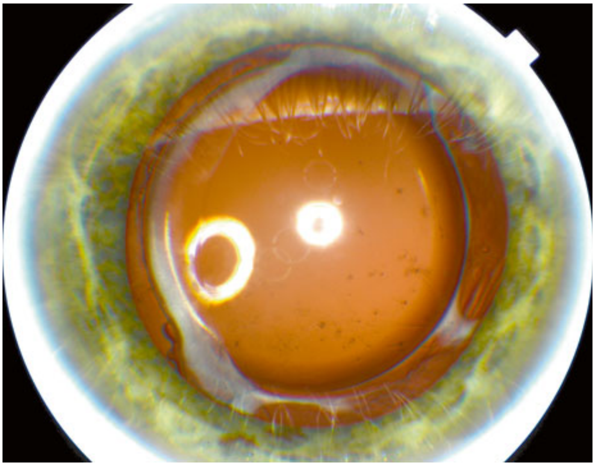


Fig. 1.5 Right eye: A regular in-the-bag implantation. The left part of the rhexis is located behind the IOL, the haptics at 1 o'clock and 7 o'clock are behind the rhexis, but the right part of the rhexis is located behind the IOL. The reason for this is that the right part of the rhexis flipped behind the IOL during the phimosis reaction

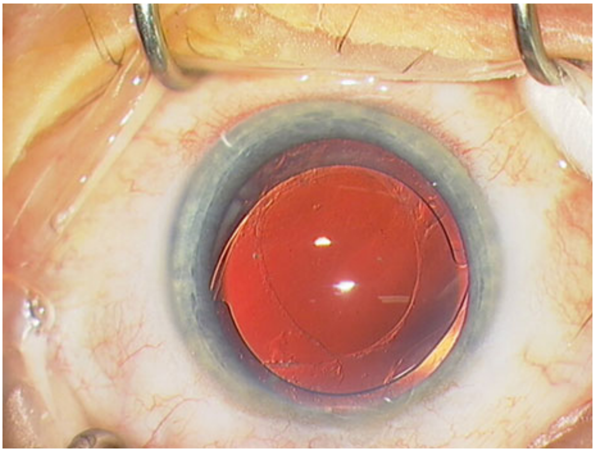


Fig. 1.6 This IOL is located in the sulcus. The sulcus is the space between iris and anterior capsule. The anterior capsule is located behind the IOL. Both, the haptics and the optic, are located before the anterior capsule. The lens and the posterior capsule were damaged due to a trauma, and a sulcus implantation was performed

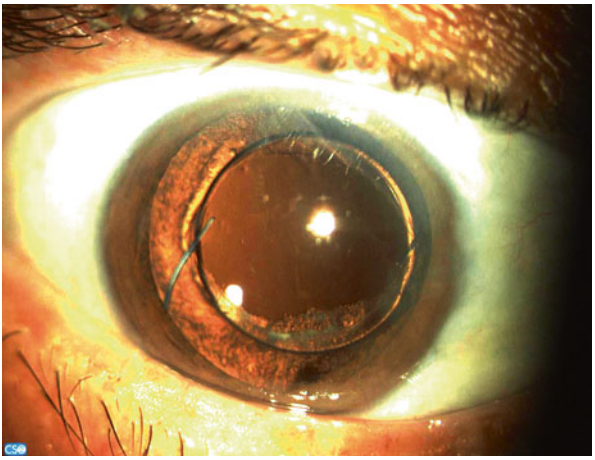


Fig. 1.7 This is a special case of a sulcus IOL: An IOL with lens capture. The optic is located behind the anterior capsule (behind the rhexis), but the haptics are located before the anterior capsule (sulcus). Typical is an oval form of the anterior capsule. The posterior capsule is damaged, and the IOL was fixated inside the rhexis in order to centre the IOL

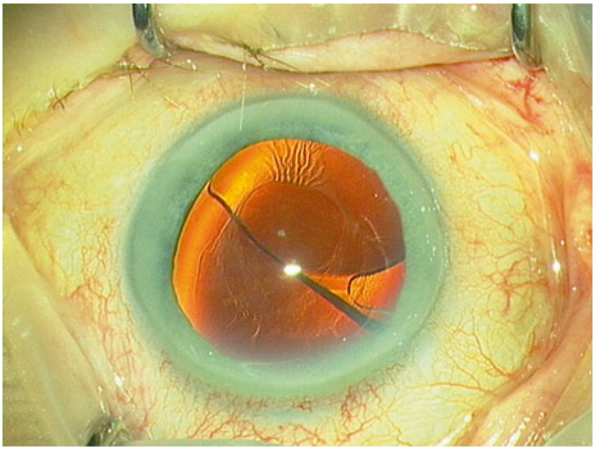


Fig. 1.8 Subluxated IOL. Only the IOL is subluxated; the anterior lens capsule is intact and centred. The IOL can be repositioned in the sulcus

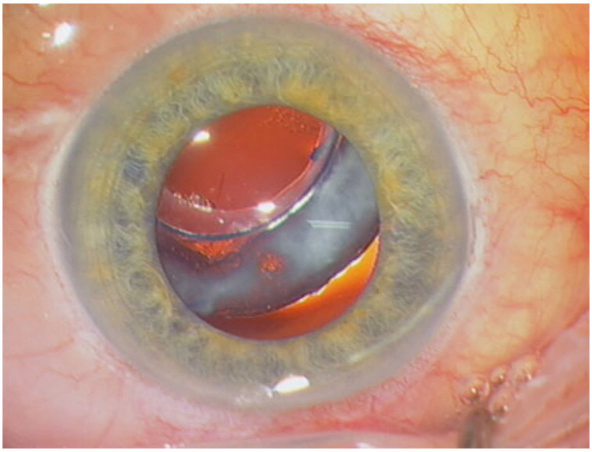


Fig. 1.9 Subluxated bag-IOL complex. The lens capsule with the IOL is subluxated due to zonular lysis. The IOL cannot be repositioned in the sulcus. A scleral or iris fixation is necessary

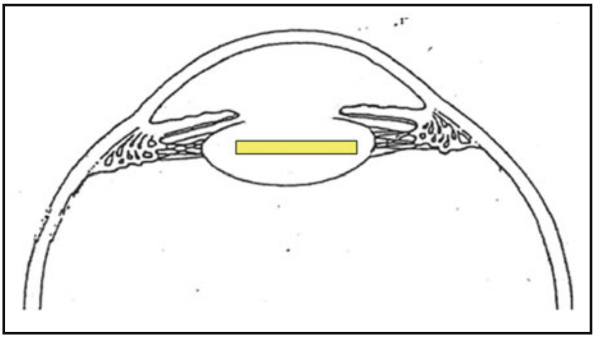


Fig. 1.10 Drawing of the anatomy of a regular in-the-bag implantation

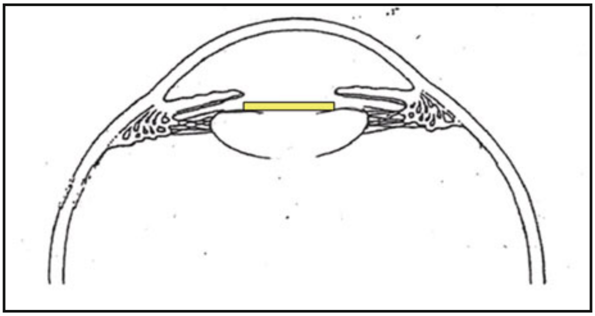


Fig. 1.11 Drawing of the anatomy of a sulcus-fixated IOL. The IOL is located between the iris and the anterior capsule

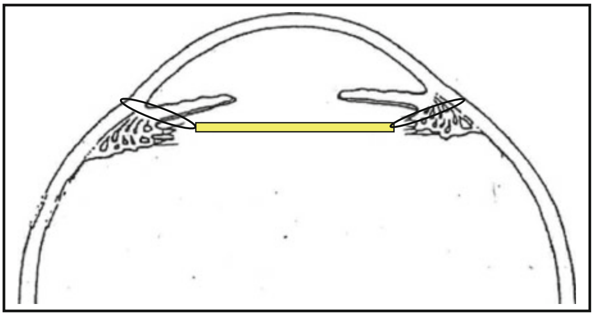


Fig. 1.12 Drawing of the anatomy of a scleral-fixated IOL. The lens capsule is absent

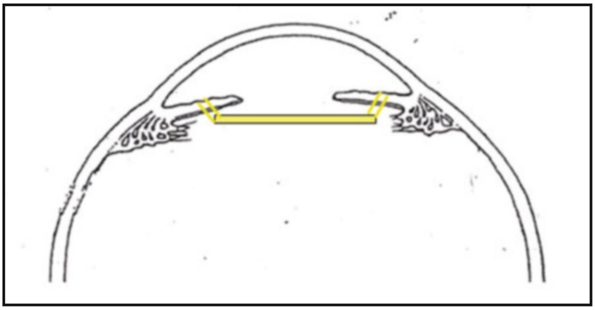


Fig. 1.13 Drawing of the anatomy of an iris-fixated IOL (retropupillar). The lens capsule is absent

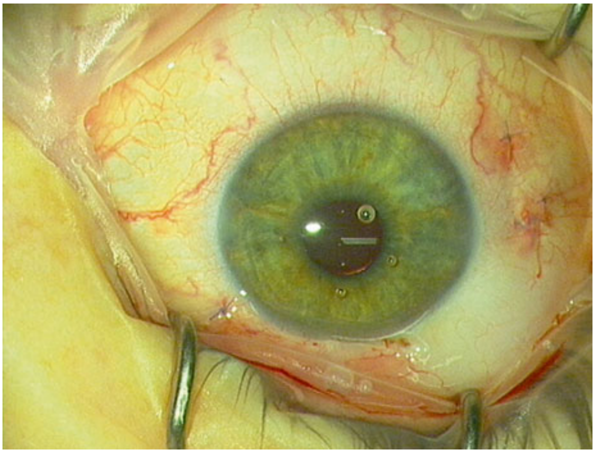


Fig. 1.14 An eye with a retropupillar implanted iris-fixated iris-claw IOL. Observe the enclaved iris tissue at 3 o'clock and 9 o'clock. The two iris claws are located here

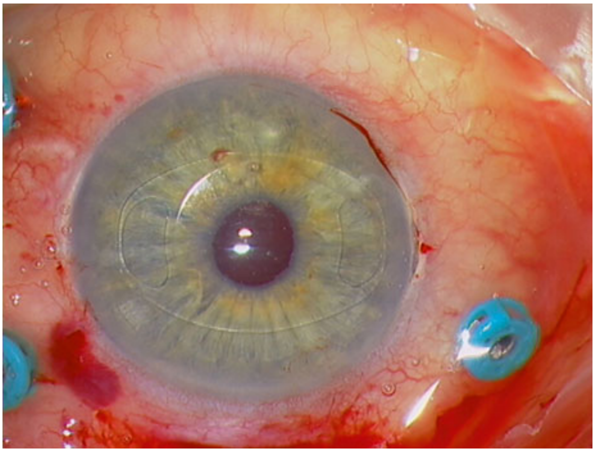


Fig. 1.15 A phakic eye with an antepupillar implanted iris-claw IOL. An iridectomy is necessary

1.4 Small-Gauge Vitrectomy

The word “vitrectomy” is composed from the Latin and Greek and literally means “vitreous cutting” (vitreous-ek-tomy). Vitrectomy was developed by German-born Robert Machemer at the University Eye Hospital in Miami. He performed the first experiments in 1969 with eggs.

In the 1970s, 20-gauge vitrectomy has evolved as the worldwide standard for vitreoretinal surgery (Fig. 1.16). All instruments have a lumen diameter (inside diameter) of 0.9 mm. For this procedure, the conjunctiva is opened, three sclerotomies are placed and the infusion cannula is sutured to the sclera. Trocar cannulas are not used, and at the end of the surgery, the sclerotomies are sutured.

In 2002, 25-gauge vitrectomy was introduced. The instruments have a lumen diameter of 0.5 mm. Trocars (cannulas) were used for the infusion and the instruments (Figs. 1.17 and 1.18). The trocars were inserted transconjunctivally and transsclerally and remained in place during the entire surgery without the need for suturing them to the sclera. A major advantage of this new technique was the reduced anterior segment trauma during the procedure, because the conjunctiva is not opened and the instruments are smaller.

In 2004, 23-gauge vitrectomy with a lumen diameter of 0.65 mm was developed at the Eye Clinic Frankfurt- Höchst by Claus Eckardt (Figs. 1.19 and 1.20). A new incision technique was developed: The sclerotomies are performed in a lamellar fashion (tunnel technique), which results in a better postoperative wound closure and less postoperative hypotony (Fig. 1.21).

The most recent development is 27-gauge vitrectomy. The instruments have a diameter of only 0.4 mm. The indication spectrum is not yet fully tested. Possible indications are, for example, vitreous opacities, peeling surgeries, or a central vitrectomy in the newborn.

In this book, we demonstrate only 23-G and 25-G vitrectomy. The main features are:

1. *Lamellar and sutureless sclerotomies*
   The sclerotomies are performed with a tangential incision (lamellar tunnel incision), i.e. the sclerotomy is self-sealing and does not require suturing (Fig. 1.21).
2. *Trocar cannulas*
   A trocar is a metal or plastic cannula, which is placed transconjunctivally in the sclerotomy (Figs. 1.17 and 1.18). Most trocars have a valve at the top that prevents fluid escaping from the trocar. The trocars are not sutured and remain in the sclerotomy during the entire surgery. The advantages of the trocar system are faster postoperative recovery, rapid visual rehabilitation, less foreign body sensation and low corneal astigmatism. The disadvantages are postoperative hypotony and transconjunctival vitreous prolapse (“vitreous wick”) with the subsequent risk of endophthalmitis.

Pros and Cons of 23-G and 25-G Vitrectomy: 25G causes less postoperative hypotony; 25G is therefore better for aphakic eyes. 25G requires never a suture but 23G requires sometimes a suture. 23G is of course more “powerful” than 25G because the lumen is larger; vitrectomy or fluid-air exchanges are faster with 23G than with 25G.

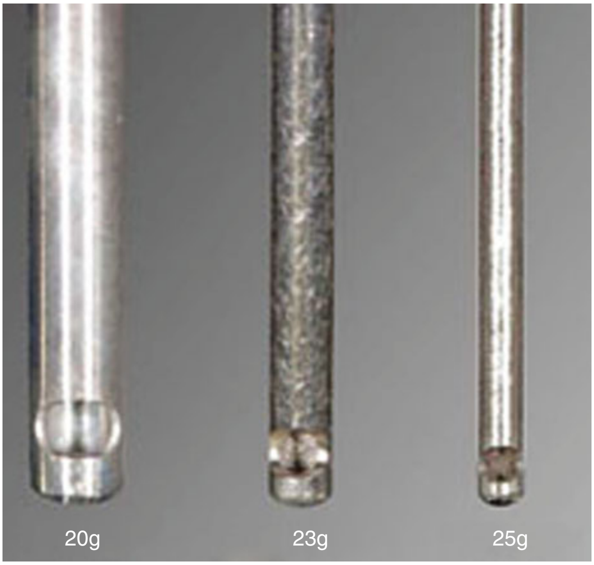


Fig. 1.16 Three vitreous cutters with different gauge sizes. 20G has a lumen diameter of 0.9 mm, 23G of 0.65 mm and 25G of 0.5 mm, respectively

Fig. 1.17 A trocar with a blue valve and the inserter. The inserter is removed after insertion of the trocar in the sclera

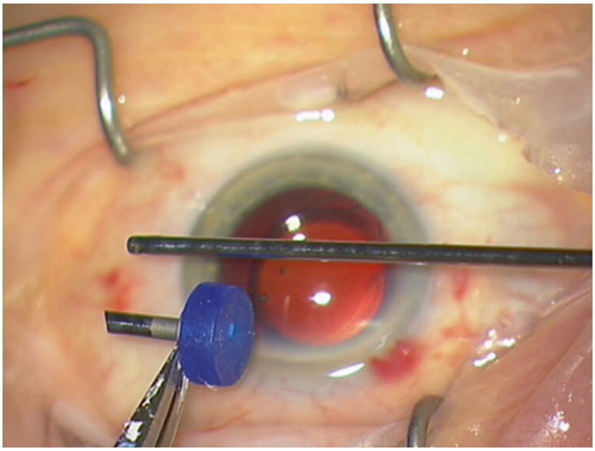


Fig. 1.18 A trocar with a blue valve and a vitreous cutter

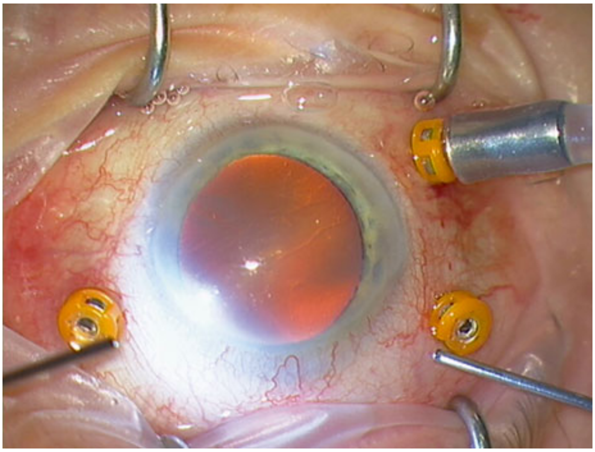


Fig. 1.19 A regular 3-port vitrectomy with 23-gauge valves. The inferotemporal trocar (*upper right*) holds the infusion line and the superior trocars are instrument trocars. The left hand holds a light pipe; the right hand holds a vitreous cutter

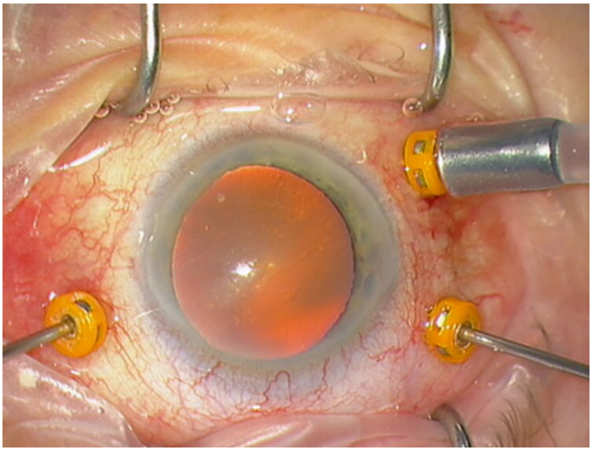


Fig. 1.20 The light pipe and the vitreous cutter are inserted in the instrument trocars. To visualise the retina, a BIOM has to be flipped in or a contact lens placed on the cornea

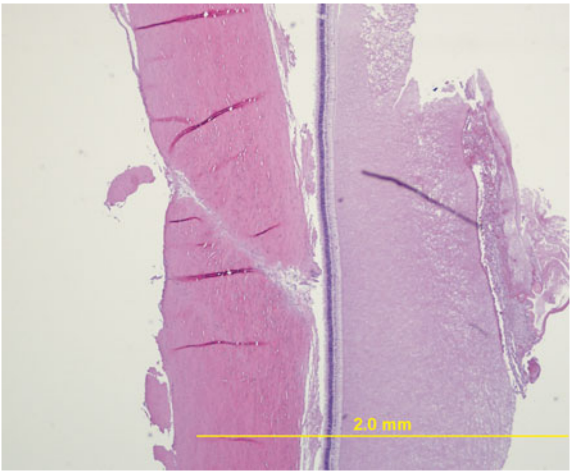


Fig. 1.21 A histology section showing the sclera at the left side and the retina at the right side. The sclera shows a lamellar (diagonal) sclerotomy. A lamellar sclerotomy allows a tight closure of the sclerotomy

1.5 SICS: The Modified ECCE

If the nucleus is too hard for phacoemulsification, you can remove the nucleus easier and with less trauma with the SICS technique. The SICS technique (small incision cataract surgery) is an evolution of ECCE. The main characteristic of a SICS technique is a self-sealing scleral tunnel wound (frown incision) where the entire nucleus is extracted. The "small" in the abbreviation relates to the "small" scleral incision being relatively smaller than an ECCE, although it is still markedly larger than a phaco tunnel. The SICS technique is nowadays the standard surgical technique for cataract surgery in Africa and rural parts of Asia.

In short, the surgical technique is as follows: A large rhexis is performed and the nucleus is luxated into the anterior chamber. Then an 8-mm-wide frown incision is dissected (scleral corneal incision) and the nucleus extracted with a "fish hook" (Fig. 1.22). After I/A, a 3-piece IOL is implanted.

This technique is very useful in case of a hard nucleus or zonular lysis. See Sects. 4.6 and 7.2.

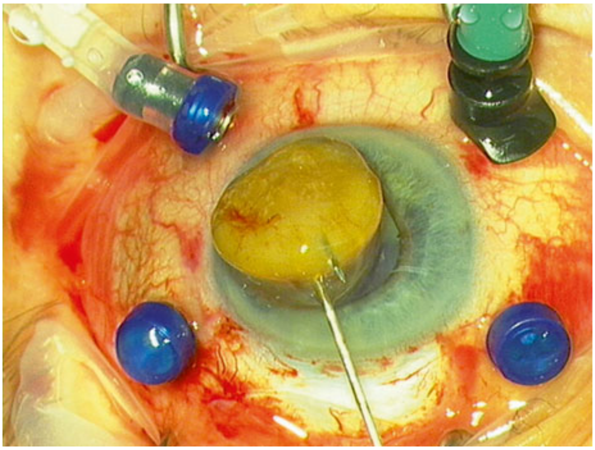


Fig. 1.22 SICS technique: The rockhard nucleus is removed with a "fish hook". At 12 o'clock an 8 mm broad frown incision was performed

Equipment

2

Contents

2.1 Devices

Phacoemulsification Machine

The modern phacoemulsification machines have an excellent phaco mode and a weaker vitrectomy mode. In most cases the vitreous cutter is 20-G and the cutting frequency 500 cuts/min. In a modern vitrectomy machine, the cutting frequency is ten times higher.

A vitreous prolapse after a posterior capsular defect is usually removed with a vitreous cutter from the limbus. The disadvantage of this technique is that it is not possible to remove the complete anterior vitreous because the iris and the lens capsule are in the way.

We will describe an anterior vitrectomy from pars plana, which can be performed with a phaco machine. A trocar is inserted through the sclera and then the anterior vitreous is removed from pars plana through the trocar. This method functions with a 20-G vitreous cutter as well as with a 23-G vitreous cutter. The infusion is at its usual place in the anterior chamber through the paracentesis.

The phaco machine from Alcon (Infinity) allows after installation of a pump the use of a 23-G vitreous cutter. This results in a much higher cut rate of 2,500 cuts/min and a smaller vitreous cutter. In addition, this 23-G vitreous cutter fits through a paracentesis, whereas a regular 20-G vitreous cutter only fits through the main incision.

But posteriorly dislocated nuclei or intraocular lenses can only be operated with a vitrectomy machine and a BIOM (= visualisation device).

U. Spandau, G. Scharioth, *Complications During and After Cataract Surgery*,
DOI 10.1007/978-3-642-54449-1_2, © Springer-Verlag Berlin Heidelberg 2014

Vitrectomy Machine

For some of the complications that are described in this book, you need a vitrectomy machine. For the extraction of a dropped nucleus, you require a fragmatome (=endo-phacoemulsification handpiece) which can only be used with a vitrectomy machine.

The new generation of vitrectomy machines such as the Constellation of Alcon, Stellaris PC of Bausch & Lomb and Eva of DORC have an excellent phaco function and an outstanding vitrectomy function. The average cutting rate is 5,000–7,500 cuts/min (Fig. 2.1). This is technically possible because high-speed vitreous cutters cut with a high flow rate (fluidics) in the central vitreous (i.e. vitreous cutter port is fully open) and with a low flow rate in the periphery (i.e. the vitreous cutter port is minimally open).

All vitrectomy machines have an integrated light source. Some devices have in addition an internal laser module.

Binocular Indirect Ophthalmo Microscope (BIOM) Systems

To obtain a sufficient view of the posterior segment, one needs either a plano-concave contact lens which is directly placed onto the cornea or a highly refractive lens (60D, 90D, 120D) which is placed in front of the lens of the surgical microscope comparable to indirect ophthalmoscopes. This results in an inverted image. By flicking a reversal system (so-called inverter) into the parallel beam path of the operating microscope, an upright image is created (Fig. 2.2). The inverter has to be turned on or off every time one switches between anterior segment and posterior segment view. It is useful to integrate the inverter function in the foot pedal of the surgical microscope.

We have experience with the BIOM system (Binocular Indirect Ophthalmic Microscope) of Oculus, the RESIGHT system from Zeiss and the EIBOS system from Moeller-Wedel (Figs. 2.2, 2.3 and 2.4).

All systems offer excellent optical images with a variety of different magnifications and fields of view. Based on our personal experience, the BIOM and the RESIGHT offer more flexibility and a better view of the retinal periphery. The EIBOS system is extremely robust and has the additional advantage of a built-in inverter that avoids the need for manual inversion when changing from the posterior segment to the anterior segment view during the surgery (Fig. 2.3).

The RESIGHT (Zeiss) system contains two fixated lenses (128D and 60D) that can be rotated into the light beam (Fig. 2.4). The handling is easy.

The Oculus BIOM system comes with different types of lenses: 120D for a wide peripheral view, 90D as a standard lens for most applications and a 60D high magnification lens for macular surgery. We recommend as a standard lens the wide-angle lens (WiFi HD), which comprises of a very good resolution and a peripheral vision. The BIOM requires a longer learning phase.

As lens I recommend regardless of the provider a wide-angle lens between 120 and 132D. This lens is sufficient for all operations described in this book.

Fig. 2.1 A high-speed vitreous cutter for vitrectomy machines allowing a cutting frequency of 5,000–8,000 cuts/min. A vitreous cutter used for phacoemulsification machines enables a cut frequency of only 500–800 cuts/min

Fig. 2.2 The BIOM system from Oculus can be used with all microscopes. The BIOM system requires some learning time, the lens change is easy

2.2 Standard Instruments for Anterior Segment Procedures

It is essential to know about a broad variety of ophthalmic instruments. Especially if you operate outside the routine cataract procedure, you may need other instruments – in case of a complication or a secondary IOL implantation. The most common instruments used in anterior segment procedures are listed here (Figs. 2.3–2.29). Special instruments are listed separately in the surgical chapters.

Fig. 2.3 The EIBOS system from Leica, which can be used with Leica and Möller-Wedel microscopes

Fig. 2.4 The RESIGHT system from Zeiss can be only used with Zeiss microscopes

Knives

Fig. 2.5 15º knife. Indication: Paracentesis. Alcon. 8065921501

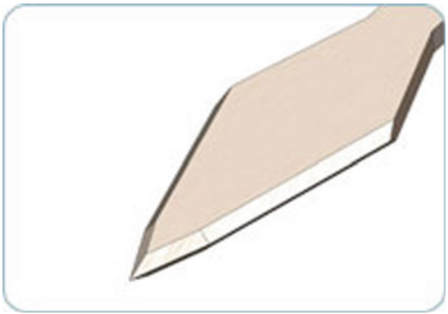


Fig. 2.6 Tunnel incision knife, 2.4-mm wide. Indication: Main incision. Slit knife. Alcon. 8065992445

Fig. 2.7 Crescent bevel up blade. Indication: Dissection of a frown incision. Crescent-angled bevel up. Alcon. 8065990002

Fig. 2.8 V-lance. 1.3-mm-wide scleral and corneal diameter. Indication: Paracentesis and 20-G sclerotomy. 20-G V-lance. Alcon. 8065912001

Forceps

Fig. 2.9 Capsulorhexis forceps. Geuder No.: 31299 or 31308

Fig. 2.10 Fragment forceps. Fragment forceps Gaskin. Geuder, No: 31624; fragment forceps Kelman-McPherson, G-31623, Gaskin fragment forceps to Kansas. B & L. E-2030

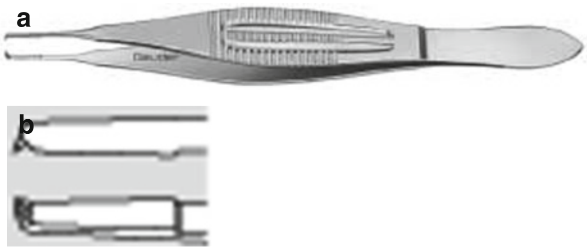


Fig. 2.11 (**a**, **b**) Suturing forceps. Indication: Manipulation of suture or iris retractor. Castroviejo suturing forceps, Geuder, 19023

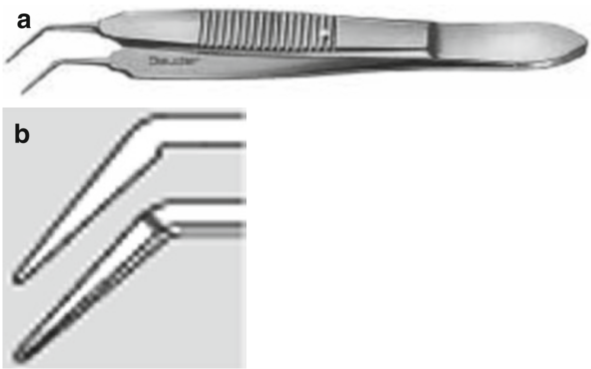


Fig. 2.12 (**a**, **b**) Tying forceps. Indication: Manipulation of suture or iris retractor. Tying forceps, Geuder, 19032

Fig. 2.13 Intravitreal serrated jaws forceps. 23G. Indication: Grasping of tissue in anterior or posterior chamber. DORC: 1286.C06

Manipulators

Fig. 2.14 Sinskey hook. Indication: Manipulation of IOL. Geuder: 16167

Fig. 2.15 (**a**, **b**) Push-pull after Dardenne or after Kuglen. Indication: Manipulation of IOL and iris, Geuder 16175 or Katalyst

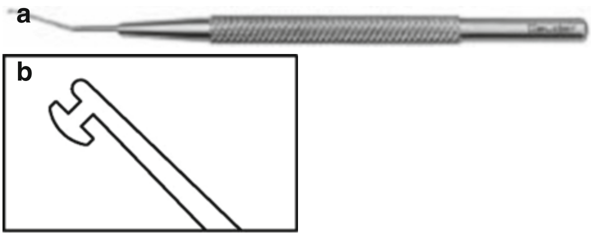


Fig. 2.16 Iris spatula. Indication: Manipulation of nucleus or IOL. Geuder 31975

Scissors

Fig. 2.17 Westcott scissors. Indication: Limbal peritomy. Geuder G-19750

Fig. 2.18 Regular capsulotomy scissors. The instrument fits only through a main incision. Geuder 19776

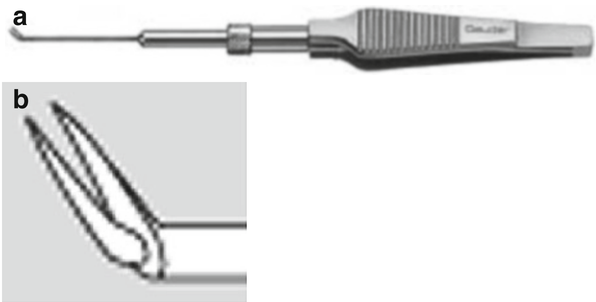


Fig. 2.19 (**a**, **b**) Capsule scissors after Kampik**.** The instrument fits through a paracentesis. Indication: Cutting of capsule or iris. Geuder 38215

Fig. 2.20 (**a**, **b**) Intravitreal scissors. 23G. Indication: Cutting of tissue in anterior or posterior chamber. DORC 1286.J06

Vitrectomy

Fig. 2.21 Calipers, Castroviejo Geuder No.: 19135

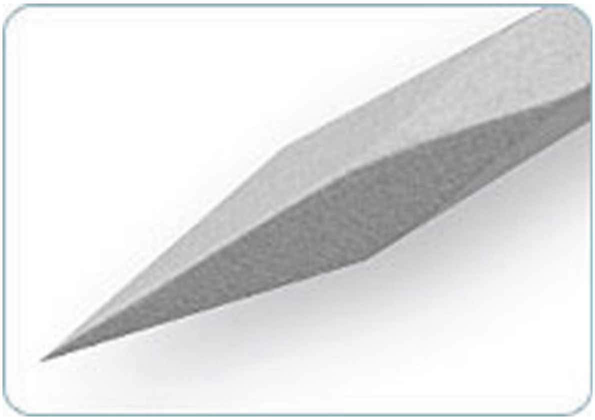


Fig. 2.22 Stiletto 23G. Indication: Lamellar sclerotomy for insertion of trocars. Beaver Visitec

Fig. 2.23 Valved trocar system by Alcon: 23G, 8065751657

Fig. 2.24 Valved trocar system by DORC: 23G, 1272.ED206

Fig. 2.25 Fragmatome: Alcon (Accurus fragmentation handpiece), DORC fragmatome 3002.M and 20-G or 23-G phaco fragmentation cannula DORC 3005.F106

Miscellaneous

Fig. 2.26 Capsular tension ring with injector: CROMA, DORC, Morcher, Arcadophta

Fig. 2.27 Iris retractors: Alcon/Grieshaber: Flexible iris retractors REF 611.75

Fig. 2.28 Triamcinolone acetonide (Volon A®): Pfizer

Fig. 2.29 Acetylcholine (Miochol, Novartis). Indication: Pupil constriction

Planning for Surgical Complications

3

Contents

If a complication such as posterior capsular defect occurs (Fig. 3.1), the following procedure is recommended:

Remove the instruments.
Inject viscoelastics.
Think.

Then ask yourself the following questions:

What is the problem?
Can I solve the problem myself?
Have I solved the problem before and do I have the required equipment sterile on site?
Do I have enough time to solve the complication now?

If you are uncertain whether you can solve the problem yourself, then you should remove the viscoelastic from the anterior chamber and send the patient to an experienced clinic. It is psychologically difficult to stop the surgery, but it is a laudable decision. It is much easier to continue with surgery than to stop. But if you do not master the complication, you are doing no service to the patient; on the contrary, you can make the situation worse. In addition you might increase the surgical trauma, which makes the second operation more difficult.

Another consideration for you to master the complication surgically is the availability of time, equipment and anaesthesia required. Time because additional ten patients have to be operated; equipment, because a pars plana vitrectomy with BIOM is required; and anaesthesia, because a PPV cannot be carried out in topical anaesthesia. If a PPV is necessary, I recommend stopping the ongoing surgery and scheduling the PPV one week later with retrobulbar anaesthesia.

U. Spandau, G. Scharioth, *Complications During and After Cataract Surgery*,
DOI 10.1007/978-3-642-54449-1_3,

For the preoperative assessment of a complicated cataract surgery such as a dropped nucleus, reflect about the following three main issues:

1. Status of lens capsule.
2. How hard is the nucleus?
3. Status of the cornea; how soon can the eye be operated?

Status of the Lens Capsule

If the nucleus and the lens capsule are luxated (e.g. zonular lysis) (Fig. 3.2), then you cannot perform a sulcus implantation but must perform a scleral-fixated or iris-fixated implantation. If the nucleus is luxated without the lens capsule and this is usually the case, then you have to examine the anterior capsule. Here are two important points: (1) Is the rhexis intact? (2) Are the zonules intact?

How do you examine an anterior capsule? Examine the anterior capsule with a maximally dilated pupil at the slit lamp. Sometimes, in a small pupil, this is not possible (Fig. 3.3). In this case you have to examine the anterior capsule during surgery and be prepared for a sulcus implantation as well as an iris- or scleral-fixated implantation. Inject viscoelastics intraoperatively into the anterior chamber and examine the anterior capsule with one or even better with two push-pull instruments, by moving the iris with the instruments to the periphery (Figs. 3.4, 3.5, 3.6 and 3.7). Alternatively you can use iris retractors.

If the rhexis is intact and the zonules are intact, implant the IOL into the sulcus and buttonhole the optic behind the rhexis. This is called "IOL capture" because the IOL is captured inside the rhexis or "haptic out, optic in" because the haptic is outside the lens capsule (and in the sulcus), and the optic is in the lens capsule (behind the rhexis).

If the zonules are inferiorly defective from 4 o'clock to 8 o'clock but the rhexis is intact, you can fixate the IOL behind the rhexis (Fig. 3.8). If you implant the IOL in such a case in the sulcus, it will subluxate inferiorly. If the zonules are superiorly defective from 10 o'clock to 2 o'clock, you can still insert the IOL in the sulcus. If more than one third of the zonules are defective, I would not perform a sulcus implantation but an iris or scleral fixation. If the zonules are intact, but the rhexis is partially defect, then implant the IOL into the sulcus, but an IOL capture (haptic in sulcus, optic in rhexis) may be difficult.

It can also happen that the IOL is well centred on the operating table but is luxated on the first postoperative day at the slit lamp. In this case, you have probably overlooked an inferior zonular lysis. In this case you can try to buttonhole the optic behind the rhexis or perform an iris-fixated IOL implantation.

How Hard Is the Dropped Nucleus?

In most cases, you can operate with the fragmatome. But if the nucleus is very hard or your fragmatome not particularly powerful, one has to perform an ECCE or a SICS. The nucleus is lifted up with PFCL and then emulsified in the pupillary plane by phaco or extracted by the SICS technique.

Status of the Cornea

If a pronounced corneal oedema is present, you cannot operate. Treat the patient first conservatively. The surgical planning depends on the size of the dropped nucleus.

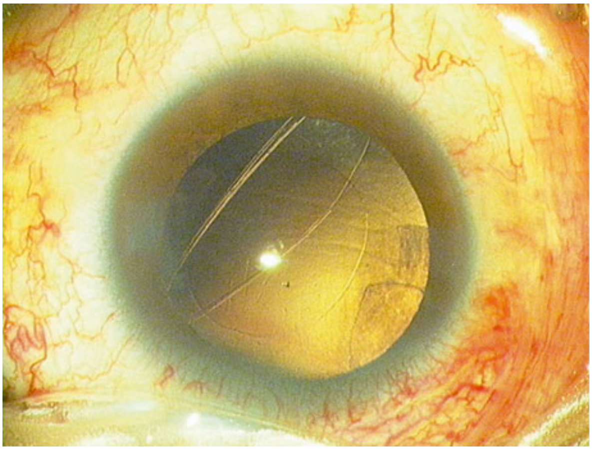


Fig. 3.1 An eye with a posterior capsular defect. The anterior capsule is intact and no zonular lysis is present

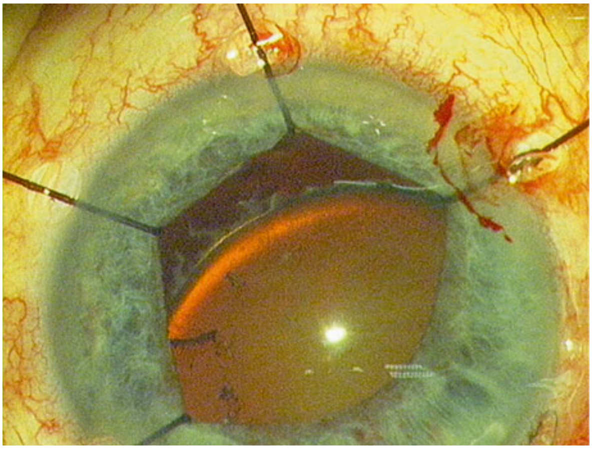


Fig. 3.2 An eye with a large zonular defect secondary to pseudoexfoliation syndrome

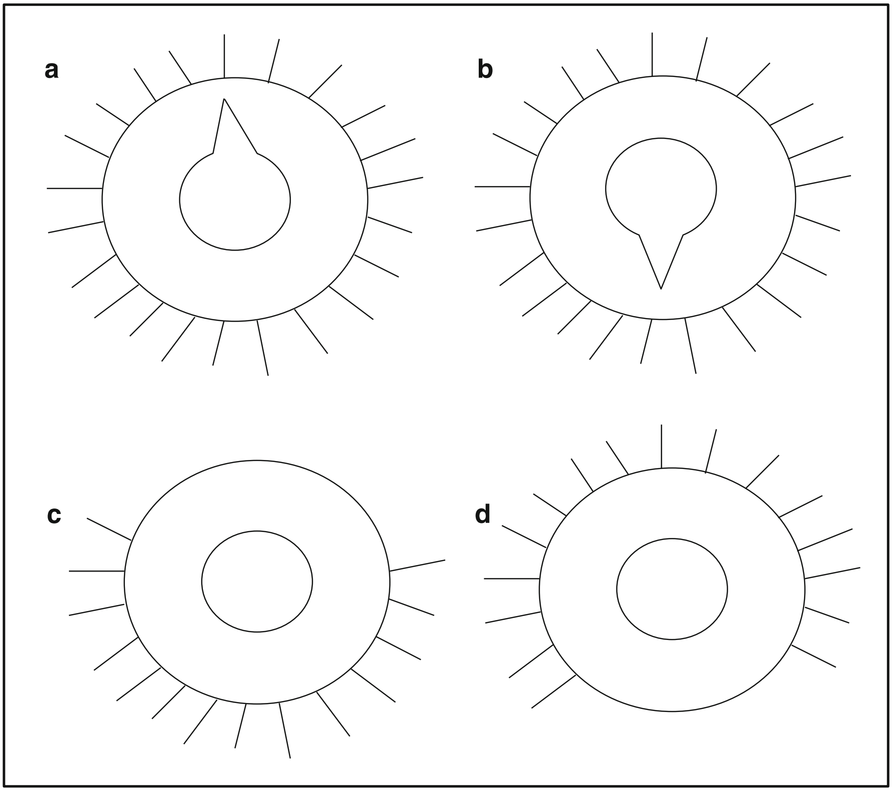


Fig. 3.3 The posterior capsule is defective in all cases (**a**–**d**). (**a**) Superior rift in the anterior capsule with intact zonules. A sulcus implantation is possible; a lens capture may increase the rift. (**b**) An inferior rift in the anterior capsule with intact zonules. A sulcus implantation is possible; a lens capture is risky. If the inferior rift enlarges, then a sulcus implantation may become impossible. (**c**) Intact rhexis with a superior zonular defect. A sulcus implantation and a lens capture are possible. (**d**) Intact rhexis with an inferior zonular defect. A sulcus implantation is not possible, exception: lens capture

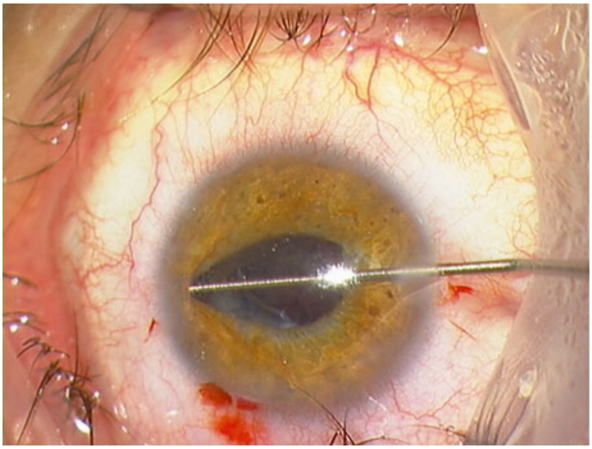


Fig. 3.4 Examination of the lens capsule of an aphakic eye. The examination is performed with a push-pull instrument, which allows an easy manipulation of the iris

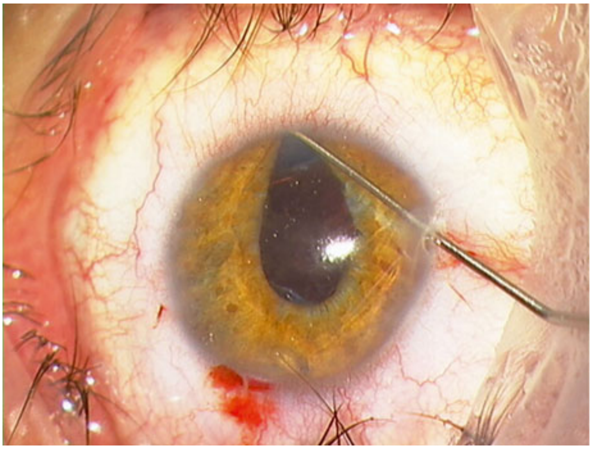


Fig. 3.5 The posterior capsule is defective. The inferior anterior capsule is not broad but intact

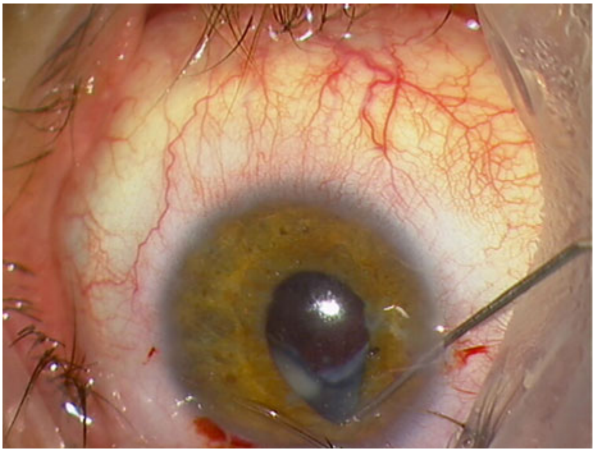


Fig. 3.6 The superior anterior capsule is broad and intact

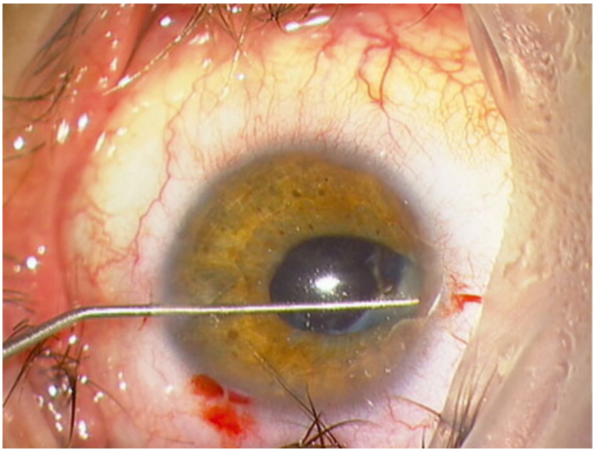


Fig. 3.7 The nasal anterior capsule is broad and intact

Fig. 3.8 Drawing of a lens capture. The IOL is implanted in the sulcus and then the IOL is buttonholed behind the rhexis. The haptics are located in the sulcus and the IOL is located behind the anterior capsule. The rhexis becomes an almond formed shape

If 50–100 % of the nucleus is luxated, we would operate within 1 week. The nucleus can cause a substantial intraocular inflammation, and the nucleus may stick to the retina. If small nuclear fragments are luxated, we would operate within 4 weeks, if the intraocular inflammation can be controlled with cortisone drops.

3.1 Different Cases for Surgical Planning

First Case: Posteriorly Dislocated (Dropped) Nucleus, Fig. 3.9

A clear case. A vitreoretinal intervention is required. Why? The vitreous must be removed to access the nucleus: Then the nucleus is removed with the fragmatome or with the PFCL method. For this surgery one needs a BIOM, a vitrectomy machine and a fragmatome. For the exact description of the operation, see Sect. 9.1.

Second Case: Posteriorly Dislocated IOL, Fig. 3.10

Also a clear case. The IOL has dropped down to the retina. Without a BIOM and a vitrectomy machine, it is not possible to extract the IOL. In addition, the vitreous must be removed in order to reach the IOL. Do not extract the IOL without removing the vitreous first. Such a manoeuvre will cause ruptures in the retina. Then you must decide whether you want to scleral fixate the same IOL or whether you want to extract the IOL together with the lens capsule and implant an iris-fixated IOL. Technically easier is the second method. You require a BIOM, a vitrectomy machine, an intravitreal (e.g. serrated jaws) forceps and an iris-fixated IOL. For the exact description of the operation, see Sect. 9.2.

Third Case: Anteriorly Dislocated IOL, Fig. 3.11

The bag IOL is spontaneously dislocated due to zonular lysis. It is possible to approach the bag IOL from the anterior chamber. Dissect a 6-mm broad frown incision and extract the IOL. Continue with an anterior vitrectomy, inject Miochol to constrict the pupil and implant an iris-fixated IOL. For this method you need a phaco machine with vitreous cutter, an intravitreal forceps to extract the IOL and an iris-fixated IOL. For the exact description of the operation, see Sect. 7.3.

An elegant alternative is the Hoffmann technique: The bag-IOL complex is scleral fixated. For this method you need a phaco machine with vitreous cutter and a 10-0 polypropylene suture with straight needles. For the exact description of the operation, see Sect. 7.4.2.

If you prefer to fixate the same (luxated) IOL, you need to remove the lens capsule first. This manoeuvre is difficult in the anterior chamber because of the lack of space. It is therefore performed in the vitreous space. You require thus a BIOM and vitrectomy machine (see Sect. 9.2). The IOL can then be sutured to the sclera or, more elegant, can be fixated into intrascleral tunnels. For the exact description of these operations, see Sects. 5.2 and 5.3.

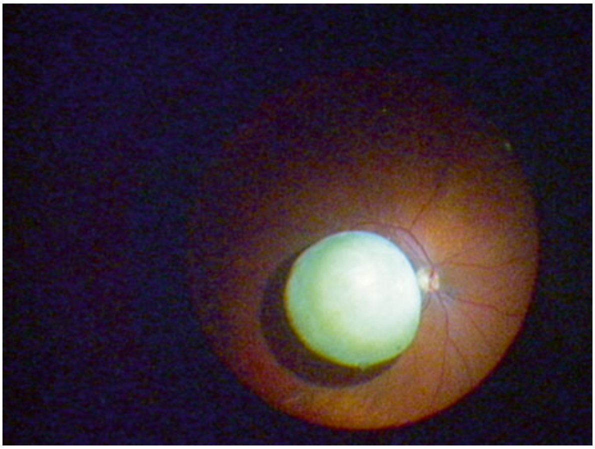


Fig. 3.9 Posterior dislocated nucleus after a trauma for 15 years ago. The patient had no symptoms (With courtesy of the Kaden Verlag)

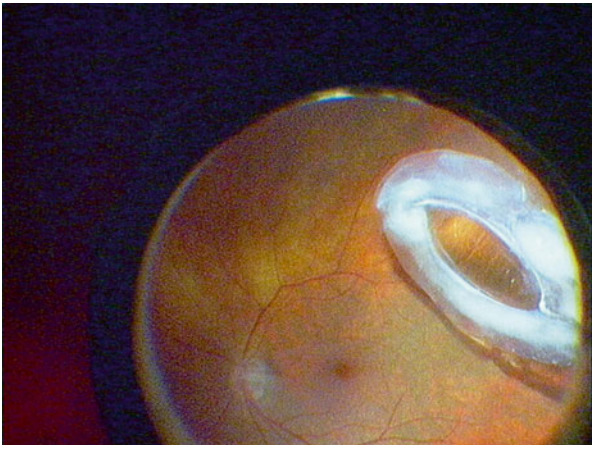


Fig. 3.10 Posterior dislocated IOL in a vitrectomised eye (With courtesy of the Kaden Verlag)

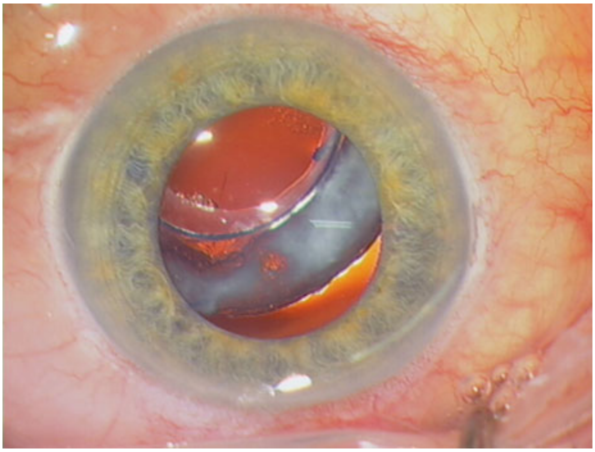


Fig. 3.11 Anterior dislocated bag-IOL complex due to zonular lysis

Fourth Case: Decentred IOL with Partially Defective Capsular Bag, Figs. 3.12 and 3.13

The surgical planning depends on the status of the anterior capsule. Examine the anterior capsule preoperatively. If the anterior capsule is intact, you can implant a sulcus-fixated IOL, otherwise an iris-fixated or scleral-fixated IOL. For the exact description of the operation, see Sect. 7.3.

Fifth Case: Zonular Lysis, Fig. 3.2

If the zonular lysis is limited (about one quadrant), insert four iris retractors and fixate them in the rhexis instead of the iris. You have to work very atraumatic, in order not to enlarge the zonular lysis. Implant after hydrodissection a capsular tension ring. If the zonular lysis includes two quadrants, and the nucleus is about to drop, you should luxate the nucleus rapidly into the anterior chamber and then extract it with an ICCE (SICS technique). Continue with an anterior vitrectomy and implant an iris or intrascleral-fixated IOL. For the exact description of these surgeries, see Sects. 7.2 and 4.6.

3.2 Correct IOL Choice

If the IOL is not located in the bag, calculations for the IOL should take into consideration the effective lens position of the optic within the eye. The general rule is, the more anterior the less diopter. An anterior chamber lens has less diopter than an in-the-bag IOL. If the IOL is completely in the sulcus, the optic will be more anterior and the power should be decreased by 0.5D to 1D in most eyes. With haptics in the sulcus but the optic buttonholed through an intact capsulorhexis, the IOL power is about the same as with primary in-the-bag placement. Intrascleral-fixated IOLs end up having the same power calculations as in-the-bag placement. Retropupillar-fixated iris-claw IOLs have approximately 2D less than in-the-bag IOLs (Figs. 3.14, 3.15, 3.16, 3.17 and 3.18). Anterior chamber IOLs have even lower A-constants because they have the most anterior effective lens position.

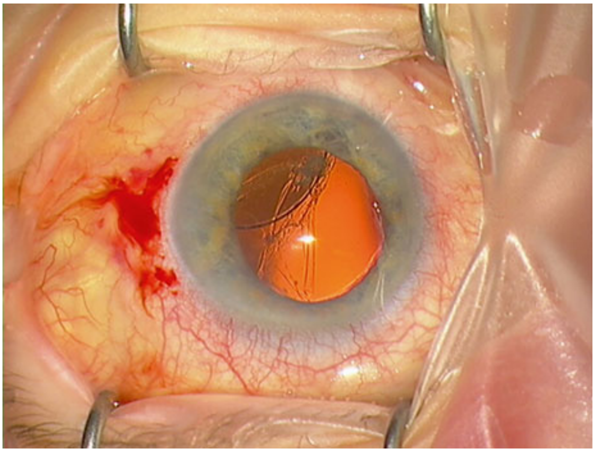


Fig. 3.12 Anterior dislocated IOL after a complicated cataract surgery. The posterior capsule is defective and the anterior capsule is nasally (*right side*) defective

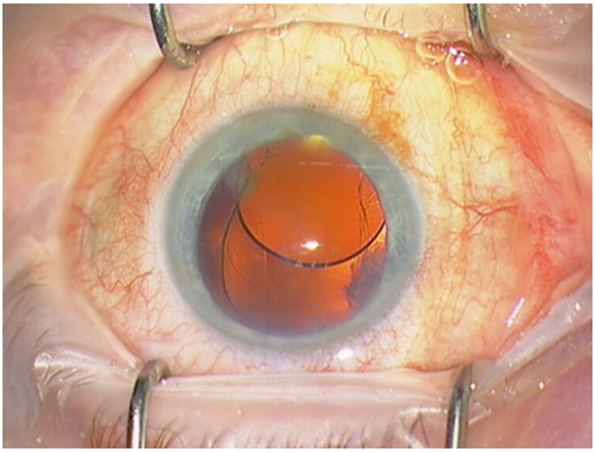


Fig. 3.13 Anterior dislocated IOL after a complicated cataract surgery. The posterior capsule is defective and the anterior capsule has an inferior defect

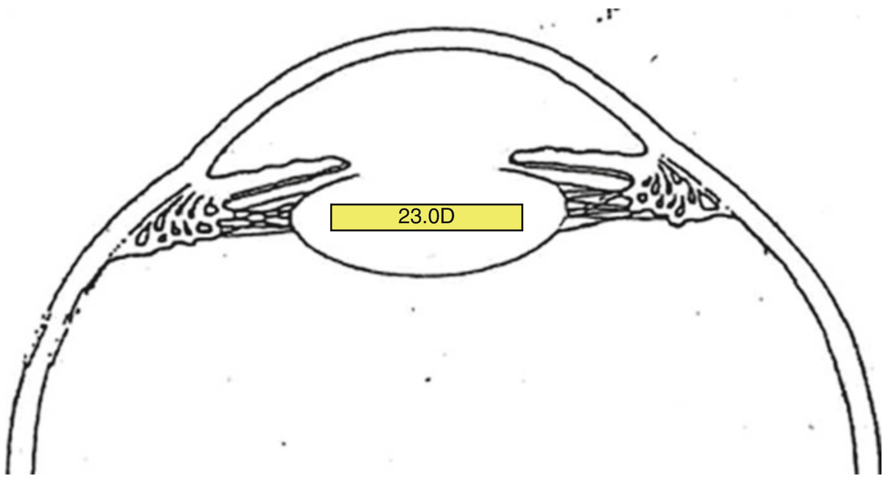


Fig. 3.14 Drawings for the surgical planning of IOL power in case of a complication. The normal case is an in-the-bag location with a +23.0D IOL

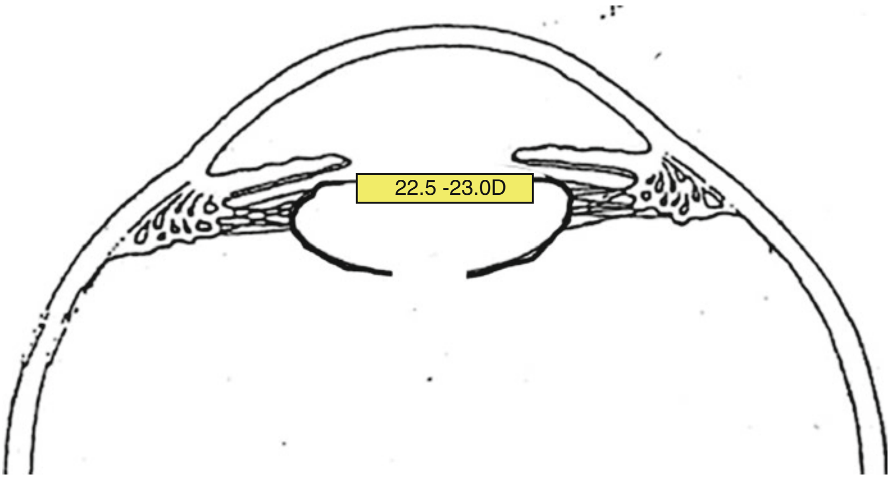


Fig. 3.15 Lens capture after posterior capsular defect. The IOL power is between 22.5D and 23.0D

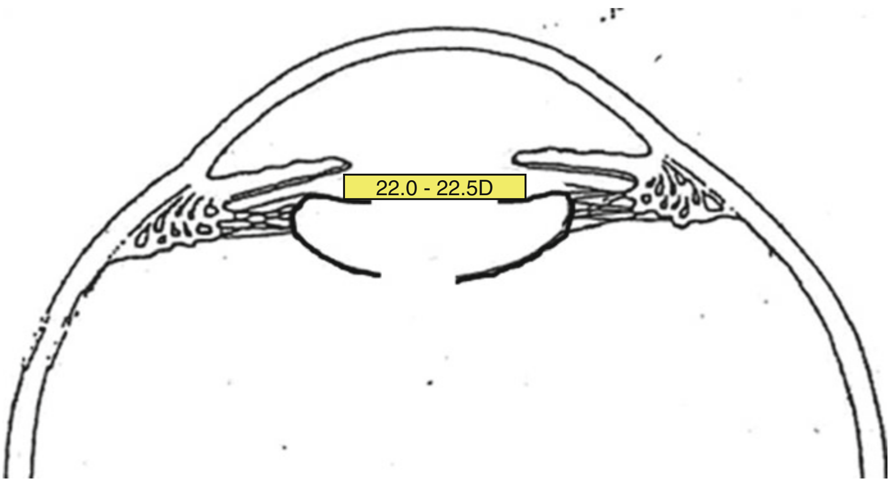


Fig. 3.16 Sulcus implantation. The IOL power is between 22.0D and 22.5D

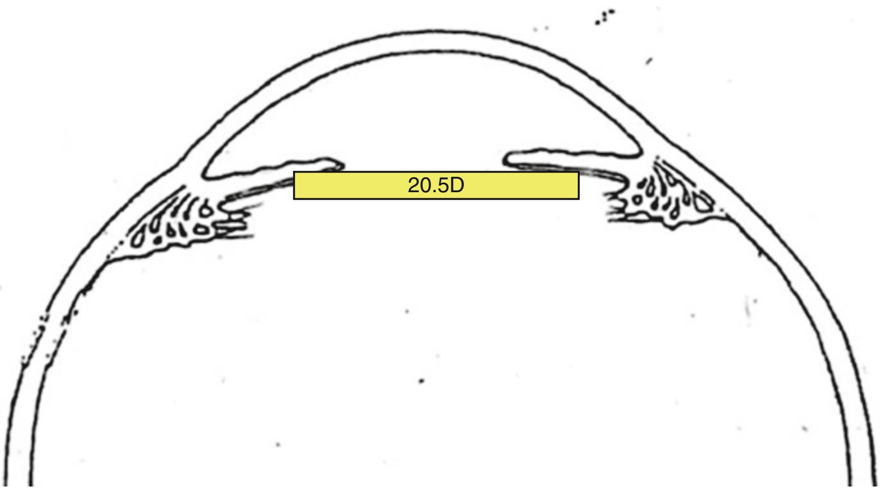


Fig. 3.17 Retropupillar iris-fixated IOL. The IOL power is approximately 20.5D

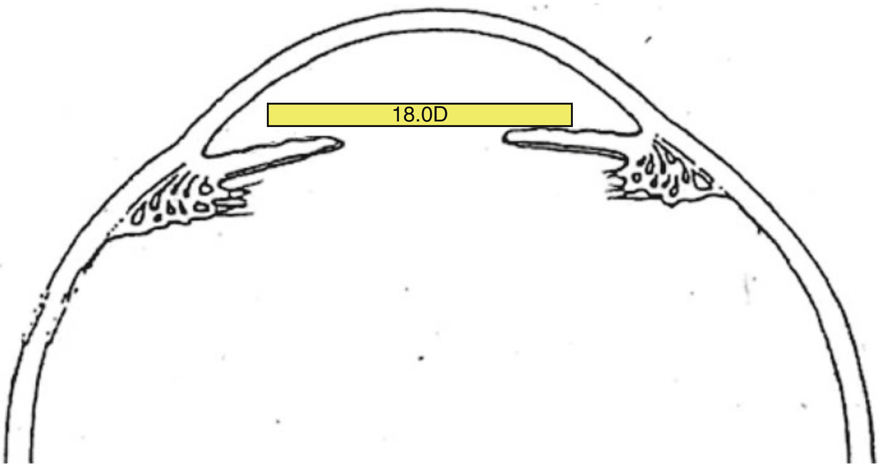


Fig. 3.18 Antepupillar iris-fixated IOL. The IOL power is approximately 18.0D

General Surgical Techniques for Anterior Segment Surgery

4

Contents

4.1 Anaesthesia

The usual anaesthesia nowadays for phacoemulsification is drop anaesthesia (e.g. tetracaine drops) and in addition intracameral anaesthesia (e.g. Xylocaine 1 %). For a secondary implantation of an iris-claw IOL or an intrascleral IOL, we recommend a peribulbar anaesthesia. We use a blunt cannula which has a low risk for a globe perforation (BD, 25G retrobulbar cannula, Atkinson).

Electronic supplementary material Supplementary material is available in the online version of this chapter at http://dx.doi.org/10.1007/978-3-642-54449-1_4. Videos can also be accessed at http://www.springerimages.com/videos/978-3-642-54448-4.

U. Spandau, G. Scharioth, *Complications During and After Cataract Surgery*,
DOI 10.1007/978-3-642-54449-1_4, © Springer-Verlag Berlin Heidelberg 2014

4.2 Standard Instruments for Phacoemulsification

What is the name of this forceps? What is the function of that instrument? The knowledge of all instruments on your phaco and vitrectomy set is essential for a successful surgery and a clear communication in the OR. In addition, you need to know the name and function of those instruments, which are not in the regular set. Why? Because the scrub nurse has to fetch the specific instrument you requested. I also recommend looking at some instrument brochures, e.g. Geuder or Storz to get an idea about the huge variety of instruments available.

Phaco Set

Here you find all details of our phacoemulsification instrument set, which we use at the University Hospital of Uppsala (Fig. 4.1). The content of course varies from hospital to hospital.

1x forceps, capsulorhexis (Geuder 31299 or 31308)
1x forceps, Mc Pherson (Geuder 31623)
1x manipulator, chopper after Neuhann (Geuder 32162)
1x manipulator, push pull after Dardenne (Geuder 16175)
1x handpiece, aspiration
1x handpiece, irrigation
1x phaco handpiece
1x injector for IOL

Incisions

Paracentesis knife, 1.3 mm

15° knife (1.3 mm). Indication: Paracentesis (Fig. 4.2). Many suppliers: DORC or Beaver-Visitec

or

Angled trapezoid knife, 1.2 mm. Alcon: 8065 921541

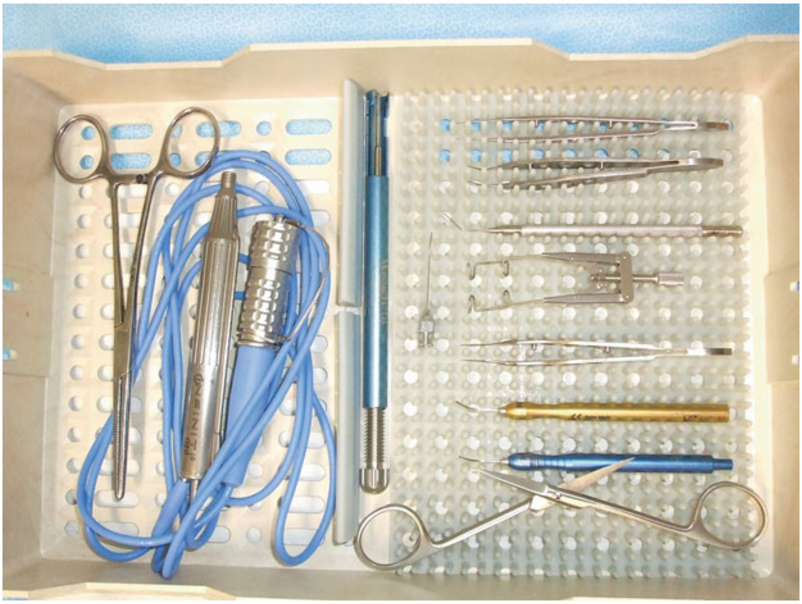


Fig. 4.1 A phacoemulsification set. It is important to know all instruments in the set

Fig. 4.2 (**a**, **b**) A 15° knife. The main indication is a paracentesis. DORC. 51.4891

Main incision knife, 2.4 mm

Indication: Main incision (Fig. 4.3). Slit knife. Many suppliers: DORC or Beaver-Visitec, 581129

Rhexis

Viscoelastics

There are two different types of viscoelastic available, the one being dispersive and the other being cohesive. The first type disperses in the anterior chamber and protects the endothelium during phacoemulsification. The second type "coheres" meaning that it expands and maintains the anterior chamber. The first type is important during the rhexis, and the latter type is required during the lens implantation.

An example of a dispersive viscoelastic is Viscoat (Alcon Laboratories, Inc, Fort Worth, Texas), and an example of a cohesive viscoelastic is Provisc (Alcon Laboratories, Inc, Fort Worth, Texas).

Cystotome

Indication: Capsulorhexis (Fig. 4.4). Many suppliers: Beaver-Visitec, Oasis

Capsulorhexis forceps

Indication: Capsulorhexis (Fig. 4.5). Many vendors such as Geuder 31299 or 31308

Phaco

During phacoemulsification, the dominant hand holds the phaco handpiece and the nondominant hand a manipulator (e.g. Chopper, spatula or push pull).

Push Pull

The push-pull instrument is a very useful instrument for anterior segment surgery. Indication: Manipulation of the nucleus and the IOL (Figs. 4.6 and 4.7). In addition, you can widen a small pupil with a push-pull instrument or examine the periphery of the capsular bag. Geuder: Iris hook Dardenne (push-pull), Geuder 16175

Chopper

1. Combined instrument with push-pull and chopper (Fig. 4.8). Indication: Chopping a hard nucleus with the chopper, manipulation of the nucleus and of the IOL with the push pull. Chopper by Neuhann, Geuder 32162
2. Chopper by Agarwal. Indication: Chopping of a hard nucleus. Geuder 32282

Irrigation and Aspiration (I/A)

I/A handpiece, bimanual

One handpiece is for aspiration (Fig. 4.9) and the other handpiece for irrigation (Fig. 4.10). You access the anterior chamber through two paracenteses. I recommend bimanual I/A because they are easier to use than the monomanual I/A. Geuder: Irrigating handpiece and aspirating handpiece.

I/A handpiece, monomanual

This monomanual or coaxial handpiece has both functions (irrigation and aspiration) integrated in one handpiece (Fig. 4.11). The handpiece is comparable in size to the phaco handpiece, and you enter the eye through the tunnel incision.

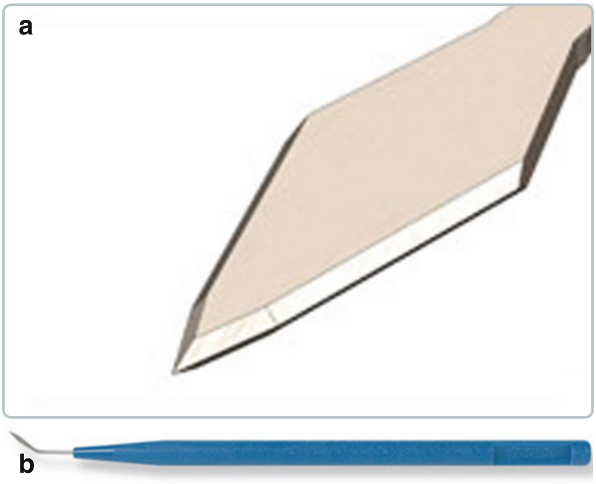


Fig. 4.3 (**a**, **b**) Tunnel incision knife, 2.4 mm. Indication: Main section. Slit knife. DORC. 54.5725 or Alcon. 8065992445

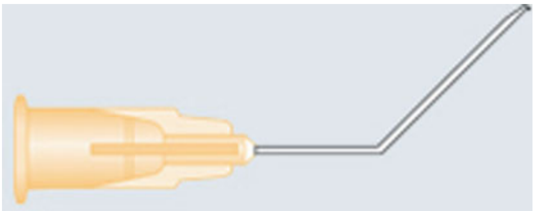


Fig. 4.4 Cystotome. Indication: Capsulorhexis. Several companies: Beaver-Visitec, Oasis. Alternatively, bend a grey 17G cannula to a cystotome

Fig. 4.5 Capsulorhexis forceps. Indication: Capsulorhexis. Many vendors such as Geuder 31299 or 31308

Fig. 4.6 Push-pull manipulator. Indication: Manipulation of the nucleus and the IOL. Geuder: Iris hook Dardenne (push-pull), Geuder 16175

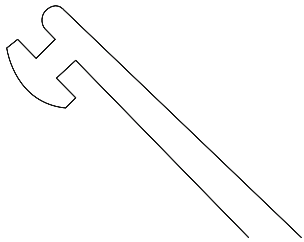


Fig. 4.7 The tip of the push-pull instrument is very useful for the rotation of an IOL or enlargement of a small pupil

Fig. 4.8 Chopper. (1) Combined instrument with push-pull and chopper. Indication: Chopping a hard nucleus with the chopper and manipulation of the nucleus and of the IOL with the push pull. Chopper by Neuhann, Geuder 32162. (2) Chopper by Agarwal. Indication: Chopping of a hard nucleus. Geuder 32282

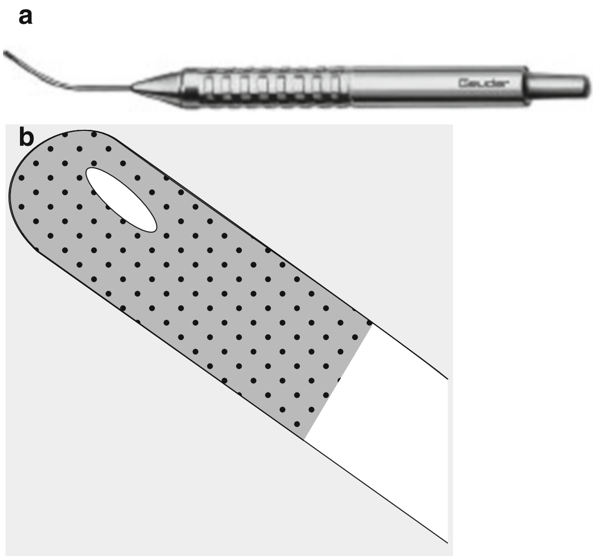


Fig. 4.9 Aspiration handpiece (**a**) and aspiration tip (**b**) for bimanual I/A. Useful *is a* rough tip for polishing. Geuder: Aspirating handpiece, 22101

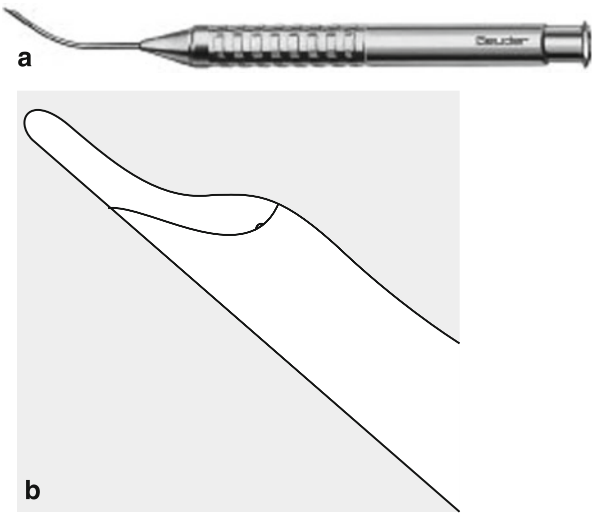


Fig. 4.10 Irrigation handpiece (**a**) and irrigation tip (**b**). Geuder: Irrigating handpiece, Geuder 22100

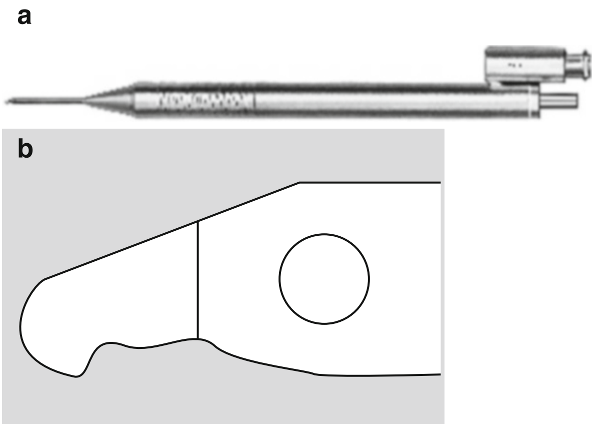


Fig. 4.11 I/A handpiece, monomanual (**a**). This monomanual or coaxial handpiece has both functions (irrigation and aspiration) integrated in one handpiece. The handpiece is comparable in size to the phaco handpiece, and you enter the eye through the tunnel incision. Irrigation/aspiration tip (**b**). Geuder 22540

4.3 Phacoemulsification of an Easy Cataract

The emphasis in this chapter lies on the management of an easy cataract, the following chapter on the management of a difficult cataract. The surgery is performed in drop and intracameral anaesthesia.

Videos 4.1 and 4.2: Easy cataract

Instruments

Phaco set

Individual Steps

1. Paracentesis incisions at 10:30 o'clock and 1:30 o'clock
2. Intracameral lidocaine and viscoelastics
3. Corneal tunnel incision at 9 o'clock
4. Capsulorhexis
5. Hydrodissection and hydrodelineation
6. Phacoemulsification
7. Irrigation and aspiration (I/A)
8. IOL implantation
9. Removal of viscoelastics
10. Hydration of corneal incisions
11. Intracameral cefuroxime

The Operation Step by Step

1. Paracentesis incisions at 10:30 o'clock and 1:30 o'clock
2. Intracameral lidocaine and viscoelastics
3. Corneal tunnel incision at 9 o'clock

Instrumentation

Paracentesis: Paracentesis knife, 1.3 mm (Fig. 4.2)

Tunnel incision: Tunnel knife: 2.4 mm (Fig. 4.3)

Intracameral anaesthesia: 1 % lidocaine, several manufacturers

Operation

We recommend to fixate the globe during these steps with a surgical forceps (e.g. Castroviejo) or even better with a cotton swab (does not cause conjunctival haemorrhage) (Fig. 4.12). The dominant hand performs a paracentesis at the grey/white (arcus senilis/limbus) border. One paracentesis is situated at 10:30 o'clock and the other at 1:30 o'clock (Fig. 4.13). The next step is the corneal tunnel incision at 9 o'clock. The tunnel is more difficult than it looks; it is important to have a drawing in mind when performing this procedure for the first time (Fig. 4.14). The corneal incision has three to four movements (see also drawing): (1) Parallel to the iris (Fig. 4.15), (2) up and parallel to the cornea (Fig. 4.16), (3) parallel to the iris (Fig. 4.17) and (4) point to the apex of the cornea for the residual part of the knife.

The main incision at 9 o'clock is much more convenient than a main incision at 12 o'clock, because it is easier to hold the phaco handpiece sidewards like a pen than downwards. Inject next 1 % lidocaine into the anterior chamber (Fig. 4.18).

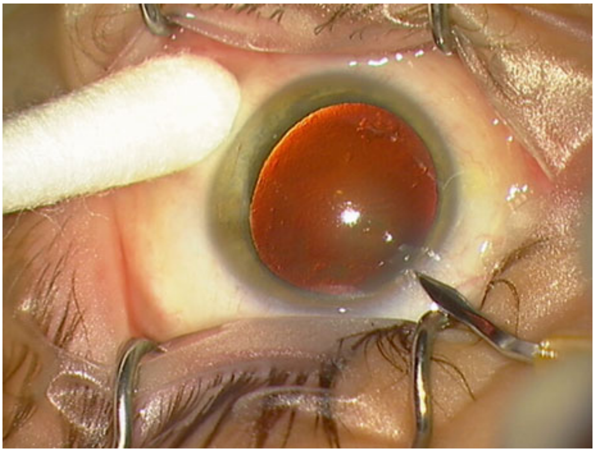


Fig. 4.12 Fixate the globe with a cotton swab. Perform a paracentesis at 10:30 o'clock with the 15° knife

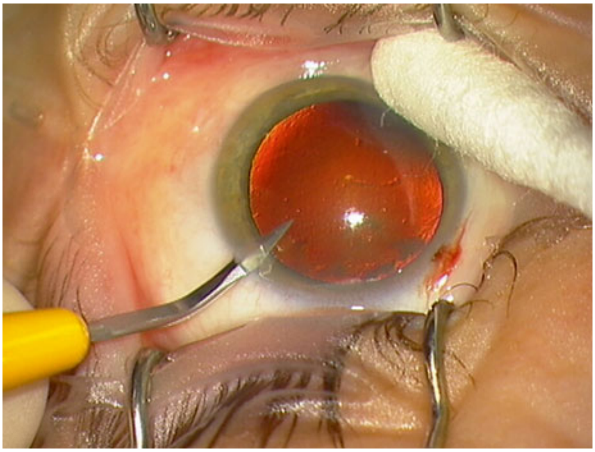


Fig. 4.13 Fixate the globe with a cotton swab. Perform a paracentesis at 1:30 o'clock with the 15° knife or this trapezoid knife (Alcon, ClearCut Sideport Angled; 1.2 mm 8065 921541)

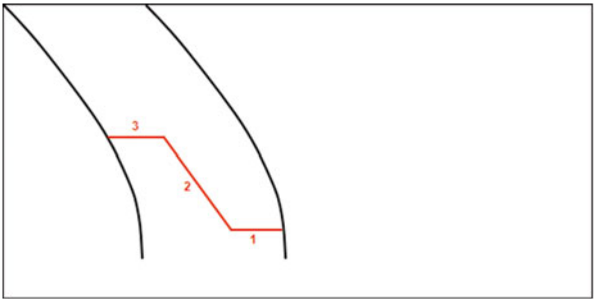


Fig. 4.14 Drawing of a tunnel incision. The incision is lamellar and therefore watertight and requires no suture. The first movement is horizontal (*1*), the second movement is upwards (*2*), and the third movement is again horizontal (*3*)

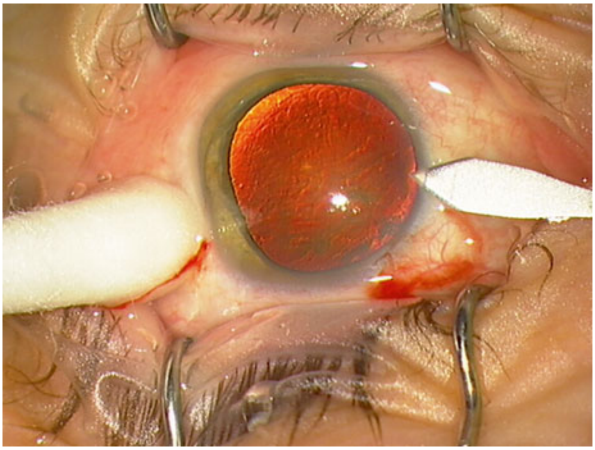


Fig. 4.15 The first movement is horizontal (see also Fig. 4.14)

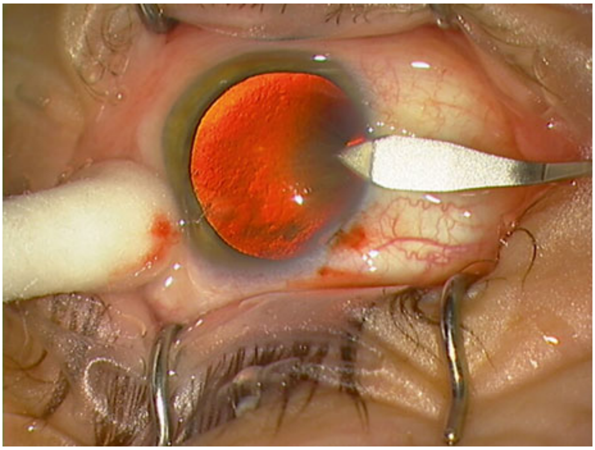


Fig. 4.16 Bend the knife downwards until it touches the conjunctiva, and move it upwards parallel to the epithelium. Stop this movement if the marking on the knife reaches the entrance of the tunnel incision (see also Fig. 4.17)

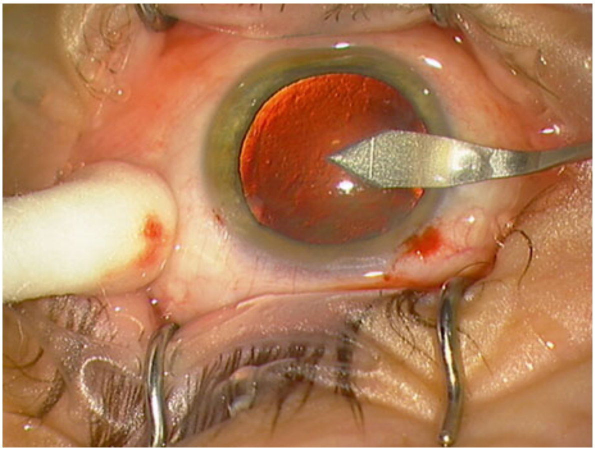


Fig. 4.17 Continue with a horizontal movement (see also Fig. 4.15). If you want to optimise the main incision, then point the knife to the apex of the cornea as soon as you enter the anterior chamber

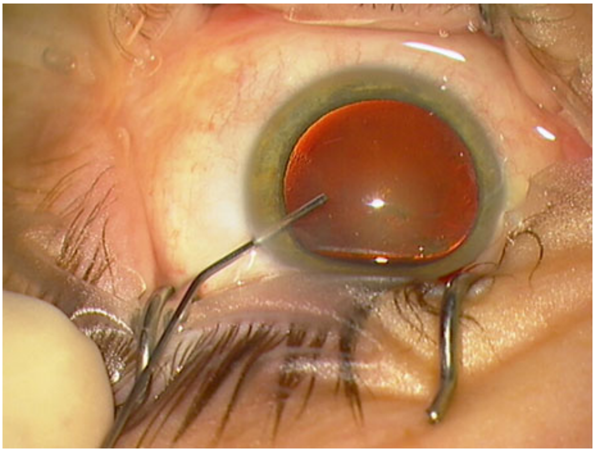


Fig. 4.18 Inject 1 % lidocaine into the anterior chamber

4. Capsulorhexis

Instrumentation

Rhexis: Cystotome (Fig. 4.4) and capsulorhexis forceps (Fig. 4.5)

Viscoelastic

Operation

The nucleus has a convex shape. The function of the viscoelastic is to maintain the anterior chamber while performing a rhexis and to flatten the nucleus. Imagine you walk along a steep hill and your feet threaten to slip away. Exactly the same happens with the rhexis if the nucleus has a convex (steep) shape. This can be avoided by (re)injecting viscoelastics.

Begin with injecting viscoelastics into the anterior chamber (Fig. 4.19). The rhexis can be performed with a cystotome or with a capsulorhexis forceps. I recommend performing the first part of the rhexis with the cannula (Figs. 4.20 and 4.21) until you created a flap, and then proceed with the forceps or even continue with the cannula.

Puncture the anterior capsule in the centre with the cystotome (Fig. 4.22), and draw the cystotome to the midperiphery (Fig. 4.23). Then pull the cystotome to create a flap (Fig. 4.24). This step is tricky because you need to control carefully the depth of the cystotome tip. If you come too deep, you shovel up anterior cortex and obscure your view; if you are too high, you lose the flap. Keep attention that the flap lies flat, and then grasp the flap at the peripheral edge with the capsulorhexis forceps and make a circular rhexis (Figs. 4.25, 4.26 and 4.27). While pulling, always keep attention that the flap is nicely folded over. In the beginning you will make many interruptions, but try with time to draw the flap for a longer and longer distance. When finishing the capsulorhexis draw the flap towards the centre of the pupil.

Important: Check if the rhexis is complete. If it remains incomplete you will aspirate the flap into the phaco probe and create a posterior capsular rupture.

Pits and Pearls No. 1

Two advices which make life for the *beginning* cataract surgeon much easier. (1) *Optics*. A main problem of the beginner is bad optics. Use methylcellulose instead of BSS for the cornea. (2) *Constant irrigation.* Use constant irrigation during phaco and I/A. You will always have a stable anterior chamber.

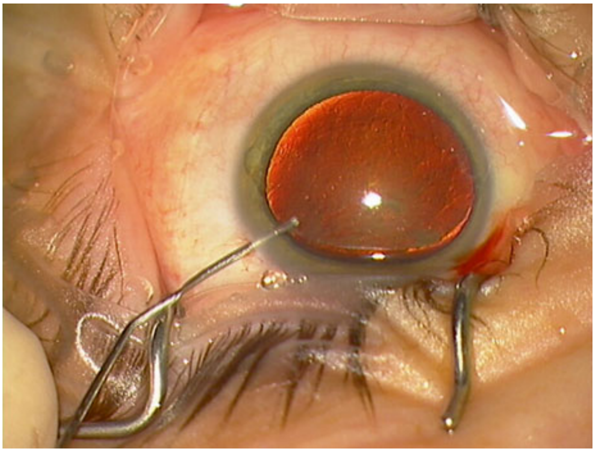


Fig. 4.19 Inject viscoelastics into the anterior chamber

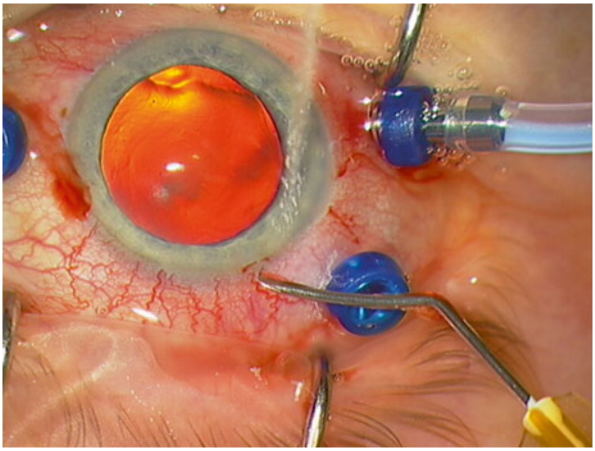


Fig. 4.20 The next step is the capsulorhexis with the cystotome. The insertion of the cystotome is difficult for the beginner. This is the correct way to insert the cystotome

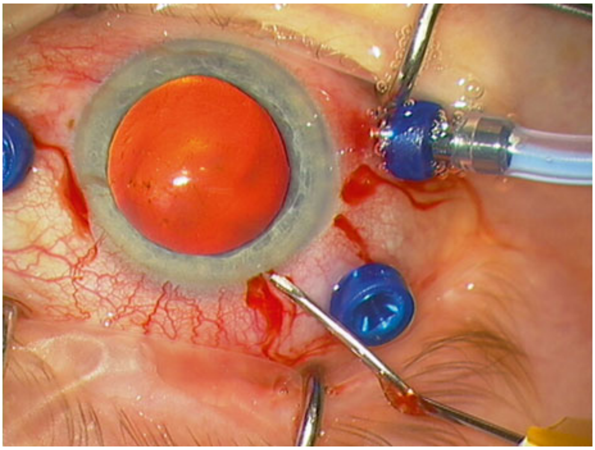


Fig. 4.21 This is the wrong way to insert the cystotome

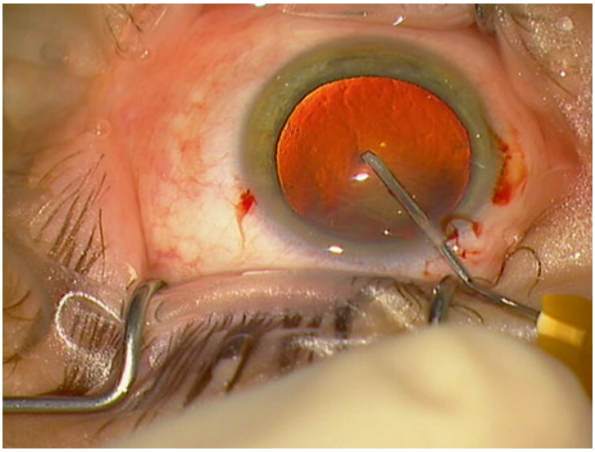


Fig. 4.22 Place the cystotome in the middle of the cornea, and open/pinch the anterior capsule

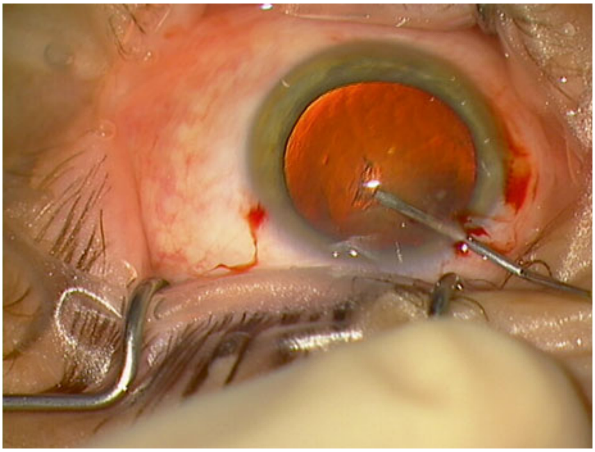


Fig. 4.23 Draw the cannula to the midperiphery approximately 2 mm away from the centre

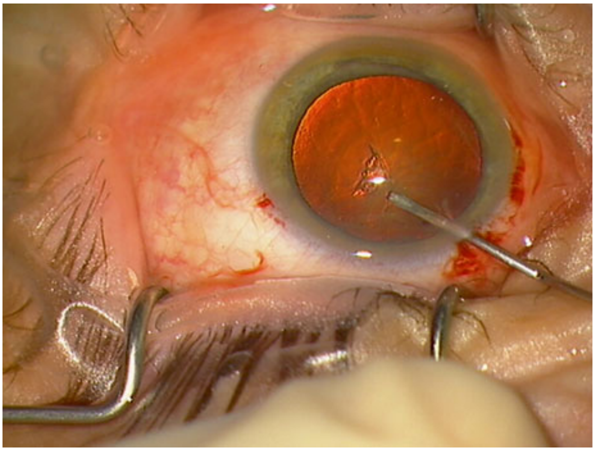


Fig. 4.24 Create a flap. This is a difficult manoeuvre. Hold the cannula superficial in order only to pull the anterior capsule; if you are too deep with the cannula, then cortical material will obscure the view

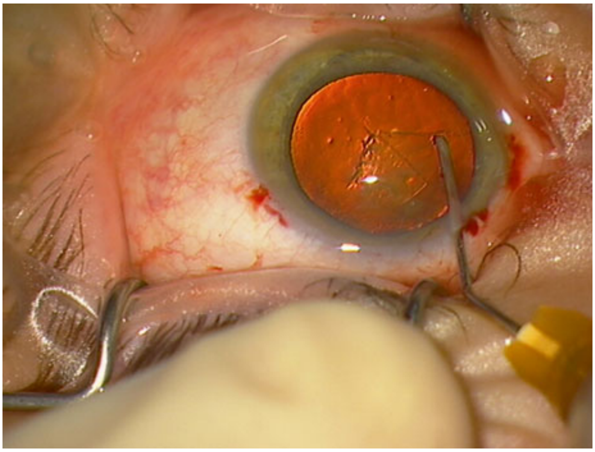


Fig. 4.25 Continue with the rhexis. Place the tip of the cystotome on the flap, and draw a circular rhexis

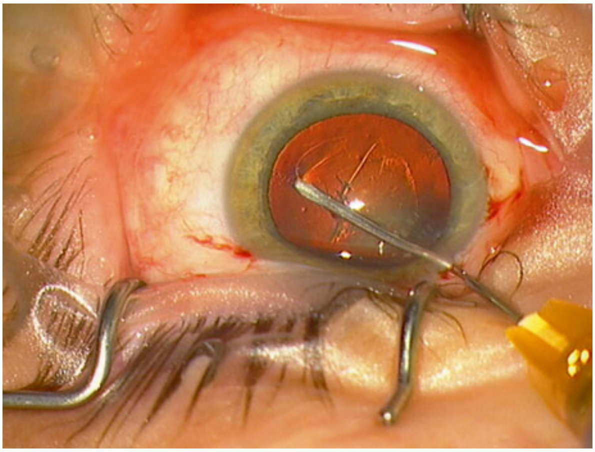


Fig. 4.26 Try to draw the flap a long stretch, and do not interrupt the movement too much. The flap should always lie flat as depicted

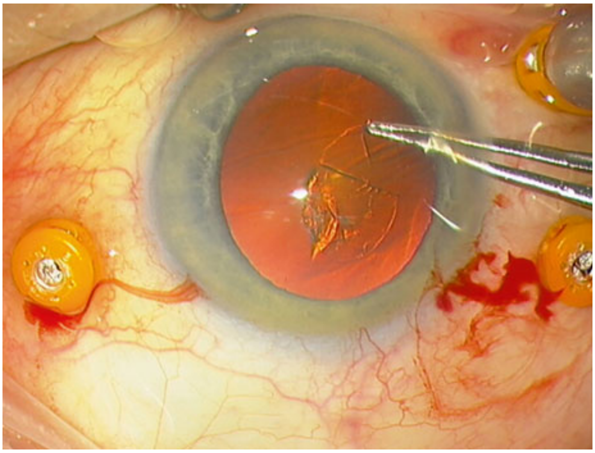


Fig. 4.27 Instead of using a cystotome, you can use a capsulorhexis forceps. Check at the end of the rhexis that the rhexis is really complete. An incomplete rhexis is dangerous because the remaining flap can be sucked in by the phaco tip resulting in an anterior rift or even in a posterior capsular defect

5. Hydrodissection and Hydrodelineation

   Instrumentation

   Syringe filled with BSS and anterior chamber maintainer cannula (Fig. 4.28)

   Operation

   As a beginner one underestimates the importance of this step. But it is actually a vital step for a successful and smooth going phacoemulsification. This step must be performed through the main incision and *not* through the paracentesis (Fig. 4.29). If you inject through the paracentesis, you will inflate the anterior chamber with subsequent iris prolapse and stress on the zonules. If you inject BSS through the main incision, the fluid can also escape through the main incision without inflating the anterior chamber. When performing hydrodissection press the cannula on the scleral part of the tunnel to facilitate fluid outflow when injecting fluid. This is especially important in a shallow anterior chamber.

   Place the cannula under the anterior capsule directly across from the tunnel incision. Hold the cannula tip in position and provide forceful injection of fluid. A successful hydrodissection is visible through a propagating wave along the posterior capsule.

   If no wave is evident after the first irrigation, then check first with your index finger how hard the globe is. If the globe is hard, then wait before you continue with the next irrigation. Place the cannula at a different position and try again. The lens should be completely mobile before you continue with phacoemulsification. The next step is the hydrodelineation where the nucleus is separated from the epinucleus. Direct the cannula into the nucleus approximately at the edge of the rhexis. A successful hydrodissection is evident by a golden ring (Fig. 4.30).

6. Phacoemulsification

   Instrumentation

   Dominant hand: Phacoemulsification handpiece

   Nondominant hand: Manipulator or chopper

   Operation

   When you operate a phaco, you are working in different machine settings (modes). All modes depend on two parameters: (1) *Vacuum/aspiration* and (2) *phacoemulsification power*.

   Phaco 1 Mode (Sculpting or Grooving): Little aspiration, much phaco. Indication: To carve the groove. Grooving requires little aspiration but much phaco power.

   Phaco 2 Mode (Quadrant removal): Much aspiration, much phaco. Indication: To aspirate the quadrants and emulsify them. The aspiration of nuclear fragments requires much vacuum, and emulsification of the nuclear fragments requires much phaco energy.

   Phaco 3 Mode (Epinucleus): Much aspiration, little phaco. The epinucleus is soft; you need little phaco but much aspiration.

   I/A 1 Mode (Cortex): Much aspiration: It requires a lot of aspiration to remove the cortex.

   I/A 2 Mode (Polishing): Little aspiration: You may only work with little aspiration at the posterior capsule in order to remove cortical strands or fibrosis.

Fig. 4.28 An anterior chamber cannula attached to a 3-ml syringe filled with BSS. Indication: Injection of BSS into the anterior chamber

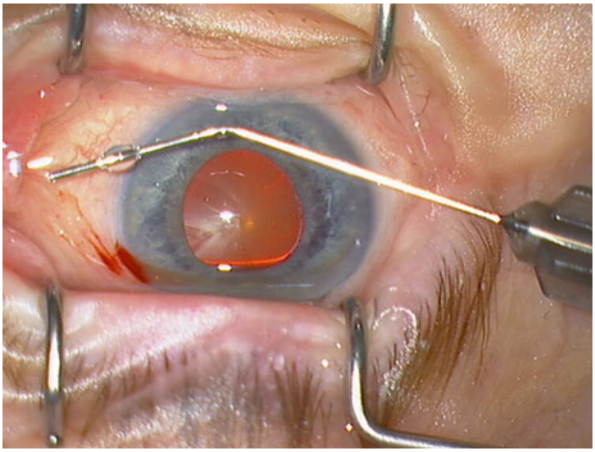


Fig. 4.29 Hydrodissection. Observe the tidal wave behind the nucleus. Continue with a hydrodelineation (separation of the nucleus from epinucleus)

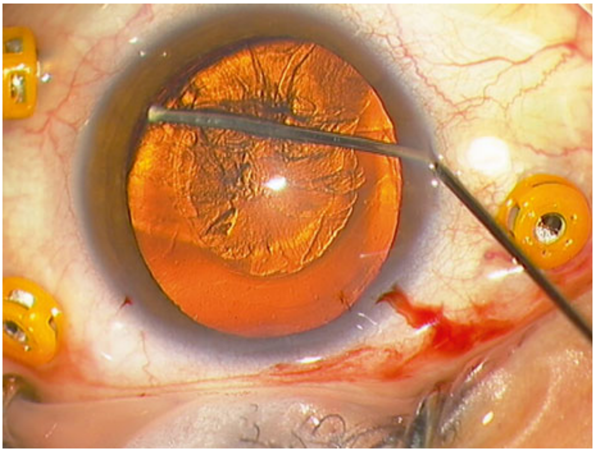
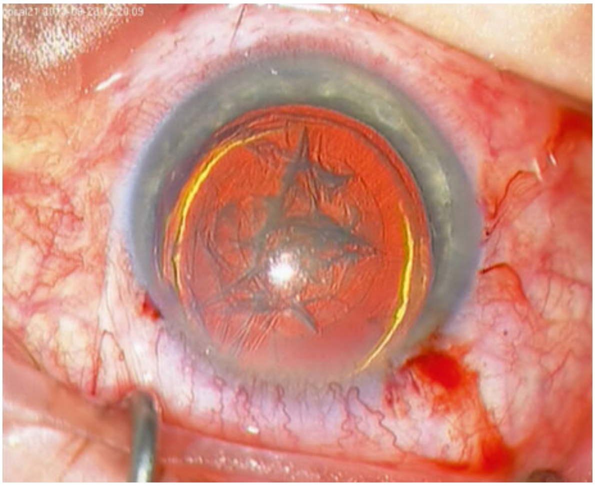


Fig. 4.30 A successful hydrodelineation is seen as a golden ring



Grooving and Cracking

Two remarks about the phaco handpiece: Firstly, the phaco handpiece has much power; be cautious when using it. It is possible to aspirate the complete iris or the complete capsular bag. If you aspirate once a part of the iris into the phaco tip, then you will inadvertently aspirate it again and again. Secondly, the phaco handpiece is coaxial which means that irrigation and emulsification are integrated in one instrument. The irrigation must always be switched on; otherwise, the anterior chamber will collapse. The problem is in order to have a continuous irrigation; you need to press permanently on the foot pedal. As a beginner you can take advantage of the continuous irrigation mode of the phaco machine. I recommend doing so for the first 100 cataracts.

Grooving: Begin by aspirating the cortex within the rhexis margins to improve the view onto the nucleus. Then sculpt the groove (Figs. 4.31 and 4.32). Point the phaco tip steep by moving the phaco tip downwards and then horizontally. The groove should not be too short, and stretch from rhexis edge to rhexis edge (in a medium-sized rhexis). Focus the microscope on the middle of the groove, in order to detect the red reflex. The fundus reflex is a secure sign with the exception of a rock-hard nucleus. Here you may be working just above the lens capsule without seeing a red reflex.

Cracking: Hold the phaco tip (only irrigation, no phaco) at the left bottom edge of the groove and the manipulator at the right bottom edge of the groove (Fig. 4.33), and then move both instruments simultaneously to the side, in a slight horizontal and upward direction (Fig. 4.34). The cracking is easy if the groove is deep enough. If you do not succeed, then deepen the groove and crack again.

Pits and Pearls No. 2

Soft nucleus: A soft nucleus is a difficult case. Do not operate a soft nucleus as a beginner. The problem is that the nucleus is difficult to remove. There are two tricks for a soft nucleus: (1) Luxate the nucleus with hydrodissection outside the lens capsule. The nucleus is now located in the anterior chamber. Remove the nucleus with the phaco handpiece in “epinucleus” mode. (2) Remove the nucleus inside the lens capsule with the phaco handpiece in “epinucleus” mode.

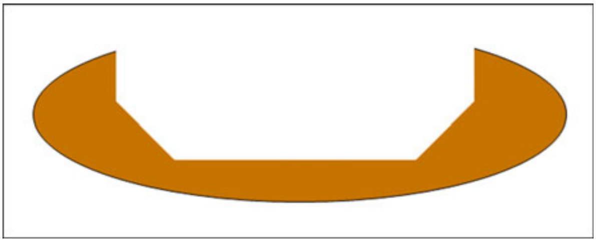


Fig. 4.31 Phacoemulsification. The groove must be steep at the edges and deep in the middle

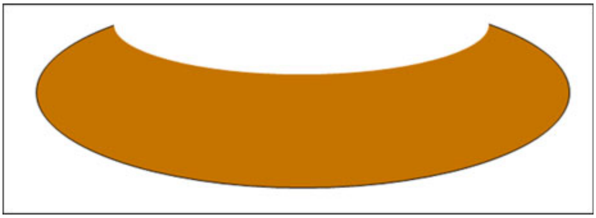


Fig. 4.32 This is a typical beginner groove. Flat at the edges and shallow in the middle. Do not perform your groove like this

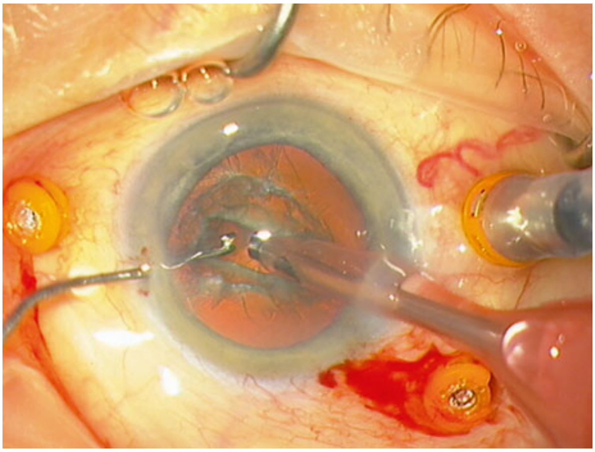


Fig. 4.33 Cracking. Place the phaco tip and the manipulator at the very bottom of the groove. This manoeuvre is easier with a dense than with a soft nucleus

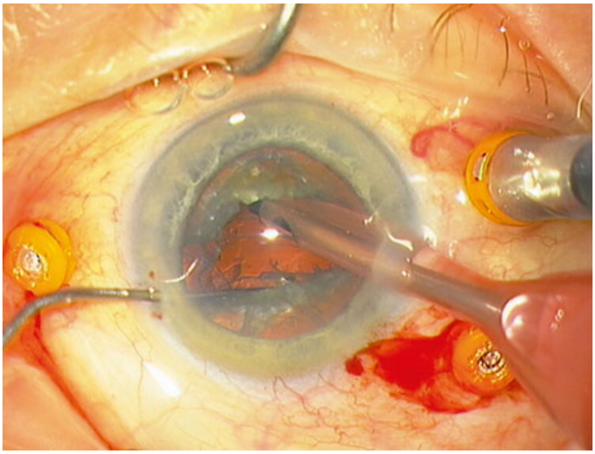


Fig. 4.34 Cracking. Move both instruments apart. The manoeuvre succeeds if the groove is deep enough. If not then deepen the groove with phacoemulsification

Pits and Pearls No. 3

Unsuccessful cracking. The reasons may be a dense nucleus or a groove, which is not deep enough. Inject viscoelastic into the groove. Take two manipulators (e.g. push pull), one in each hand, place them at the bottom edges of the groove and crack the nucleus (Fig. 4.35 and 4.36).

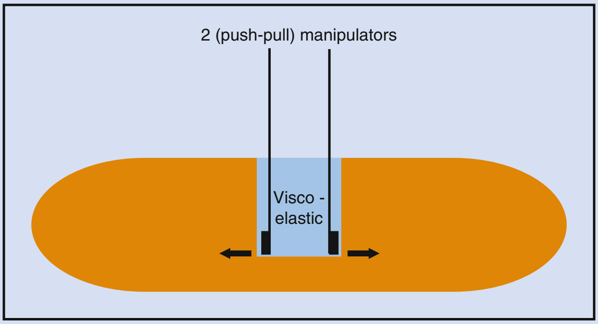


Fig. 4.35 Difficult cracking. In the case of a very dense nucleus, you may not succeed with the cracking manoeuvre although the groove is deep enough. Inject viscoelastics inside the groove. Place two manipulators at the bottom of the groove, and proceed with the cracking movement

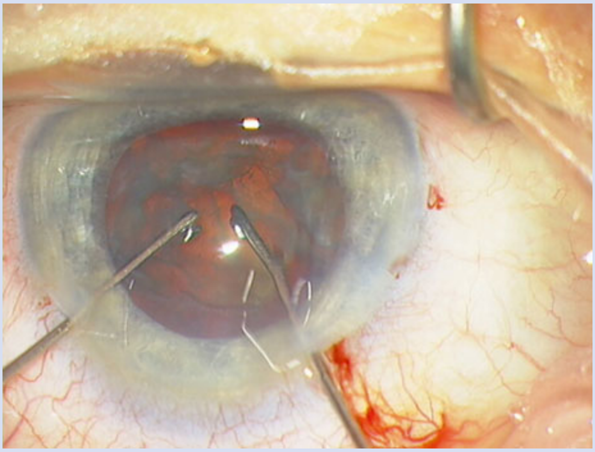


Fig. 4.36 Difficult cracking. It is essential to crack the groove. Do not proceed with a not or only partially cracked groove. You can only remove fragments, which are completely cracked!

Pits and Pearls No. 4

Conjunctival chemosis. A chemosis may occur at the paracenteses and especially at the tunnel incision and may be disturbing. Take the tunnel knife, and make a small incision in the conjunctiva to the left or the right from the tunnel (Fig. 4.37).

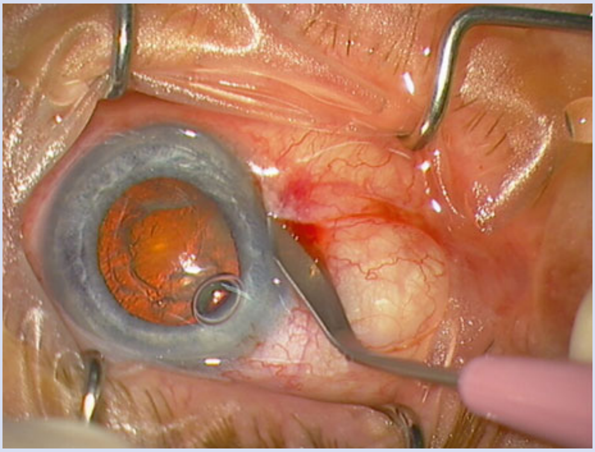


Fig. 4.37 Conjunctival chemosis. The cause is a too posterior (scleral) main or side incision. Cut the conjunctiva (3–4-mm limbal incision) at the left and right side of the main incision

Rotate

Begin by placing both instruments at the far periphery of the groove (Figs. 4.38 and 4.39). Then push simultaneously both instruments so that the nucleus rotates. You can rotate clockwise or anticlockwise, but adjust the instruments appropriately. The rotation manoeuvre requires some learning time. Rotate 90° and sculpt the next groove. Crack the groove again and continue with the quadrant removal.

Quadrant Removal (Phaco or Flip)

Do not move the phaco tip too much; stay more or less in the middle of the pupil. Use instead the manipulator to feed the phaco tip with nuclear fragments.

The first quadrant is always the most difficult to remove; the subsequent quadrants come easy. First check if the quadrant you want to remove is mobile. Have both edges been fully cracked? If not then finish this job first before removing the quadrant. Otherwise you will not succeed. Then change the machine settings to quadrant removal mode. You need more aspiration than in the sculpting mode in order to suck in the quadrant. Touch the quadrant with the phaco tip, increase aspiration, and draw slowly the phaco handpiece backwards. Check if the quadrant follows or if it remains stuck. You can repeat this manoeuvre a few times but every time you will remove some tissue from the quadrant until it gets difficult to aspirate the residual quadrant.

In this case a "flip" manoeuvre helps (Figs. 4.40, 4.41 and 4.42). You need a blunt manipulator such as a push-pull manipulator. The best instrument, however, is an iris spatula (Fig. 2.16) because there is no risk to damage the posterior capsule. Begin by rotating the quadrant you want to remove onto the opposite side of the paracentesis with the manipulator (see drawing). Direct the tip of the manipulator between the nucleus and the epinucleus. The risk to damage the posterior capsule is low. Then flip the nucleus up and move it in front of the phaco tip. After emulsification of the first quadrant, rotate the next quadrant in front of the phaco tip. Aspirate and emulsify it. The last half fragment can either be emulsified in toto or – and what we recommend – be cracked first. Rotate the fragment in front of the tip (Fig. 4.43), change the machine setting to sculpting mode, make a groove in the nuclear fragment and crack it in two halves. Then change the machine setting to quadrant removal, and emulsify the last two quadrants.

During removal of the nucleus, epinucleus sometimes comes in the way. Avoid removing it in this stage because it serves as a protection of the posterior capsule.

Pits and Pearls No. 5

Epinucleus during phaco. Do not remove the epinucleus during the removal of quadrants. Why? The epinucleus serves as a scaffold for the posterior capsule. The epinucleus prevents a floppy movement of the posterior capsule and consequently prevents that the posterior capsule is aspirated into the phaco tip.

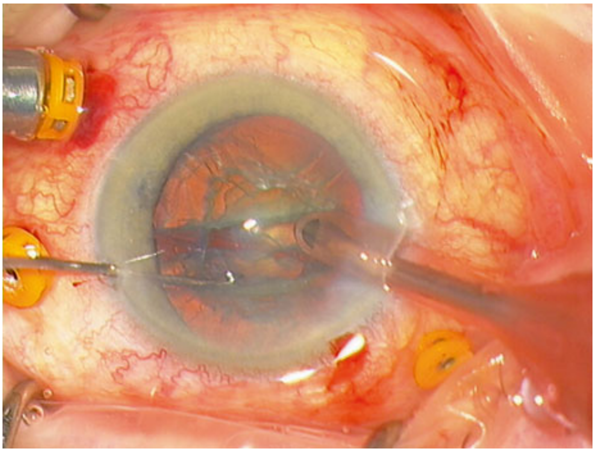


Fig. 4.38 Rotation of the nucleus. A precondition of a successful rotation is a good hydrodissection. Place the manipulator at one peripheral end of the groove and the phaco tip at the opposite peripheral end of the groove, and perform a rotational movement

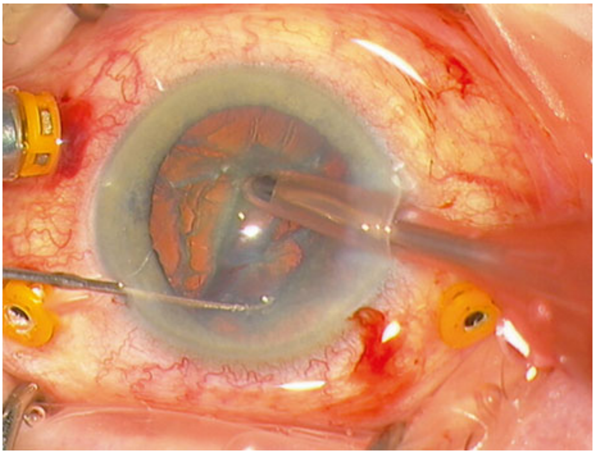


Fig. 4.39 A successful rotation of the nucleus

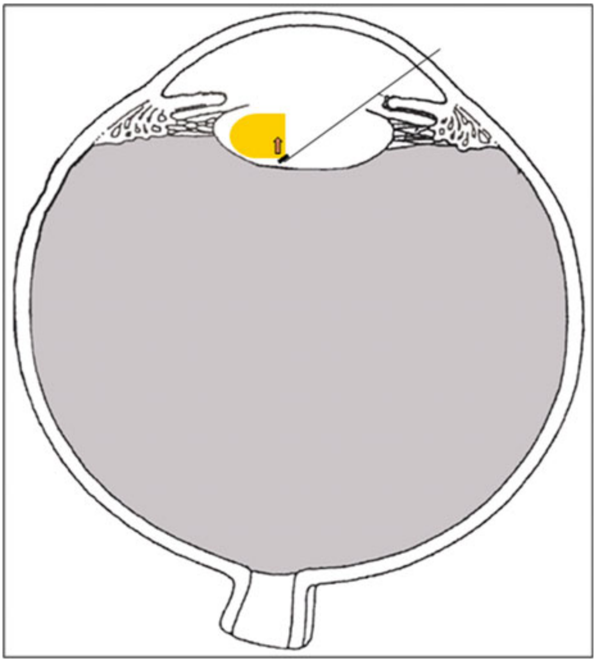


Fig. 4.40 Drawing of a flip manoeuvre. Place the manipulator below the fragment, and elevate (flip) the fragment. The flip manoeuvre is a great help especially for the beginner. If you are not able to remove the first fragment with the phaco tip, then perform a flip manoeuvre

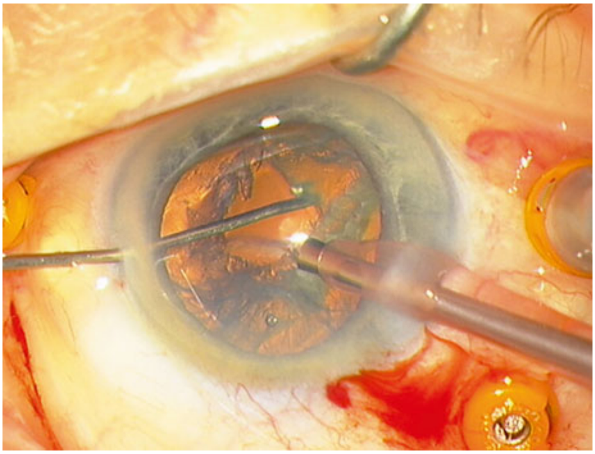


Fig. 4.41 Flip manoeuvre. The push-pull manipulator is placed below the fragment

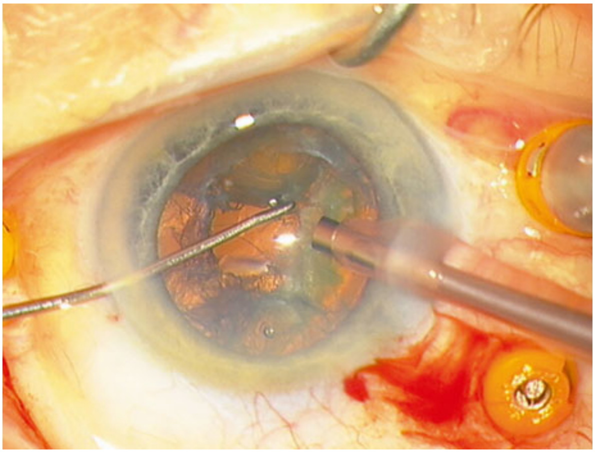


Fig. 4.42 Flip manoeuvre. The nuclear fragment is elevated and can now be easily removed with phacoemulsification

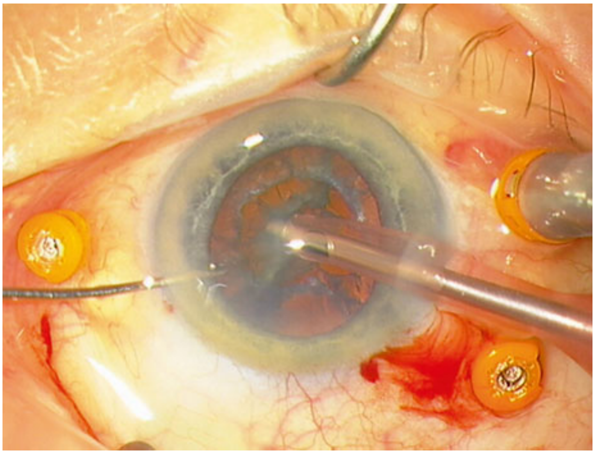


Fig. 4.43 Grooving of a half fragment. This manoeuvre must be performed in the "sculpting" mode, not in the "fragment removal" mode. After grooving the half fragment has to be cracked in two quarters

Pits and Pearls No. 6
Removal of phaco handpiece from anterior chamber. Remove first the manipulator (e.g. chopper) and then the hand piece, NOT vice versa. Why? If you remove the phaco handpiece first, the anterior chamber will flatten, and you will struggle to remove the manipulator. The same applies for I/A with bimanual handpieces. Remove irrigation last.

Pits and Pearls No. 7
Unsuccessful quadrant removal. Cause: Insufficient hydrodissection. Solution: Repeat hydrodissection. Take a syringe with BSS, and place the cannula between the anterior capsule and the nucleus you want to remove. Inject BSS and press the cannula a bit down at the same time. If you succeed the nuclear fragment will luxate up in the capsular bag. I recommend performing this step every time when you have problems removing a quadrant.

Epinucleus Removal
The success of this step depends again on a successful hydrodissection. As a beginner it might be wise to remove the epinucleus with bimanual I/A handpieces or even easier with a coaxial I/A handpiece. Change the machine settings to Epinucleus mode. Place the phaco tip at the epinucleus and aspirate the epinucleus. Don't touch the rhexis edge! Aspirate slowly and try to remove adjacent epinucleus by moving the phaco tip horizontally. The epinucleus around the main tunnel incision is difficult to remove if hydrodissection was not complete. Remove it in the next step.

7. Irrigation and Aspiration (I/A)
   Instrumentation
   I/A handpiece, bimanual (Figs. 4.9 and 4.10). One handpiece is for irrigation and another handpiece for aspiration. You access the anterior chamber through two paracenteses.
   Operation
   Change the machine settings to I/A mode. We recommend to use bimanual I/A handpieces (Fig. 4.44). If you are a beginner, then use the continuous irrigation mode to avoid an anterior chamber collapse. Begin by placing the irrigation tip in the anterior chamber and holding it still. Proceed by directing the aspiration tip under the anterior capsule approximately 1–2 mm beyond the rhexis edge. Aspirate and observe if cortex gets aspirated. If so draw the aspiration tip slowly towards the middle of the pupil. Make sure that the cortex follows with, if not increase, aspiration. If you are finished with one side of the lens capsule, then change instruments and do the other side.

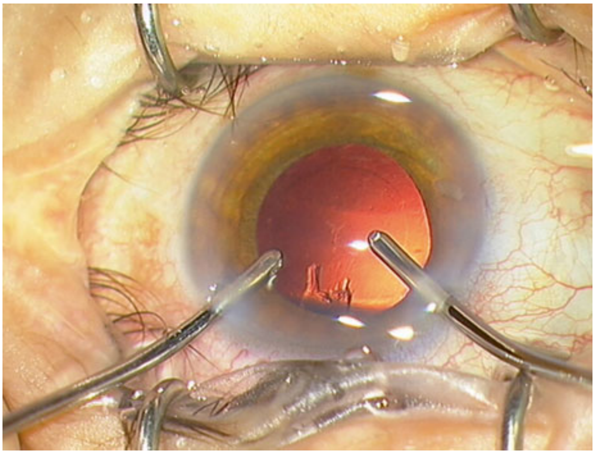


Fig. 4.44 Bimanual I/A. Sometimes a residual cortex remains at 12 o'clock, which is difficult to remove

Pits and Pearls No. 8

Residual cortex: If a small cortical strand remains, leave it. Safety comes first. Do not insist in removing it and risking a posterior capsular defect.

But there are a few tricks to solve this problem. (1) The simplest solution is a paracentesis at the opposite side of the vitreous strand. Access the anterior chamber from the new paracentesis, and remove the residual cortex (Figs. 4.45 and 4.46). (2) Implant the IOL in the capsular bag, and rotate the IOL 360°. The haptics loosen the residual cortex. Remove finally the viscoelastic and the residual cortex with I/A. If you hold the aspiration tip above (not behind) the IOL, you do not risk to injure the posterior capsule.

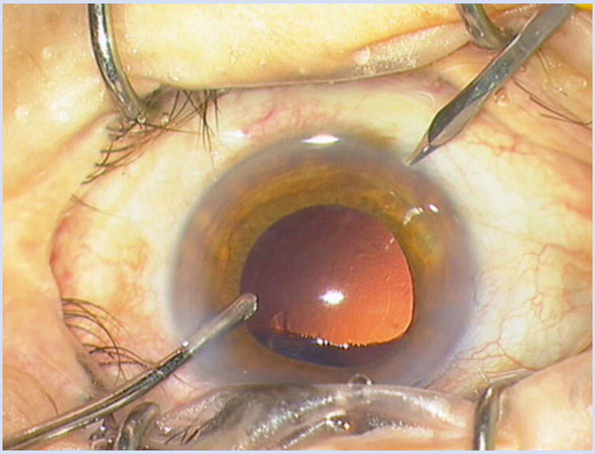


Fig. 4.45 Residual cortex at 12 o'clock. Perform a paracentesis at 6 o'clock

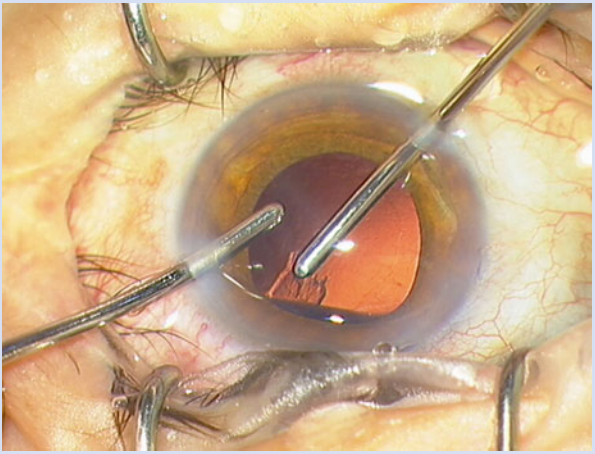


Fig. 4.46 Residual cortex at 12 o'clock. Insert the aspiration handpiece at 6 o'clock, and remove the residual cortex

8. IOL implantation
9. Removal of viscoelastics

   I recommend to learn how to load an IOL in an injector. Every skill you master on your own is worth it. Inflate the capsular bag with viscoelastic. Hold the injector like a pencil, and rotate the tip into the tunnel incision (Fig. 4.47). If it does not fit, then do not insist, but enlarge the tunnel with the 2.4-mm knife. Place the tip in the capsular bag, and turn with the nondominant hand the screw thread until the IOL is completely inside the anterior chamber. You can either press the IOL into the capsular bag or rotate it into the capsular bag. For the latter place a push-pull instrument at a haptic and rotate the IOL into the capsular bag. Double-check that both haptics are located behind the anterior capsule. The easiest way to do so is by checking whether the anterior capsule lies above or below the haptics. It is a frequent beginner mistake to leave one haptic in the sulcus. If one haptic remains in the sulcus, then the rhexis would be oval, not round; in addition an IOL with both haptics in the bag lies more posterior and is not tilted.

Pits and Pearls No. 9

Unstable anterior chamber. If you have an unstable anterior chamber, then inject air into the anterior chamber. Air has a higher surface tension than BSS. The anterior chamber is therefore more stable under air than under BSS.

10. Hydration of corneal incisions
11. Intracameral cefuroxime

    Instrumentation

    Intracameral antibiotics. Cefuroxime (cefuroxime, several providers such as GlaxoSmithKline and others)

    Operation

    Place the syringe filled with BSS almost parallel to the limbus into the paracentesis incision, and inject a little BBS (Figs. 4.48 and 4.49). The manoeuvre is easier than it looks. Inject finally cefuroxime intracameral as endophthalmitis prophylaxis.

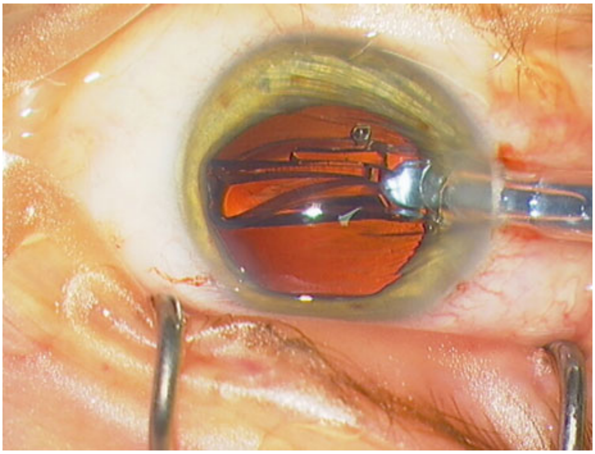


Fig. 4.47 IOL implantation. If the main incision is too small for the cartridge, then enlarge it with the main incision blade. The implantation of a 1-piece IOL is simple. The implantation of a 3-piece IOL requires some training

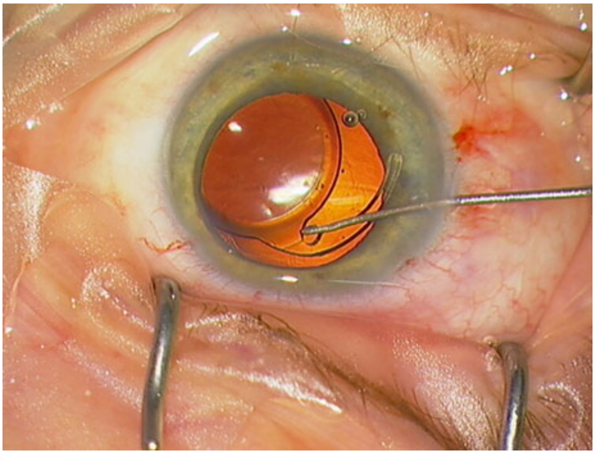


Fig. 4.48 The push-pull instrument facilitates the IOL implantation, especially in case of a 3-piece IOL. Place the tip of the instrument at the haptic, and rotate the IOL into the lens capsule. Check after implantation that the IOL is completely implanted into the bag. Examine especially the haptics: Is the lens capsule at the haptic round (haptic in the bag) or oval (haptic in the sulcus)?

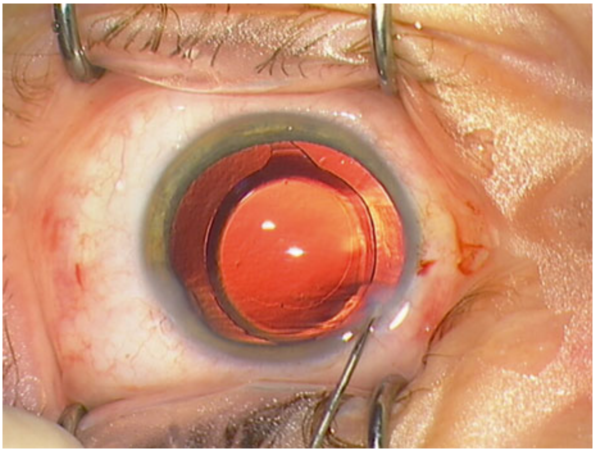


Fig. 4.49 Hydration of paracentesis. Make the side incisions watertight by injecting BSS into the corneal stroma

4.4 Phacoemulsification of a Difficult Cataract

4.4.1 Small Pupil: Implantation of Iris Retractors and Malyugin Ring

4.4.1.1 Small Pupil

Especially as a beginner you should always work with a wide pupil. Do not perform a cataract operation if the pupil is small. You will regret it. There are several possibilities to widen the pupil: (A) With two push-pull instruments, (B) with iris hooks and (C) with Malyugin ring. And in case of a small fibrosed pupil, you can perform D) a sphincterectomy.

Instrumentation for Widening with Push-Pull Instruments

Two push-pull instruments (Geuder, Fig. 4.7)

Insert both push-pull instruments simultaneously through both side incisions. Place the instrument at the opposite side at the pupillary edge, and widen the pupil horizontally (Fig. 4.50). Then perform the same manoeuvre vertically. Inject again viscoelastics. If you are not satisfied with the pupil's size, then you have to continue with insertion of iris retractors.

Instrumentation and Material for Iris Retractor Insertion

1. Iris retractors (Fig. 4.51)
2. Surgical suturing forceps (e.g. Castroviejo forceps) (Fig. 4.52)
3. Anatomical tying forceps (e.g. Paufique tying forceps, Geuder 19045) (Fig. 4.53)
4. A grey 27-G cannula attached to a 3-cc syringe (Fig. 4.54)

Place a grey cannula (27G) on a 3-ml syringe, and bend the cannula rectangularly (Fig. 4.54). Make a paracentesis (more scleral than an ordinary paracentesis) (Fig. 4.55). Grasp an iris hook with an anatomic tying forceps, and insert the iris hook in the anterior chamber (Fig. 4.56). You can fixate it at once or after insertion of all iris retractors. Then introduce the remaining three iris retractors. For fixation of the iris hook, grasp the silicone stopper with the surgical forceps and turn the iris hook around its axis until the hook lies correctly behind the pupillary edge (tricky manoeuvre). Take the anatomic suturing forceps in the other hand, grasp the end of the iris hook and push the silicone stopper towards the limbus (Figs. 4.57 and 4.58). If you do not get the hook under the iris, then inject viscoelastics behind the iris so that the iris is elevated. If necessary you can even insert a fifth iris hook (Fig. 4.59).

For removal grasp the hook at the limbus with the tying forceps and the silicone stopper with the suturing forceps (Fig. 4.60). Pull the silicone stopper upwards while fixating the iris hook with the tying forceps. Loosen the hook at the pupillary edge, and pull the hook slowly and obliquely outside.

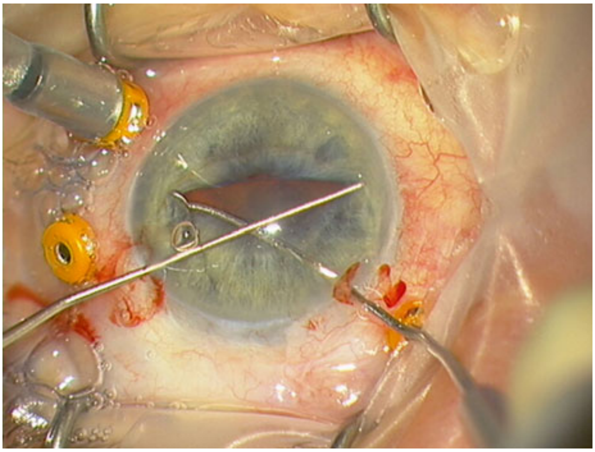


Fig. 4.50 Pupil stretching: Insert two push-pull instruments through the side incisions, place them at the pupillary edge at the opposite side, and dilate the pupil. Perform the same manoeuvre at 6 o'clock and 12 o'clock, then reinject viscoelastics, and perform the rhexis

Fig. 4.51 Iris retractors. The iris retractor consists of a hook and an adjustable silicone stopper, which provides grip and allows adjustment of pupil size. Indication: Small pupil, zonular lysis and examination of the anterior capsule. Alcon/Grieshaber: Flexible iris retractors REF 611.75

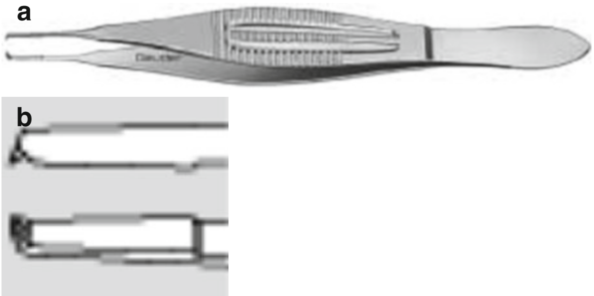


Fig. 4.52 (**a**, **b**) Instruments for insertion of iris retractors: Suturing forceps. Indication: Fixation of stopper. *Castroviejo* suturing forceps, Geuder, 19023

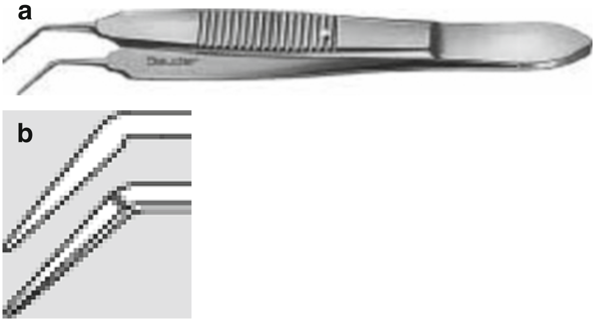


Fig. 4.53 (**a**, **b**) Instruments for insertion of iris retractors: Tying forceps. Indication: Fixation of iris retractor. *Tying* forceps, Geuder, 19032

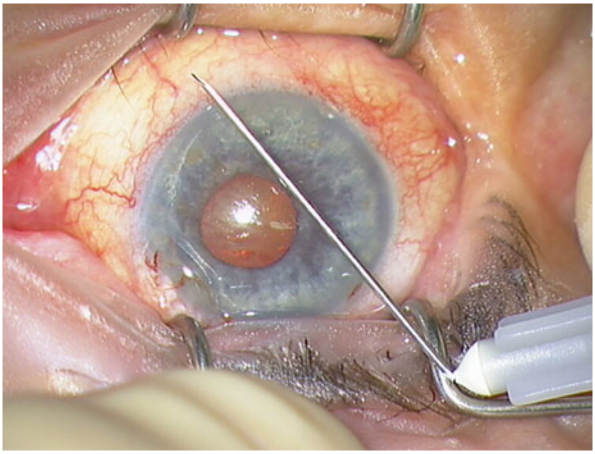


Fig. 4.54 Instruments for insertion of iris retractors: Grey cannula (27G) attached to a 3-cc syringe. Indication: Sclerotomy for iris hook

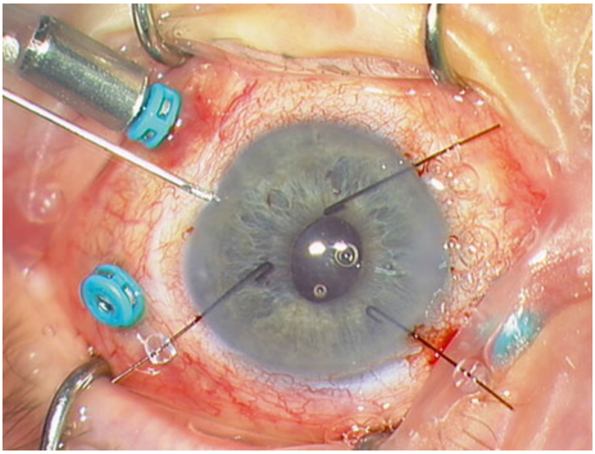


Fig. 4.55 Insertion of iris retractors: Perform a scleral incision with the grey cannula attached to a syringe

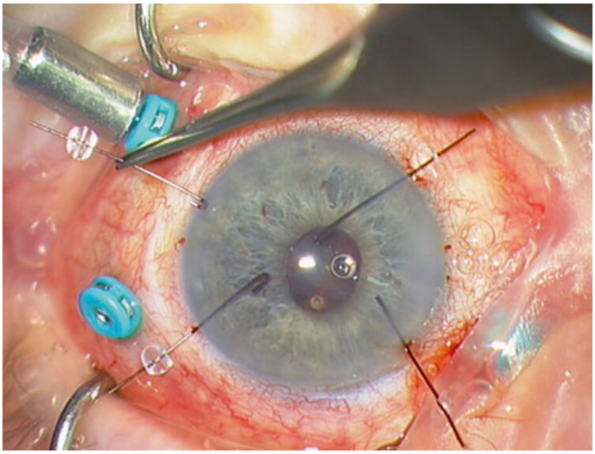


Fig. 4.56 Insertion of iris retractors: Hold an iris retractor with the tying forceps, and insert the iris retractor

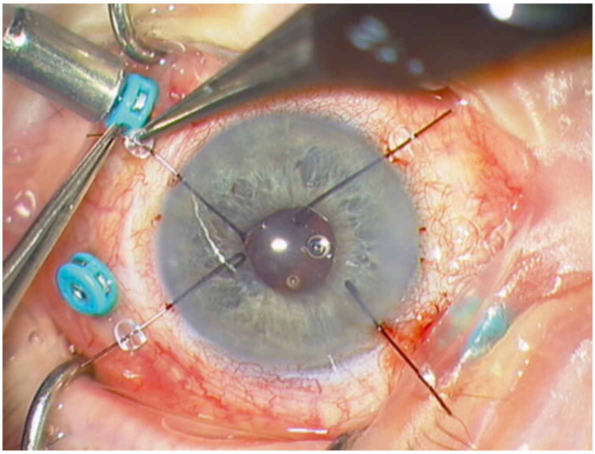


Fig. 4.57 Insertion of iris retractors: Hold the iris retractor with the tying forceps, and pull the silicone stopper with the suturing forceps towards the limbus

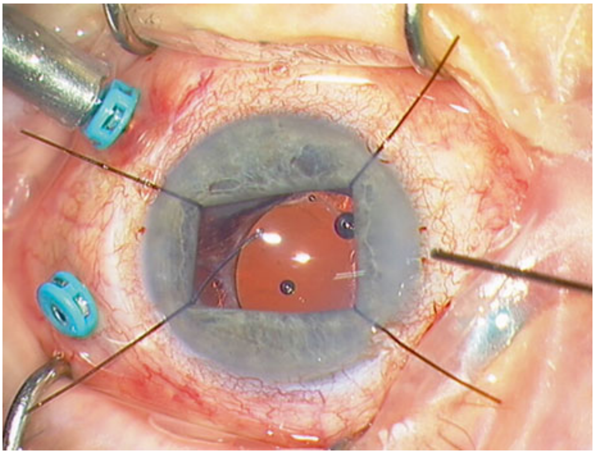


Fig. 4.58 Insertion of iris retractors: The insertion of four iris hooks is usually sufficient. Here the iris hooks were inserted to visualise the lens capsule

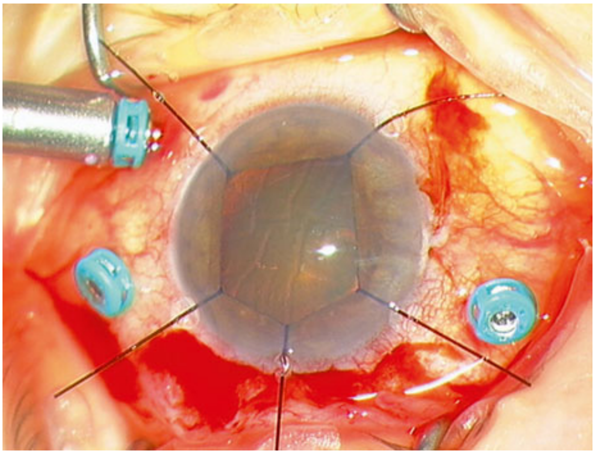


Fig. 4.59 Insertion of iris retractors: If necessary insert five iris retractors

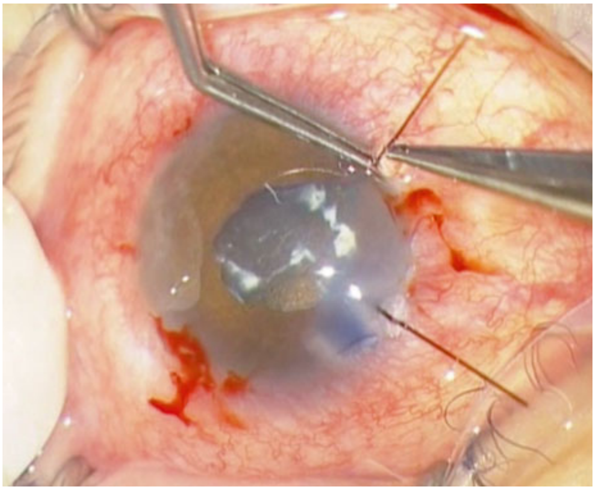


Fig. 4.60 Removal of iris retractors: Hold the iris retractor with the tying forceps between the limbus and silicone stopper (left instrument). Then grasp the silicone stopper with the suturing forceps, and retract the silicone stopper (right instrument). Then remove the iris hook cautiously with the tying forceps

Insertion of a Malyugin Ring

Video 4.3: Implantation of a Malyugin ring

The Malyugin ring creates a round enlarged pupil (Fig. 4.61) compared to iris retractors which create a rectangle. The Malyugin ring is easy to implant and explant but more traumatic to the iris tissue than iris retractors. Damage to the iris sphincter is less common if you use the 6.25-mm Malyugin ring.

Instrumentation and Material for Malyugin Ring

1. Malyugin ring with injector (MST, USA)
2. Implantation: Kuglen hook or push-pull manipulator (Fig. 2.15)
3. Explantation: Intravitreal forceps (Fig. 2.13) or surgical forceps (Fig. 2.11)

A Malyugin ring has four scrolls. Main incision at 12 o'clock. Inject the ring, and place the distal scroll in the pupillary edge at 6 o'clock. Remove the injector. Position the proximal scroll at 12 o'clock with a manipulator, and then finally position the lateral scrolls.

For removal, disengage the distal scroll, then the proximal scroll and finally the lateral scrolls. Place the ring on top of the iris. Grab the scroll at 12 o'clock with the forceps from the main incision, and extract the complete ring.

Spincterectomy in Small Fibrosed Pupil

Video 4.4: Sphincterectomy

In case of very small pupil and fibrosed sphincter (Fig. 4.62) or fibrosed membranous pupillary ring, a very effective method to increase pupil size is mechanical removal of the membrane and cutting the sphincter muscle (sphincterectomy). This usually results in moderate pupil dilatation sufficient for phacoemulsification.

Instruments

Endoforceps (e.g. Scharioth IOL fixation forceps set 1286.SFD, DORC Int., The Netherlands)

Individual Steps

1. Insertion of permanent infusion or injection of more OVD.
2. Releasing of posterior synechiae.
3. Removal of fibrosed tissue from pupillary margin.
4. Refill with OVD (e.g. Healon5) to increase pupil size.

Standard main incision and side ports are prepared. The anterior chamber is filled with OVD. Posterior synechiae are released with blunt instrument (e.g. spatula). Through side port incision an endoforceps is introduced, and the fibrosed tissue at pupillary margin is grasped (Fig. 4.63). Then this tissue is pulled to release contraction (Fig. 4.64). Sometimes a second instrument is used to counterpressure the tissue and to facilitate separation (Fig. 4.65). This procedure is repeated 360° all around. Occasionally the tissue cannot be removed just by pulling; in this case dense tissue could be cut with endoscissors. After complete removal of the fibrosed tissue, the anterior chamber is refilled with OVD. The use of viscoadaptive OVD (e.g. Healon5, AMO, USA) could lead to additional increase in pupil size. These manipulations should result in moderate pupil dilatation sufficient for phacoemulsification (Fig. 4.66). Otherwise additional techniques and/or devices are needed.

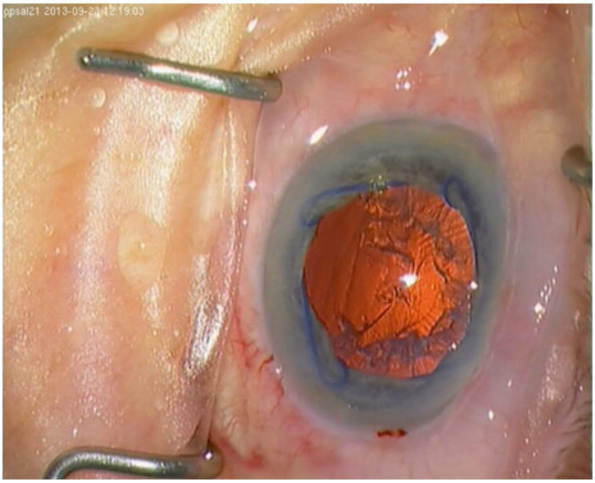


Fig. 4.61 A Malyugin ring achieves a round dilatation of the pupil

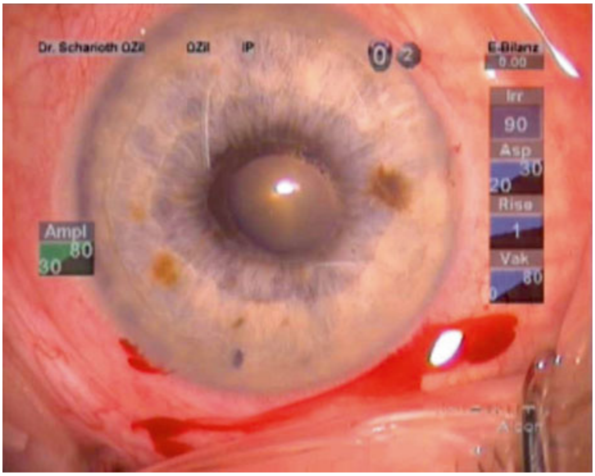


Fig. 4.62 Very small pupil with fibrosed pupillary margin prior to any manipulation

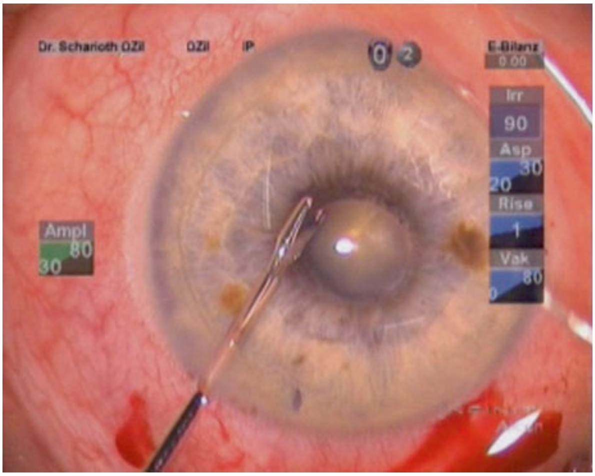


Fig. 4.63 Endoforceps is used to grasp the fibrosed tissue

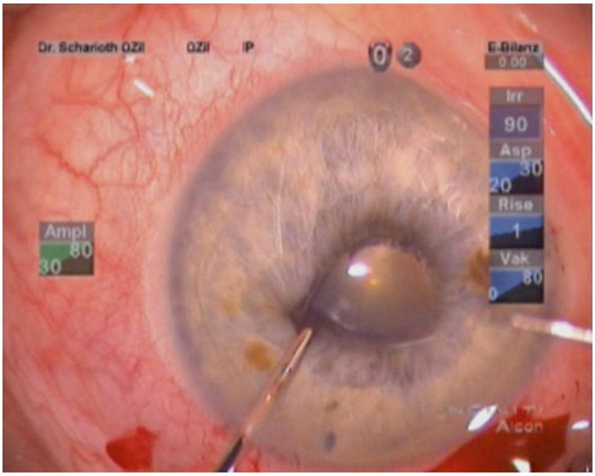


Fig. 4.64 With the endoforceps the fibrosed tissue is pulled from iris tissue

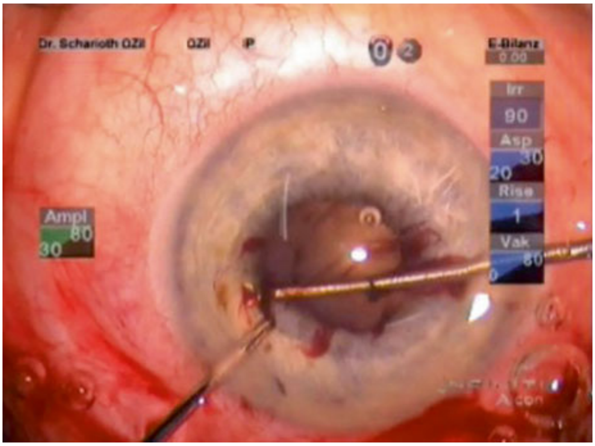


Fig. 4.65 In case of very strong adhesion of the fibrosed tissue to the iris, a second instrument could be used to help separation

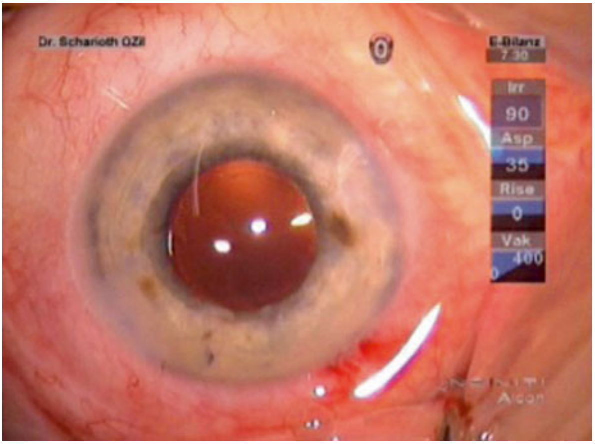


Fig. 4.66 Same eye after completion of phacoemulsification and IOL implantation

4.4.1.2 Posterior Synechiae

Posterior synechiae do not cause a surgical problem in most cases; inject viscoelastic into the anterior chamber and remove the synechiae with the viscoelastic cannula (Figs. 4.67, 4.68, 4.69 and 4.70). If you have circular posterior synechiae, you have to work from both paracenteses. If the pupil is not sufficiently dilated after removal of the synechiae, you should use iris retractors. If the nucleus is mature and you want to stain with VisionBlue, then you must first remove the synechiae and then inject the dye; otherwise, you will only stain the small pupil.

4.4.2 Problems During Capsulorhexis

4.4.2.1 Flat Anterior Chamber

Inject Healon GV (Fig. 4.71) in case of a flat anterior chamber. It facilitates the capsulorhexis very much. In addition, perform a long main incision in order to prevent iris prolapse.

Pits and Pearls No. 10

Flat anterior chamber: When using a regular capsulorhexis forceps, you loose viscoelastics through the main incision. You might need to reinflate the anterior chamber a few times during rhexis. As an alternative you can perform the rhexis from the side incision. From the side incision you can use a cystotome (Fig. 4.4) or a special capsulorhexis forceps (Figs. 4.105 and 4.106). These instruments enable a rhexis through the side incision and prevent an outflow of viscoelastics.

4.4.2.2 Extending Capsulorhexis

Instrumentation

1. Capsulotomy scissors (Fig. 4.72)

   Halt the rhexis, reinject viscoelastic to flatten the nucleus and continue the rhexis. If the rhexis extended peripherally to the zonules, you have two options (Fig. 4.73). You can (a) place back the flap of the lens capsule, grasp the peripheral edge with the forceps and pull the capsule towards the centre (Figs. 4.74 and 4.75). If the manoeuvre succeeds the rhexis and continues from the zonules inwards, then fold the capsular flap back and continue with the rhexis or (b) cut the lens capsule with a capsulotomy scissors (Fig. 4.76) and complete the rhexis. For the beginner, I recommend the second method, because it is technically easier.

   Important: A rhexis, which extends peripherally to the zonules, is quite stable and only continues to the posterior capsule, if you continue the rhexis with force.

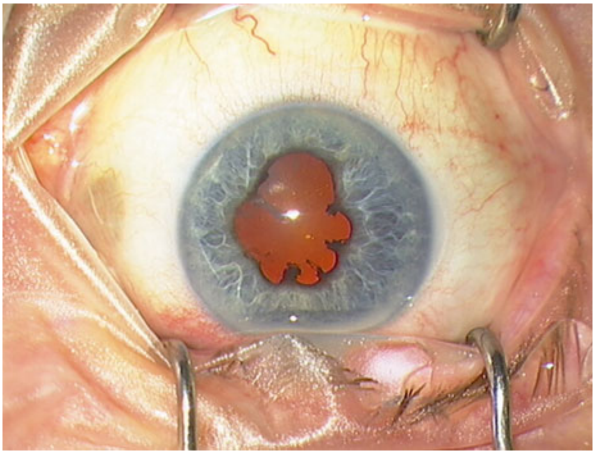


Fig. 4.67 Posterior synechiae do not present a surgical problem

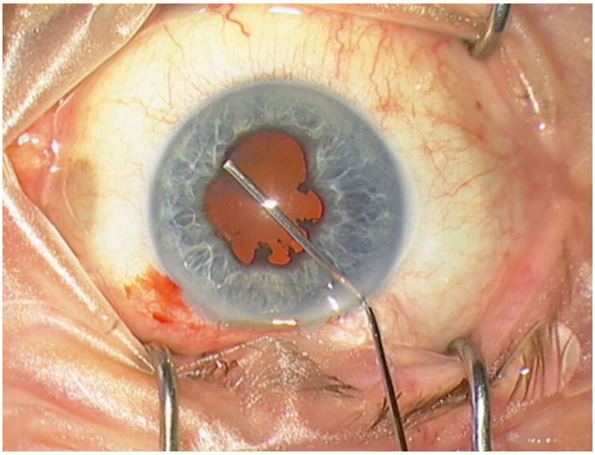


Fig. 4.68 Posterior synechiae. Inject viscoelastics

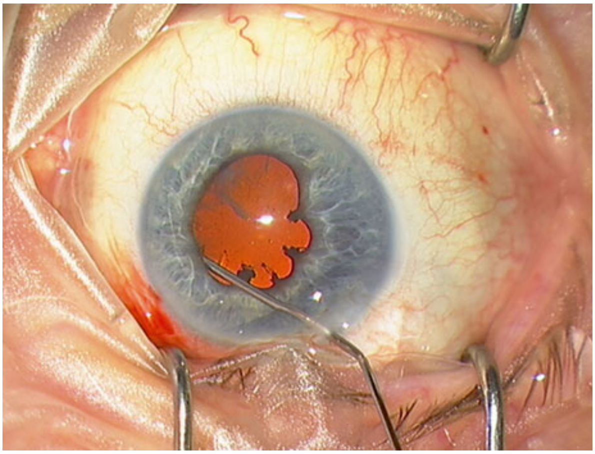


Fig. 4.69 Posterior synechiae. Remove the synechiae with the viscoelastics cannula

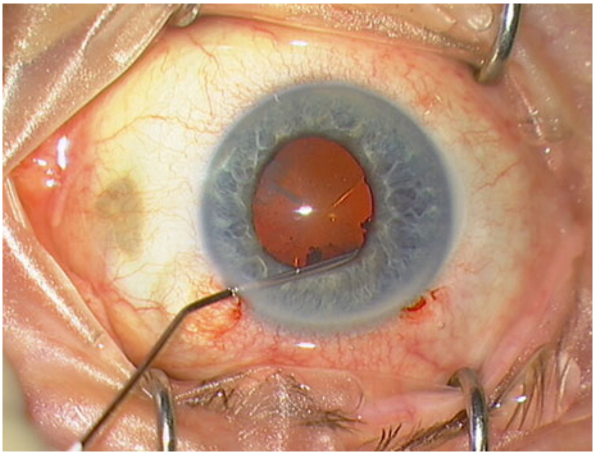


Fig. 4.70 Posterior synechiae. If necessary work from both side incisions

Fig. 4.71 Healon GV (AMO). A highly cohesive viscoelastic, which is very helpful in shallow anterior chambers or floppy iris syndrome

Fig. 4.72 Capsulotomy scissors. Indication: Peripheral extension of the rhexis and cutting of an IOL. Geuder 19776

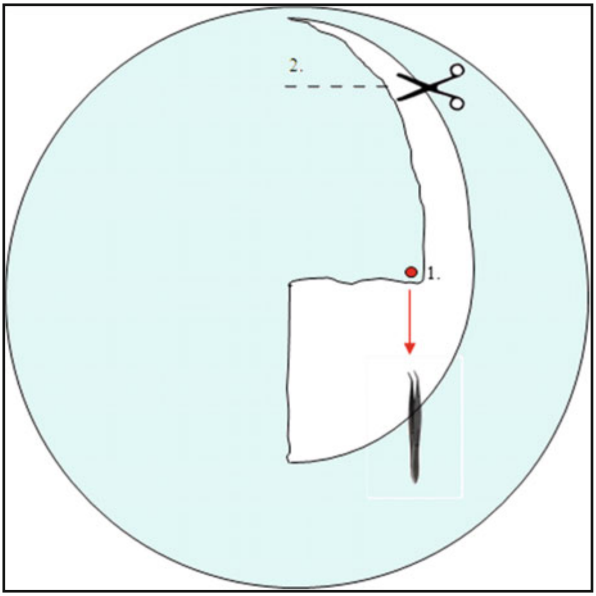


Fig. 4.73 Peripheral extension of capsulorhexis. Two solutions: (1) Place the flap back. Grasp the edge of the flap with the capsulorhexis forceps and pull the flap in the direction of the *arrow*. The peripheral rhexis will continue centrally. (2) Cut the anterior capsule with the capsulorhexis forceps and continue with the rhexis

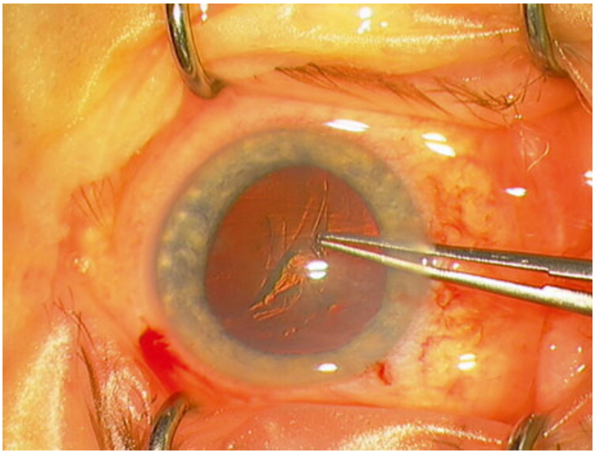


Fig. 4.74 Peripheral extended rhexis with the first solution. Place the flap back, grasp the end of the flap with the capsulorhexis forceps and pull the flap towards the centre. The rhexis will continue inwards

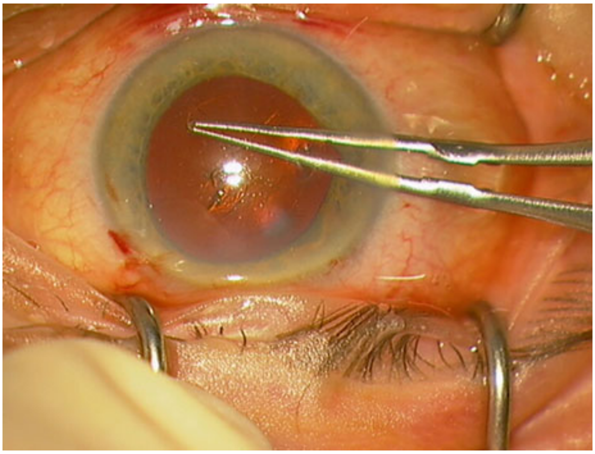


Fig. 4.75 Fold the flap back and continue with the rhexis

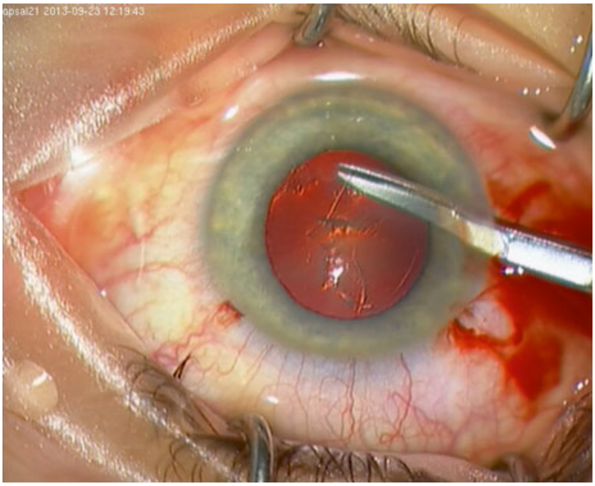


Fig. 4.76 Cut the anterior capsule with a capsulotomy scissors at the site of peripheral extension. Then continue with the rhexis

4.4.2.3 Outside Notch in the Rhexis

Instrumentation

1. Capsulorhexis forceps (Fig. 4.5)

   An outside notch is dangerous because the rhexis can extend peripherally at the notch. As soon you detect this defect inject viscoelastic into the anterior chamber, grasp one side of the notch with the capsulorhexis forceps and make the defect round (Fig. 4.77). Only a round rhexis is stable. If you detect the outside notch during I/A, you can also grab (aspirate) the defect bit of rhexis with the tip of the aspiration handpiece and remove it by making a round movement.

4.4.2.4 White Mature Nucleus: Injection of VisionBlue®

Material

VisionBlue® (DORC)

Procedure: Begin with the injection of an air bubble into the anterior chamber. The air bubble protects the endothelium from a possible toxic effect of VisionBlue (trypan blue). Inject next VisionBlue® (Fig. 4.78). Wait approximately 30 s, and then irrigate the anterior chamber with BSS (Fig. 4.79). Inject at last viscoelastics and proceed with the rhexis (Fig. 4.80).

You will never regret to have used VisionBlue® (Fig. 4.81), but you often regret not to have used it. However, it is never too late to use VisionBlue®. If you notice during a rhexis that you need VisionBlue®, then remove the viscoelastic with I/A and inject VisionBlue®. Remove then the dye with BSS, inject viscoelastic and proceed with the rhexis.

Pits and Pearls No. 11

Small Pupil and White Nucleus. First insert iris retractors and then stain the nucleus. If you first stain the pupil, then you will only stain the central part of the nucleus.

You will never regret having used iris hooks but sometimes regret not to have used them. It is never too late to use iris retractors. If you cannot cope with a small pupil during phaco or I/A, then don't hesitate to insert iris retractors. The same applies for VisionBlue.

4.4.3 Problems During Hydrodissection

4.4.3.1 Iris Prolapse

An iris prolapse is caused by an increased intraocular pressure. A short tunnel incision, a flat anterior chamber and a tense patient aggravate the prolapse risk. If you then overinflate the anterior chamber with BSS, the iris presses towards the incisions (Fig. 4.82). What to do? Wait and press carefully on the paracentesis incisions to release intracameral fluid. Check with the finger if the eye gets soft. If not continue to release carefully BSS from the paracentesis. Then push the iris *gently* back (Fig. 4.83). If the pressure does not subside, then wait 5–10 min.

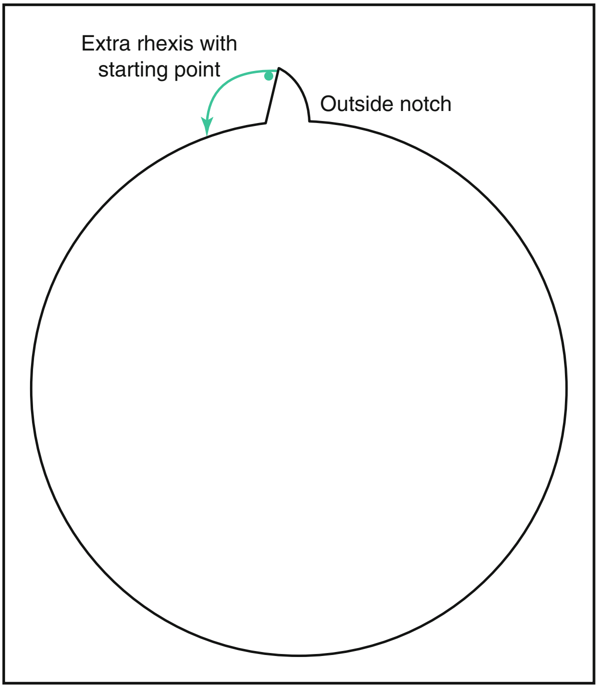


Fig. 4.77 Outside notch of capsulorhexis. Grasp the anterior capsule with the capsulorhexis forceps, and pull the flap in the direction of the *arrow*. The aim is a round rhexis

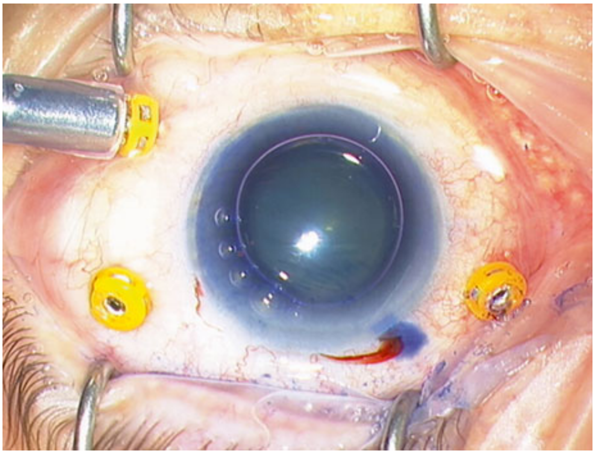


Fig. 4.78 Inject first an air bubble in order to protect the endothelium and then the dye

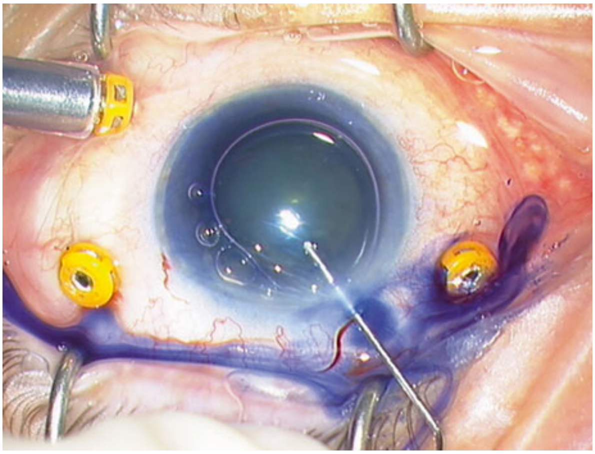


Fig. 4.79 Wait a few seconds and then remove the dye with BSS

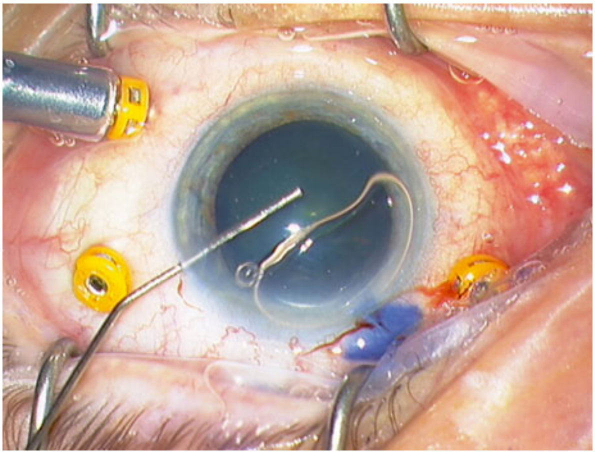


Fig. 4.80 Inject viscoelastics and remove the air bubble

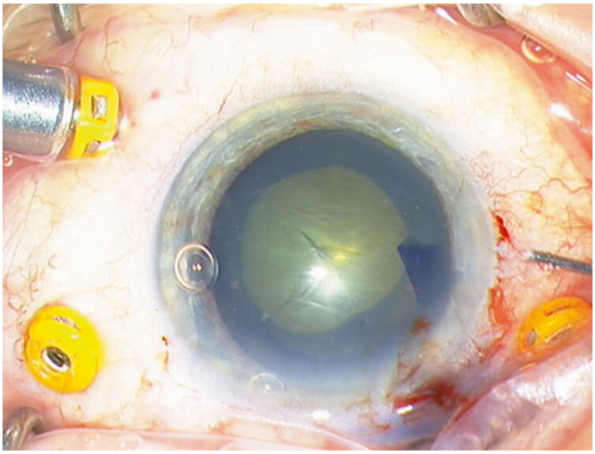


Fig. 4.81 You never regret using VisionBlue

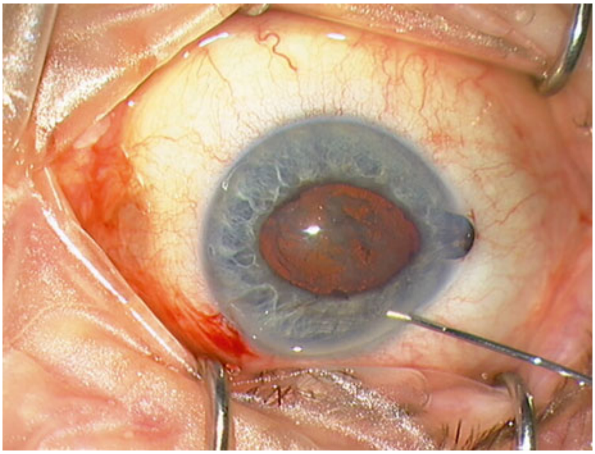


Fig. 4.82 Iris prolapse during hydrodissection

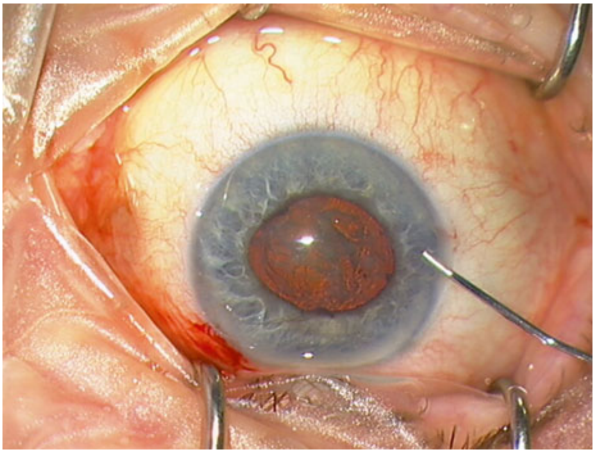


Fig. 4.83 Iris prolapse. Release fluid from the anterior chamber via the paracentesis. Check with the finger if the pressure is reduced. If not, release more fluid from the anterior chamber

If the iris prolapse recurs, I recommend a new tunnel incision. The procedure is as follows: Reposition the iris prolapse, close the tunnel incision with an Ethilon 10-0 interrupted stitch and make a new and longer tunnel incision. If you continue with the same main incision, you will cause a significant iris trauma and have continuous problems under phacoemulsification.

Remember: An iris prolapse is caused by increased intraocular pressure. It is therefore useless to push the iris prolapse back if the pressure is still high. You will not succeed! Reduce the intraocular pressure, and the iris prolapse will disappear almost by its own.

4.4.3.2 Excessive Pressure from Behind During Surgery

In these cases the anterior chamber is completely flat, and an I/A with maximal bottle height is not possible. There are two possible solutions: (1) Wait. Wait 10 min. If the pressure subsides, continue cautiously. It is possible that an excessive pressure from behind reoccurs. In this case, I would stop the surgery and plan a new intervention in general anaesthesia in the following days. (2) Anterior/core vitrectomy. Insert a trocar 3.5 mm behind the limbus. Perform a short anterior vitrectomy from pars plana *without* infusion. Remove so much central vitreous until the globe is soft. Feel with your index finger. Then continue with phacoemulsification.

> **Pits and Pearls No. 12**
> *Pressure from Behind (Vis à Tergo).* If you work in drop anaesthesia, and the patient is tense, you should perform a peribulbar anaesthesia to relax the eye and the patient.

4.4.4 Complications During Phacoemulsification

Video 4.5: Hard nucleus and small pupil

4.4.4.1 Posterior Capsule Rupture and Dropping Nucleus

See also Sect. 7.1.

A dropping nucleus can only be saved from pars plana and not from the anterior chamber because you need to place the viscoelastic cannula behind the nucleus. You have to work fast; otherwise, the nucleus will be lost. If you suspect a dropping nucleus in an early stage of the surgery (e.g. large zonular lysis), then perform the sclerotomy or insert a trocar in advance in order not to lose time.

Instrumentation

1. Paracentesis knife, e.g. 15° knife (Figs. 2.5 or 2.8)

OR

2. 23-G trocar (Fig. 4.84)

Stab the paracentesis knife 4 mm posterior the limbus into the middle of the eyeball, through the conjunctiva and the sclera. This manoeuvre is exactly the same as an intravitreal injection. Insert the viscoelastic cannula into the sclerotomy, place it behind the posterior capsule and inject viscoelastic behind the nucleus. Then luxate the nucleus with the viscoelastic cannula into the anterior chamber (Fig. 4.85).

Fig. 4.84 Trocar with inserter (Alcon). The trocar is at the left side; the handpiece/inserter has a knife for the sclerotomy at the left side and a marker for the sclerotomy on the right side

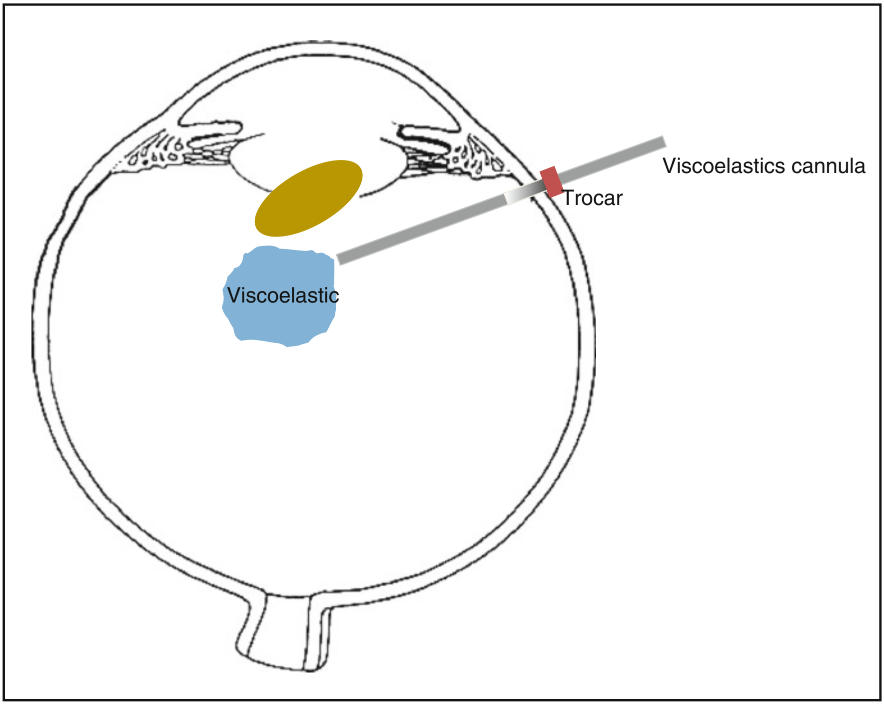


Fig. 4.85 Nuclear elevation from pars plana. In case of a posterior capsular defect and luxation of the nucleus, insert a trocar and inject viscoelastics posterior to the nucleus. Luxate then the nucleus with the viscoelastic cannula into the anterior chamber

Alternatively to a 20-G sclerotomy, you can insert a 20-G or 23-G trocar (Fig. 4.86). The insertion of a trocar is faster, and the trocar has a marking for the sclerotomy. The viscoelastic cannula fits easily through the trocar.

The next steps are removal of the nucleus, anterior vitrectomy and suturing of the sclerotomy. For further details see also Sect. 7.1.

4.4.4.2 Lens Capture

A continuous curvilinear capsulorhexis (CCC) provides a tear-resistant opening that allows use of a technique of capturing the intraocular lens (IOL) optic through the capsulorhexis opening when the opening is at least 1.0–2.0 mm smaller than the optic diameter (Fig. 4.87). The technique provides stability and long-term centration of the IOL and prevents the vitreous from extending anterior to the IOL.

For surgical technique see Sect. 7.1.

4.4.5 Problems During I/A: Implantation of Capsular Tension Ring

4.4.5.1 Reflux (Backflush) Function

If you accidentally aspirate the capsule, then you need to release it. If you activate the backflush function, then the irrigation handpiece flushes out the aspirated material. It is essential to know this function because you will now and then aspirate the posterior capsule, and unless you activate the backflush function, the capsule will tear. Check, therefore, before you start with surgery how to activate the backflush function on the foot pedal. It is usually right down.

4.4.5.2 I/A with Small Pupil

An I/A is difficult if the pupil is small (Fig. 4.88). Take advantage of the bimanual I/A handpieces, and move the iris to the side with the irrigation handpiece and aspirate the residual cortex with the aspiration handpiece (Fig. 4.89). If you have an aspiration handpiece with rough tip (Fig. 4.9), you can place the aspiration handpiece so far in the periphery of the capsular bag until the rough tip is covered by the pupillary edge (Fig. 4.90). And again: If you do not feel secure during I/A because of a small pupil, then insert iris retractors.

4.4.5.3 Zonular Lysis: Implantation of a Capsular Tension Ring

If you detect a small zonular lysis (one quadrant), then complete I/A and implant then the capsular tension ring. See also Sect. 7.2.

Instrumentation

Capsular tension ring with injector (Fig. 4.91)

Capsular Tension Ring: Indication: Zonular lysis

Procedure: Inflate the capsular bag with viscoelastic (Figs. 4.92, 4.93 and 4.94). Inject the capsular tension ring with an injector. It is important that you place the tip in the capsular bag and not in the sulcus. Sometimes problems arise with the end of the capsular tension ring because it does not come to lie in the capsular bag but in the sulcus. If this happens luxate the end part of the capsular tension ring with a push-pull instrument or a Sinskey hook into the capsular bag.

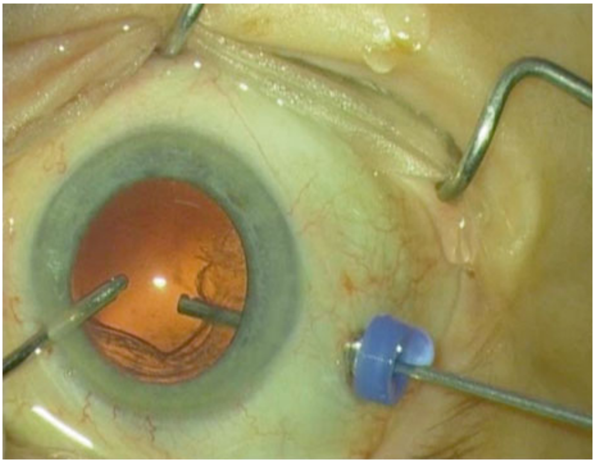


Fig. 4.86 An anterior vitrectomy from pars plana. Insert a trocar 3.5 mm behind the limbus. Then vitrectomise the anterior vitreous

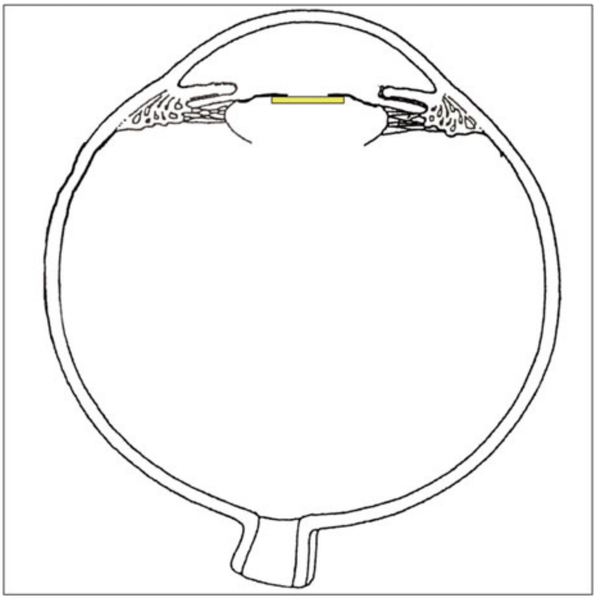


Fig. 4.87 Lens capture. In case of a posterior capsular defect, the IOL is implanted into the sulcus. Try to fixate the optic behind the rhexis. Buttonhole the optic behind the rhexis; the haptics remain in the sulcus

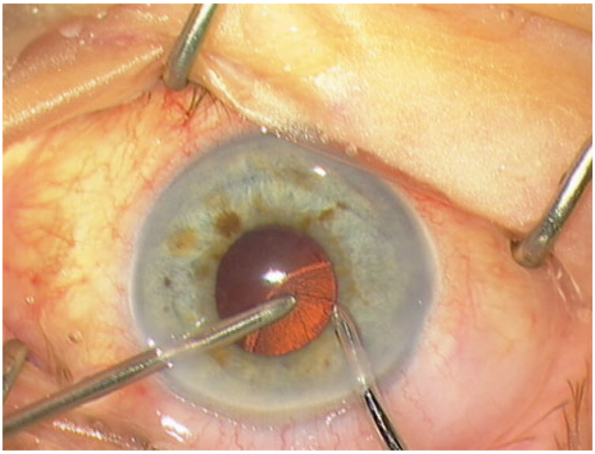


Fig. 4.88 Small pupil during I/A

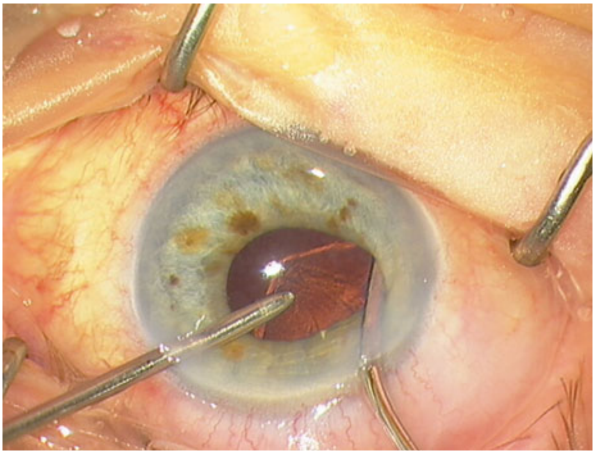


Fig. 4.89 Move the iris aside with the irrigation tip and remove the residual cortex

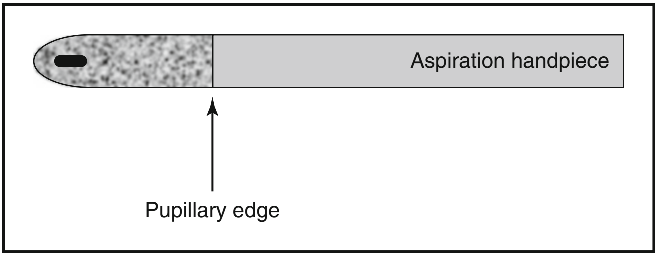


Fig. 4.90 Alternatively you can move the aspiration tip so far behind the iris until the dusted part of the tip is completely behind the iris, and then aspirate the residual cortex

Fig. 4.91 Capsular tension ring. Indication: Zonular lysis. I recommend a preloaded capsular tension ring with injector. There are many providers, for example, CROMA, AMO, Morcher, Arcadoptha and Geuder 32955

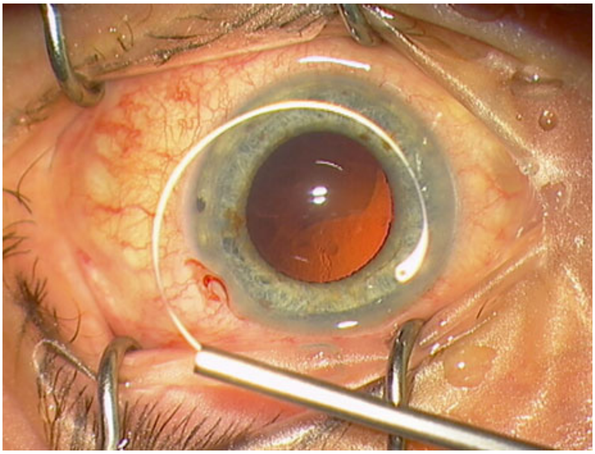


Fig. 4.92 The tip of the capsular tension ring injector and the capsular tension ring

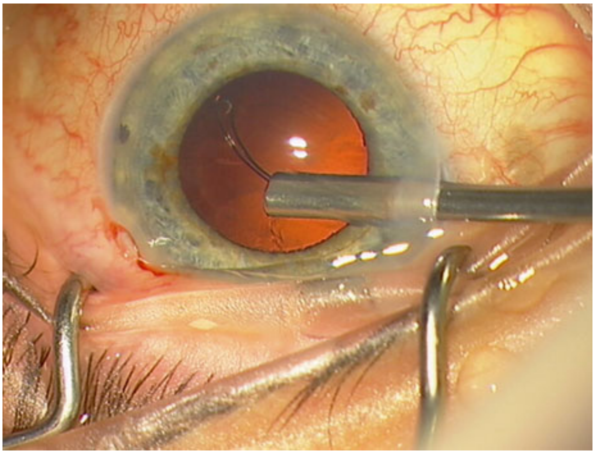


Fig. 4.93 It is important that the tip of the capsular tension ring is located in the capsular bag and not in the sulcus

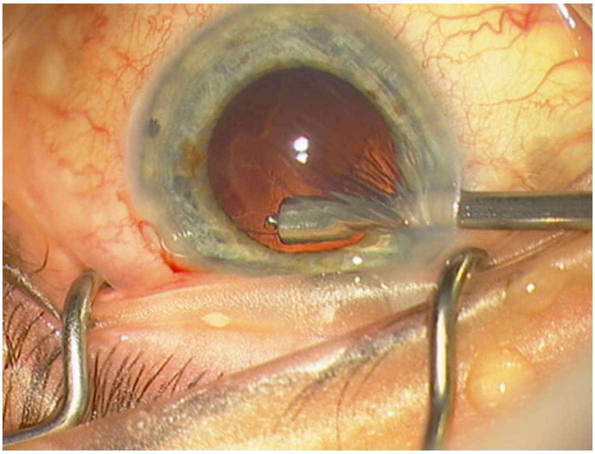


Fig. 4.94 Be also aware that the end of the capsular tension ring is located in the bag. If not, you can luxate it with a push-pull manipulator into the bag

4.4.6 Problems During IOL Implantation

Video 4.6: IOL complication during wound-assisted implantation 1

Video 4.7: IOL complication during wound-assisted implantation 2

Today cataract surgery and IOL implantation is performed through very small incisions. If the cartridge is too big to introduce it into the main incision, a so-called wound-assisted implantation is performed. This is usually the case with incisions smaller than 2.2 mm. After the eye is filled with OVD, the tip of the cartridge is connected to the main incision. It is very important to keep direct connection of the cartridge to the wound during the implantation. Most surgeons use a second instrument to stabilise and counterpressure the eye. Then the implantation is performed quickly. Sudden motion of the eye or patient, loss of counterpressure, soft eye and others can cause disconnection during the implantation. If this happens the IOL unfolds within the main incision (butterfly phenomenon).

Instruments

1. Anterior chamber maintainer or pars plana infusion (Fig. 5.12)
2. Tying forceps (Fig. 2.12)

Individual Steps

1. Insertion of permanent infusion or injection of more OVD
2. Decision making: continue implantation or explantation of IOL
3. If IOL was removed refill with OVD and repeat IOL implantation
4. Remove OVD
5. Hydrate incision and if leaking suture main incision

If IOL is unfolding within the main incision, decision has to be made whether implantation is continued (Fig. 4.97) or aborted and IOL is removed from the main incision (Fig. 4.95).

If less than one half is within the main incision, it is not possible to continue the implantation (Fig. 4.96). Removal is recommended. Even this could be very difficult. There could be a very high pressure within the main incision. This is the case if a hydrophobic IOL was used or the incision was extremely small. Try just to pull at the outer part of the IOL. Create a counterpressure with a second instrument under the IOL, or use side port incision (e.g. with the irrigation handpiece). If this is too traumatic, try to externalise the IOL haptic which might be still within the folded optic. This will release some of the pressure and usually allow withdrawal of the IOL. Use a tying forceps or a toothed forceps (e.g. Colibri forceps).

If more than one half is already through the main incision, it is better to complete the implantation (Fig. 4.97). Stabilise the anterior chamber with OVD or continuous irrigation. Then start to push the IOL with an atraumatic instrument (e.g. tying forceps). If this is not possible, the pressure within the main incision could be too high (Fig. 4.98). IOL haptic should be externalised from the main incision to reduce pressure within the main incision (Fig. 4.99). This should be performed very carefully. Inject some OVD into the folded IOL to reduce friction. Pull gently at the IOL haptic. Once it is externalised start again to push the IOL through the main incision (Fig. 4.100). Now IOL is checked for damages. If IOL is undamaged, it is placed in the capsular bag (Figs. 4.101 and 4.102). If damages are affecting central visual axis or correct centration of the IOL, it should be exchanged.

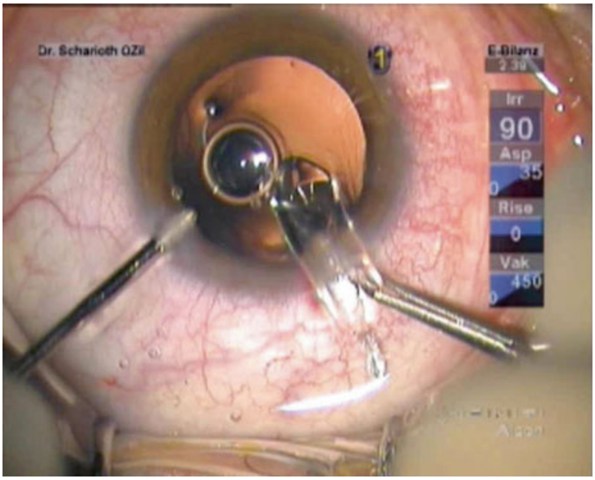


Fig. 4.95 IOL is unfolding within the main incision, forceps is pulling, and a second instrument is creating a counterpressure and stabilising the eye

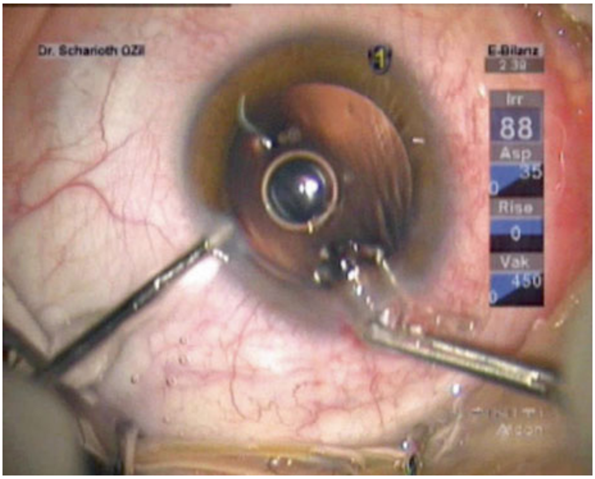


Fig. 4.96 IOL is explanted after haptic was removed from main incision

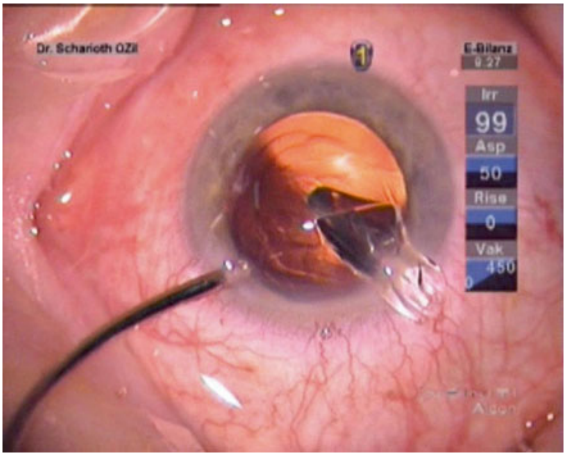


Fig. 4.97 IOL is unfolding within the main incision; more than 50 % are already through

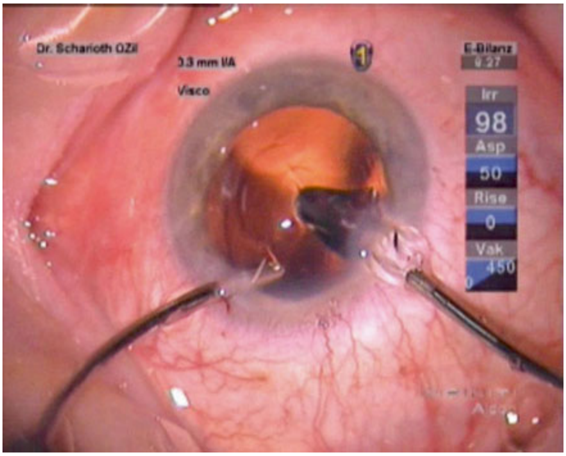


Fig. 4.98 Attempt is made to push the IOL through the main incision, but resistance is too high

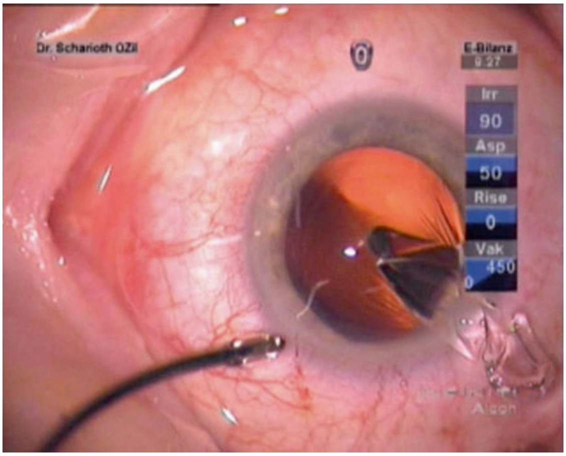


Fig. 4.99 IOL haptic is externalised; this releases some pressure from within the main incision

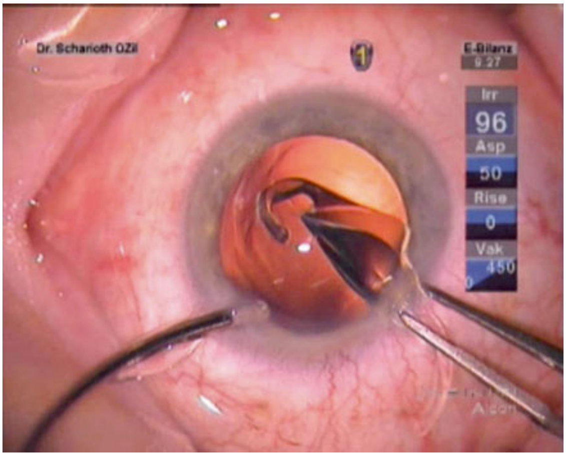


Fig. 4.100 With a tying forceps IOL is folded and slowly pushed through the main incision; counterpressure is created with a second instrument

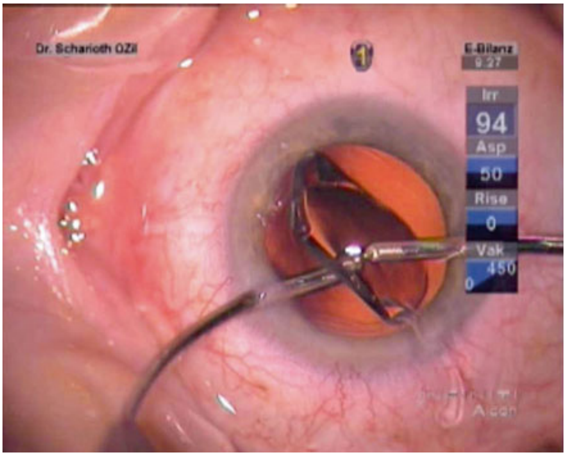


Fig. 4.101 Implantation is completed with bimanual irrigation and aspiration handpieces

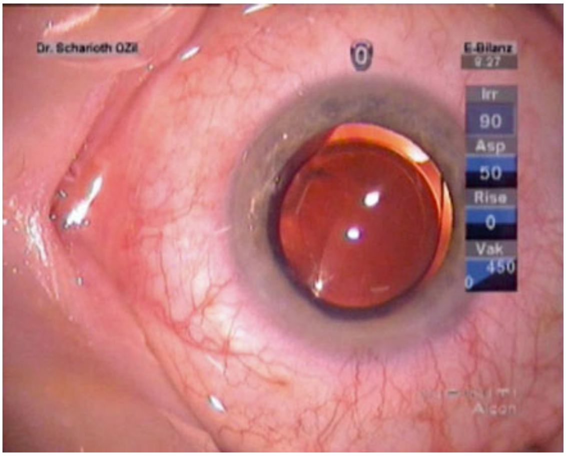


Fig. 4.102 IOL well centred within the capsular bag and IOL optic undamaged, after hydration incisions were self-sealing

The worst case is the so-called butterfly where the middle of the IOL optic is unfolding within the main incision. There sometimes it is not possible to move the IOL. The pressure within the main incision is so high that neither explantation nor implantation works. The only solution in this case is to enlarge the incision. Start with a side port incision next to the main incision and cut towards the main incision. Connection of both incisions will release pressure within the main incision, and IOL could be explanted.

Finally check incisions for leakage. The main incision is often damaged and needs to be sutured with an Ethilon 10-0 interrupted stitch or a cross-stitch.

Pits and Pearls No. 13

Wound-assisted IOL implantation can cause IOL unfolding within the main incision. Complete filling with OVD and continuous connection between IOL cartridge and main incision are mandatory. Create continuous pressure and counterpressure between the eye and the cartridge. Ensure patients cooperation.

If unfolding within the main incision occurred, explant the IOL if less than 50 % are within the wound. Try to complete implantation if more than 50 % are within the main incision.

4.4.7 Problems During Final Steps

If the main incision is leaking, then it should be sutured. Suture the main incision with an interrupted stitch or even better with a cross-stitch. The stitch can be removed 1 week postoperatively.

Suturing of Tunnel Incision

Instrumentation

1. Needle holder (Fig. 4.103)
2. Suturing forceps (Fig. 4.52)
3. Tying forceps (Fig. 4.53)
4. Suture. Ethilon 10-0 (Ethicon)

   Operation

   Grasp the upper lip of the main incision with the suturing forceps. Move the needle through the upper lip and the lower lip of the main incision with the needle holder. Suture 3-2-1 knots with the needle holder and the tying forceps.

   More stable than an interrupted stitch is a cross-stitch (Fig. 4.104). A stitch on the main incision should not be too tight. The main incision should be form-stable in order to avoid leakage. Try to avoid corneal folds; otherwise, you might induce astigmatism. You can remove the stitch after 1 week.

Fig. 4.103 Needle holder. Indication: Needle holder. Barraquer, Geuder 17500

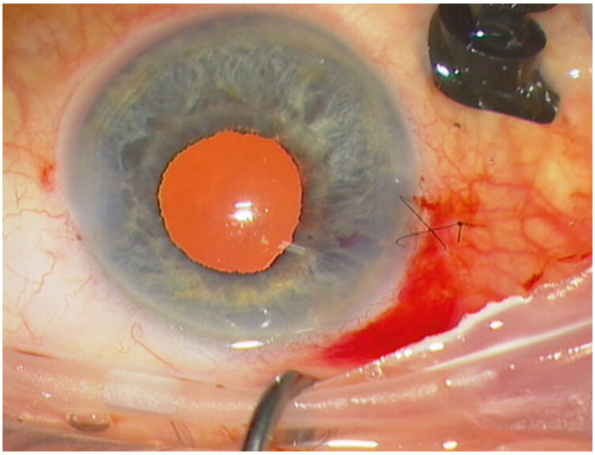


Fig. 4.104 Cross-stitch on a main incision with Ethilon 10-0

4.5 Traumatic Cataract

Videos 4.8, 4.9, 4.10 and 4.11: Special techniques for anterior chamber and 3x traumatic cataract

The surgery of an old traumatic cataract is not as difficult as the eye looks like. The main difficulty is the rhexis because the anterior lens capsule tissue is very fibrotic. To perform the rhexis you need special scissors (Figs. 4.105 and 4.106). These scissors enable to cut the anterior lens capsule from the side incisions. Often more than two side incisions are necessary to perform a circular rhexis (Figs. 4.107, 4.108 and 4.109).

If the posterior capsule is also fibrotic, then a posterior capsular rhexis needs also to be performed. This can be done in the easiest way at a later time point with a vitreous cutter from pars plana.

Instruments

1. Phaco set
2. Special capsule scissors
3. Regular capsulorhexis forceps

Individual Steps

1. Capsulorhexis
2. Phacoemulsification
3. I/A
4. IOL implantation

The Operation Step by Step

1. Capsulorhexis
   Use Healon GV if possible to inflate the anterior chamber. Enlarge the pupil if necessary (Figs. 4.110 and 4.111). Stain the anterior capsule with VisionBlue. Pinch a hole in the middle of the lens capsule with the cystotome. Perform a capsulorhexis with the capsulorhexis forceps. If you cannot continue with the rhexis due to a fibrosis, then cut the fibrosis with the special capsule scissors (Figs. 4.112 and 4.113). Then continue with the rhexis using the capsulorhexis forceps or cystotome (Fig. 4.114). Fibrotic parts of the lens capsule have to be removed with the capsulorhexis forceps (Figs. 4.115 and 4.116).
2. Phacoemulsification
3. I/A
4. IOL implantation
   Continue with phacoemulsification or with I/A if the nucleus is soft (Fig. 4.117). Implant a 1-piece IOL or even better a 3-piece IOL in the capsular bag (Fig. 4.118).
   Remark: The lens capsule in this specific case was fibrotic. It was not possible to remove the fibrosis without risking damage to the posterior capsule. The fibrosis was also too thick for removal with YAG capsulotomy. One month later, I created therefore a posterior capsular opening with a vitreous cutter from pars plana.

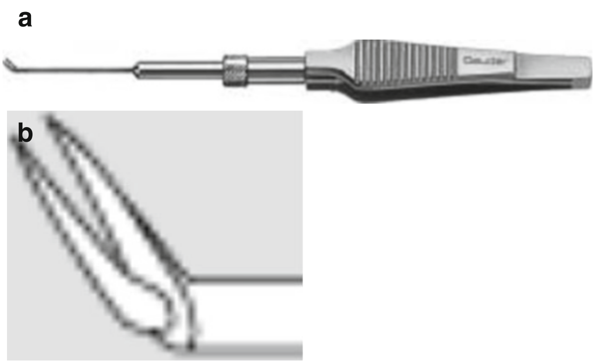


Fig. 4.105 Capsule scissors after Kampik (**a**, **b**). The instrument fits through a paracentesis. 22G. Indication: Cutting of capsule or iris. Geuder 38215

Fig. 4.106 Intravitreal scissors (**a**, **b**). 23G. Indication: General cutting of tissue. DORC 1286.J06

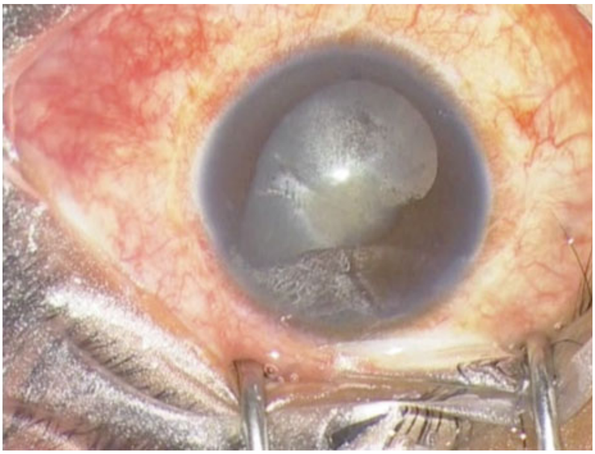


Fig. 4.107 Traumatic cataract after blunt trauma with a paint ball

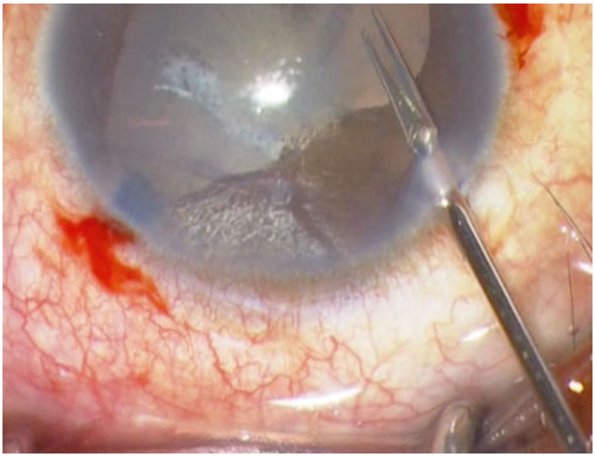


Fig. 4.108 Cutting a membrane with 23-G intravitreal straight scissors. A side incision at 11 o'clock is used

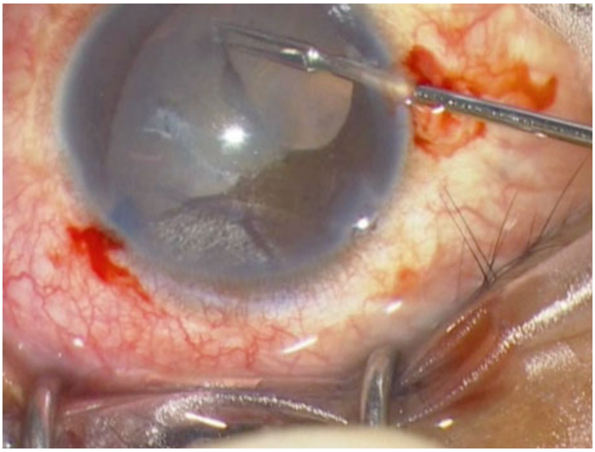


Fig. 4.109 Observe that a different side incision is used (8 o'clock). Cutting another membrane with 23G intravitreal scissors

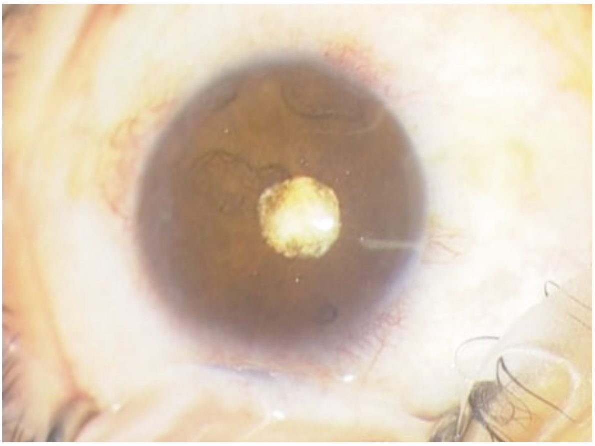


Fig. 4.110 Traumatic cataract after blunt trauma with a fist

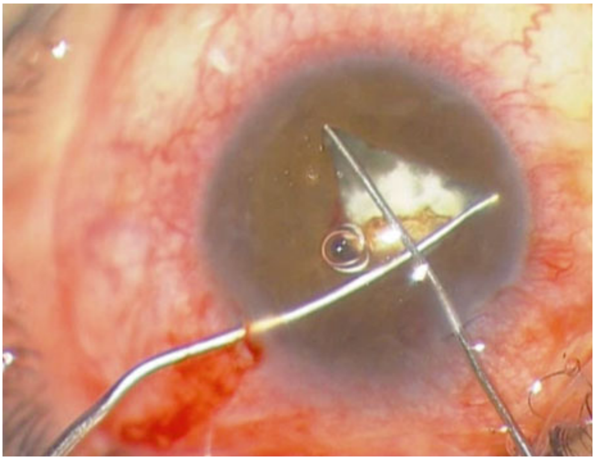


Fig. 4.111 Enlarging the small pupil with two push-pull instruments

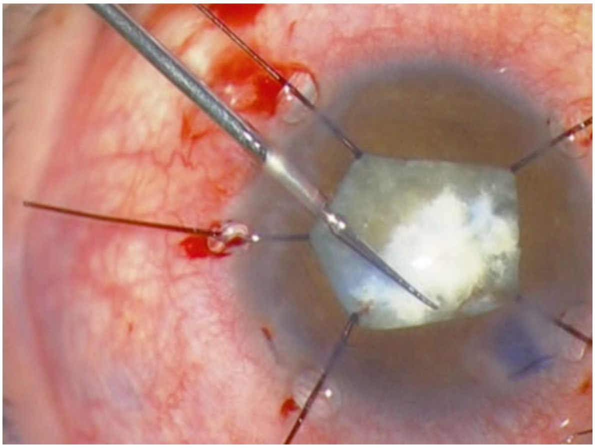


Fig. 4.112 Cutting a fibrotic part of the lens capsule with intravitreal straight scissors

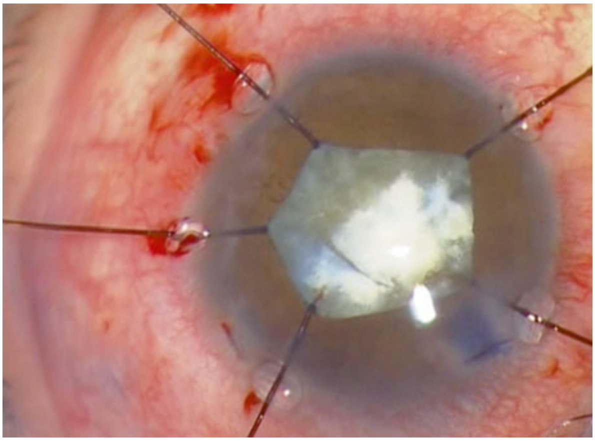


Fig. 4.113 Observe the cut in the white part of the fibrosis

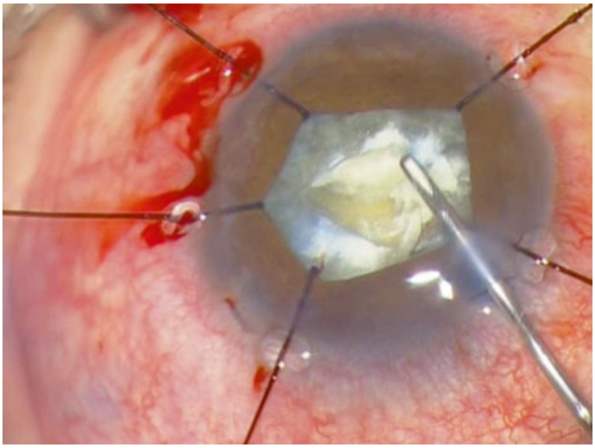


Fig. 4.114 Difficult rhexis due to much fibrosis

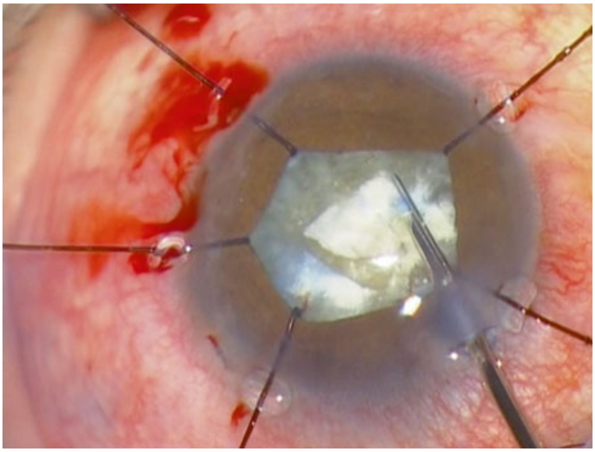


Fig. 4.115 Cutting the fibrosis with intravitreal straight scissors

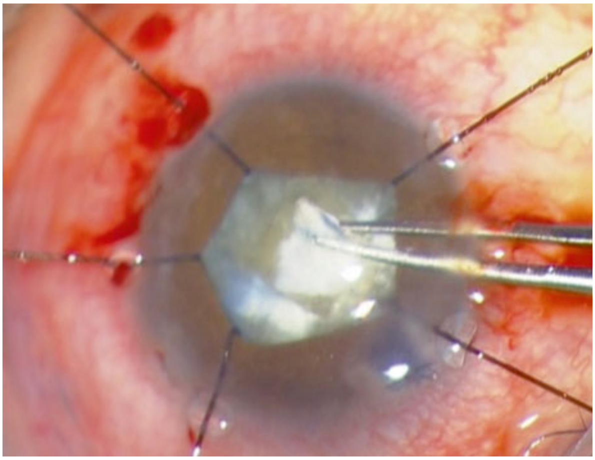


Fig. 4.116 Removing the fibrosis with a capsulorhexis forceps

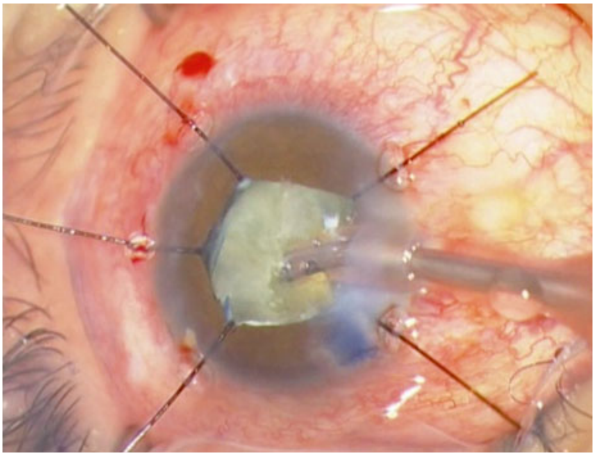


Fig. 4.117 Phacoemulsification of a dense nucleus. In some trauma cases the nucleus is reduced to a fibrotic remnant

Fig. 4.118 Implantation of a one-piece IOL into the capsular bag

4.6 SICS

Video 4.12: SICS technique

Video 4.13: SICS and inferior zonular lysis

If the nucleus is too dense for phacoemulsification and you risk a corneal decompensation, you can remove the nucleus faster and with fewer complications in toto (Fig. 4.119). An excellent technique is SICS (modified ECCE). The main difference between SICS and ECCE is the main incision. In ECCE a corneal incision from 10 o'clock to 2 o'clock is performed; in SICS a frown incision of the sclera is performed. A frown incision is V shaped; it widens from the sclera to the anterior chamber (Fig. 4.120). A frown incision is more tight and stable than a corneal incision. A suture is not always necessary. We prefer to suture the frown incision with a Vicryl 8-0 cross-stitch. We recommend performing the surgery in retrobulbar anaesthesia.

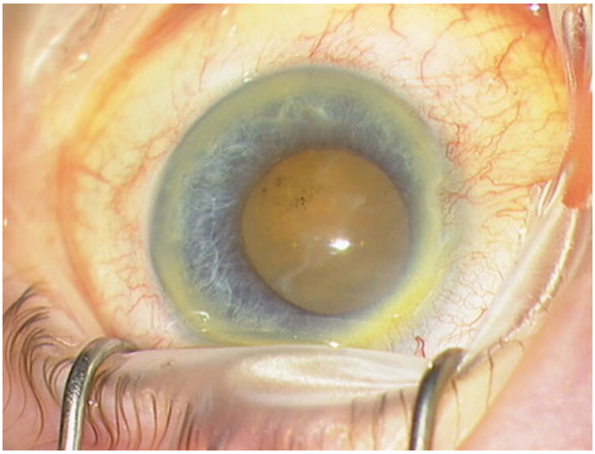


Fig. 4.119 A very dense nucleus, visual acuity is hand movements

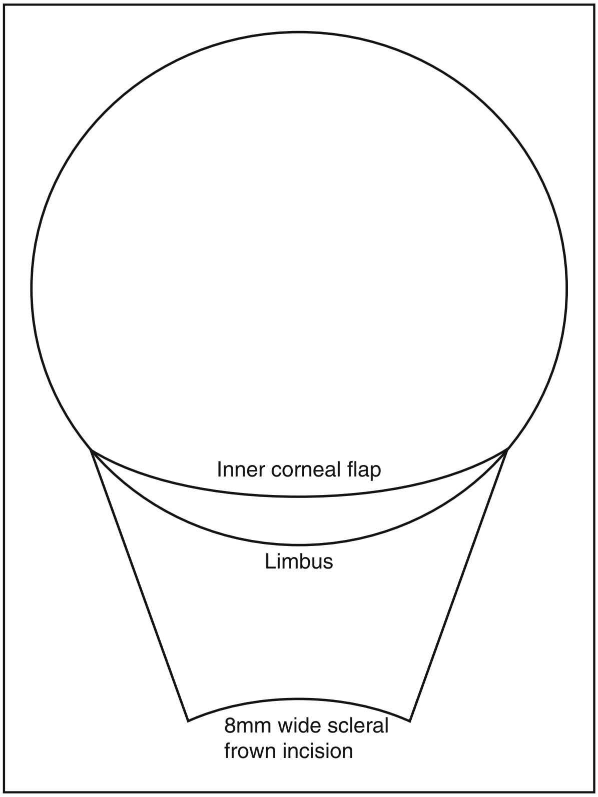


Fig. 4.120 Drawing of a frown incision. The incision is 8 mm broad and has a “V” shape

4.6.1 Standard Instruments for SICS

Phaco Set

Phaco handpiece and IOL injector are not needed.

Frown Incision

Westcott scissors (Fig. 4.121).

Indication: Limbal peritomy. Geuder 19750

Caliper (Fig. 2.21).

Indication: Marking of main incision and sclerotomy. The main incision for the implantation of an iris-fixated PMMA IOL is 6-mm wide. Caliper by Castroviejo, Geuder 19135

Paracentesis knife, 15° knife (Fig. 2.5)

Indication: Paracentesis. Many suppliers, e.g. DORC, Alcon or Beaver-Visitec

Crescent-angled bevel up knife (Fig. 4.122)

Indication: Dissection of a frown incision. Crescent-angled bevel up. DORC 51.1118. Alcon. 8065990002 or Beaver-Visitec, 373835

Main incision knife, 2.4 mm (Fig. 2.6)

Indication: Main incision. Slit knife. Many suppliers, e.g. Alcon or Beaver-Visitec

Rotation of the Nucleus

Y-manipulator or nucleus rotator (Fig. 4.123)

Indication: Rotation of the nucleus, very useful during SICS surgery for luxation of the nucleus into the anterior chamber. Nucleus rotator after Neuhann, Geuder 32160

Extraction of the Nucleus

Lens extraction hook (Fig. 4.124)

Indication: Extraction of the nucleus. Lens extraction hook after Henning/Friedrich, Geuder 32034

Alternative: 27-G grey cannula. Bend a 27G cannula to a fish hook.

Fig. 4.121 Westcott scissors. Indication: Limbal peritomy. Geuder 19750

Fig. 4.122 (**a**, **b**) Crescent-angled bevel up knife. Indication: Dissection of a frown incision. Crescent-angled bevel up. Alcon. 8065990002 or Beaver-Visitec, 373835

Fig. 4.123 (**a**, **b**) Y-manipulator or nucleus rotator. Indication: Rotation of the nucleus, very useful during SICS surgery for luxation of the nucleus into the anterior chamber. Nucleus rotator after Neuhann, Geuder 32160

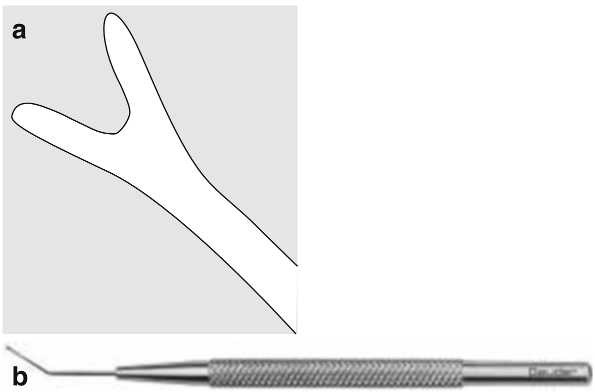


Fig. 4.124 Lens extraction hook. Indication: Extraction of the nucleus. Lens extraction hook after Henning/Friedrich, Geuder 32034

4.6.2 SICS Surgery

Instruments

1. Phaco set
2. Lens nucleus rotator
3. 15º knife
4. Crescent bevel up knife
5. 2.4-mm tunnel knife
6. Caliper
7. Lens extraction hook or 27-G cannula

Individual Steps

1. Capsulorhexis
2. Limbal peritomy
3. Frown incision
4. Luxation of the nucleus into anterior chamber
5. Injection of viscoelastics behind the nucleus
6. Rotation of the nucleus into the anterior chamber
7. Extraction of the nucleus
8. I/A
9. Implantation of a 3-piece IOL
10. Suturing of frown incision and conjunctiva

The Operation Step by Step

1. Capsulorhexis
   Begin with a paracentesis at 10 o'clock and 2 o'clock, and inject viscoelastics into the anterior chamber. Perform then a large rhexis because the nucleus must be dislocated from the capsular bag (Fig. 4.125).
2. Limbal peritomy
3. Frown incision
   Continue with a limbal peritomy from 11 o'clock to 1 o'clock with a Westcott scissors. Cauterise bleeding vessels and mark an 8-mm-wide incision with a caliper. Perform an arc-shaped and about 0.3-mm-deep incision with the 15° knife (Fig. 4.126). Dissect a scleral tunnel with the crescent-angled bevel up knife (Fig. 4.127). Do not dissect too deep (iris prolapse) but not too thin either (flap defect). If the blade is shining through the sclera, it is at the correct height. Then open the main incision with the 2.4-mm tunnel knife (Fig. 4.128). Be aware that the frown incision has a V shape and not a U shape like the normal tunnel incision, i.e. the frown incision widens from the sclera to the anterior chamber (Fig. 4.129).

Pits and Pearls No. 14

Caution: The frown incision in SICS surgery has a "V" shape. The scleral (frown) incision in iris-claw implantation surgery has the shape of a "U".

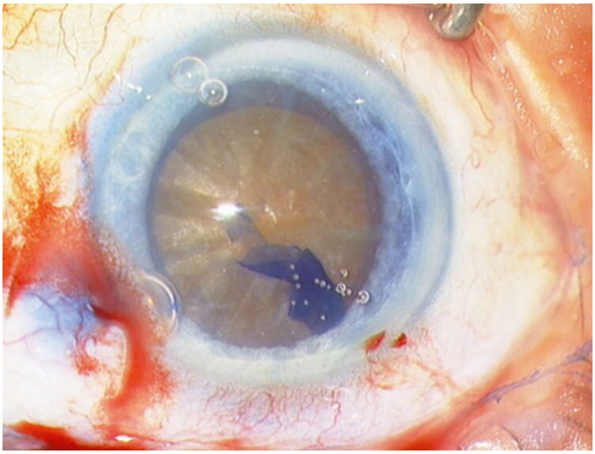


Fig. 4.125 Perform a large rhexis. A large rhexis is necessary to luxate the nucleus out of the lens capsule

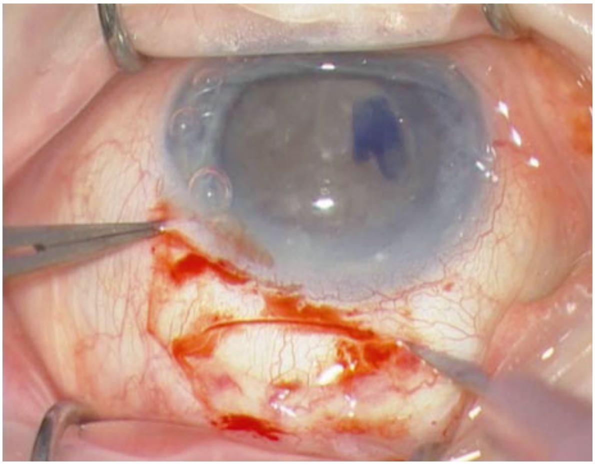


Fig. 4.126 Perform an 8-mm-long and approximately 0.3-mm-deep scleral incision with the 15° knife

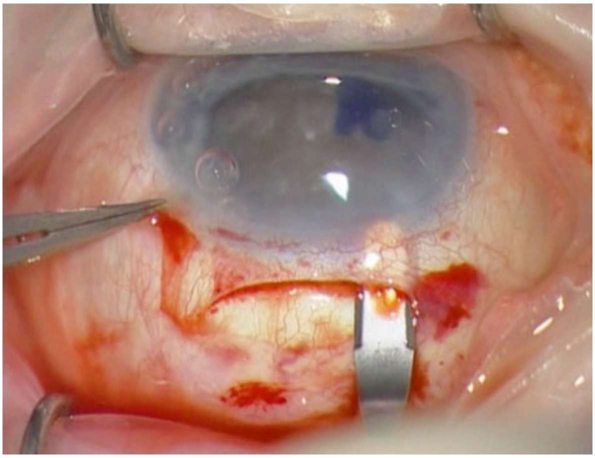


Fig. 4.127 Dissect a scleral flap with a crescent bevel up knife. If the blade of the knife is visible through the tissue, you are on the right level

4. Luxation of the nucleus into anterior chamber
5. Injection of viscoelastics behind the nucleus
6. Rotation of the nucleus into the anterior chamber
   Nondominant hand: Y-manipulator
   Dominant hand: Viscoelastic syringe
   Continue with hydrodissection. If the rhexis is large enough, the nucleus dislocates under hydrodissection from the capsular bag. If the nucleus fails to dislocate from the capsular bag during hydrodissection, then you need to luxate the nucleus manually into the anterior chamber. Place the tip of the Y-manipulator at the superior edge of the nucleus, and lift the nucleus up. Inject with the other hand viscoelastics behind the nucleus in order to inflate the lens capsule (Figs. 4.130 and 4.131). Then lift the nucleus completely into the anterior chamber. It is important to inject viscoelastics behind the nucleus in order to avoid a posterior capsular defect.
7. Extraction of the Nucleus
   For nucleus extraction use a lens extraction hook (Geuder), or bend a 27-G grey cannula to a fish hook (Figs. 4.132, 4.133, 4.134 and 4.135). Before extracting the nucleus assure yourself that there are viscoelastics above and behind the nucleus. Then insert the fish hook with the hook pointed to the side. Place the hook behind the middle of the nucleus (Figs. 4.136 and 4.137), turn the hook into an upright position and draw the nucleus slowly out (Fig. 4.138). Check first that you did not catch the inferior iris with the fish hook. If the nucleus gets stuck in the frown incision, then do not insist; reinject viscoelastics and enlarge the frown incision with the 2.4-mm tunnel knife and repeat the extraction manoeuvre.
8. I/A
9. Implantation of a 3-piece IOL
10. Suturing of the frown incision and conjunctiva
    Continue with I/A (Fig. 4.139). Then implant a 3-piece IOL because of the large rhexis (Fig. 4.140). The IOL requires no folding, because the main incision is sufficiently large. Proceed to suture the main incision with a Vicryl 8-0 cross-stitch (Fig. 4.141). If necessary suture also the conjunctiva (Fig. 4.142). Remove the viscoelastics with I/A from the anterior chamber.
    Caution: Keep an eye on the frown incision during surgery. Avoid that the incision is gaping because this may lead to a choroidal detachment. Close therefore the incision as soon as possible with a suture.

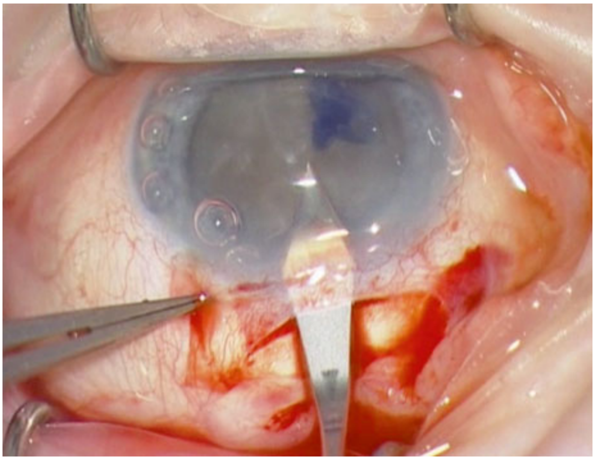


Fig. 4.128 Open the anterior chamber with a 2.4-mm blade. Do not enter the anterior chamber too close to the limbus; otherwise, the iris will prolapse

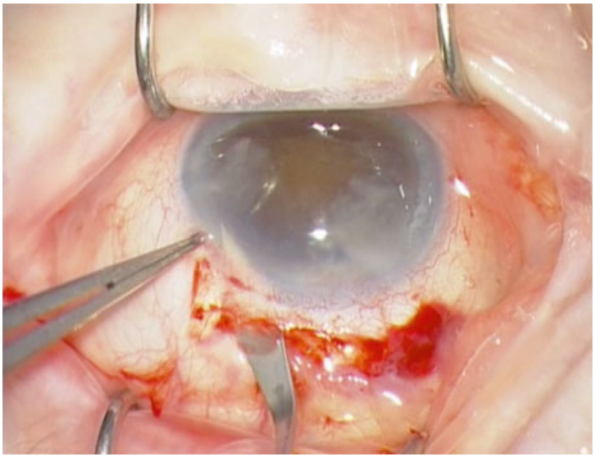


Fig. 4.129 This manoeuvre is unusual for a regular tunnel but important for a SICS tunnel. The SICS tunnel has a V shape; continue to open the anterior chamber to the far left and the far right

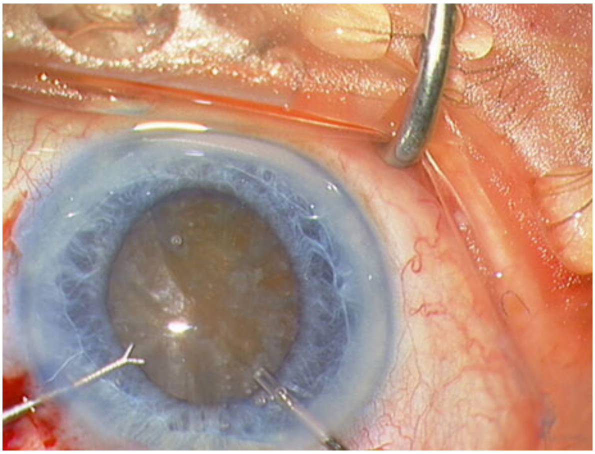


Fig. 4.130 The left hand holds a Y-manipulator or push-pull manipulator and the right-hand viscoelastics. Place the Y-manipulator on the superior edge of the nucleus

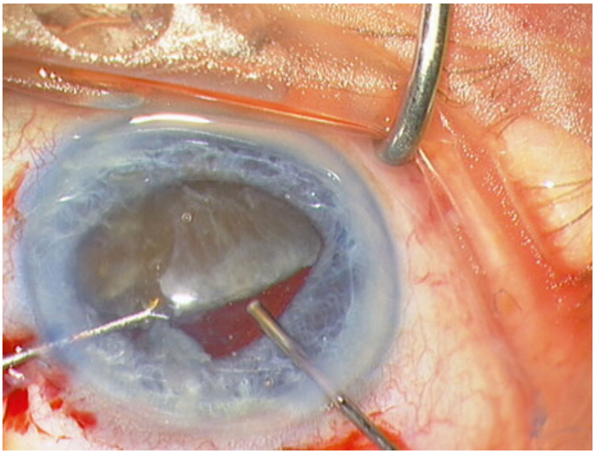


Fig. 4.131 Then lift the nucleus up with the Y-manipulator, and inject viscoelastics into the open space between the nucleus and lens capsule in order to inflate the lens capsule

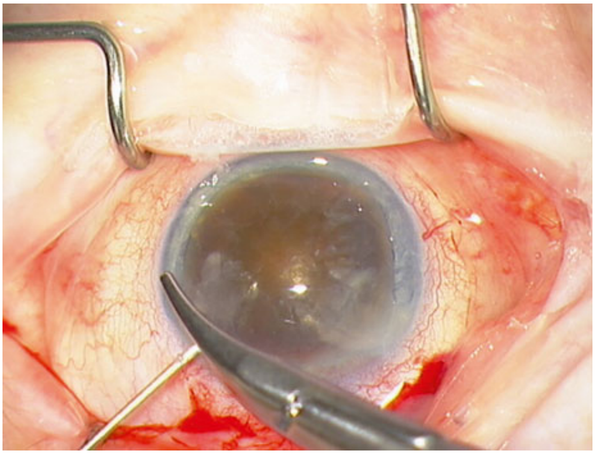


Fig. 4.132 Bend a 27-G grey cannula to a “fish hook”. Begin by grasping the tip of the cannula with the needle holder, and bend it 180º

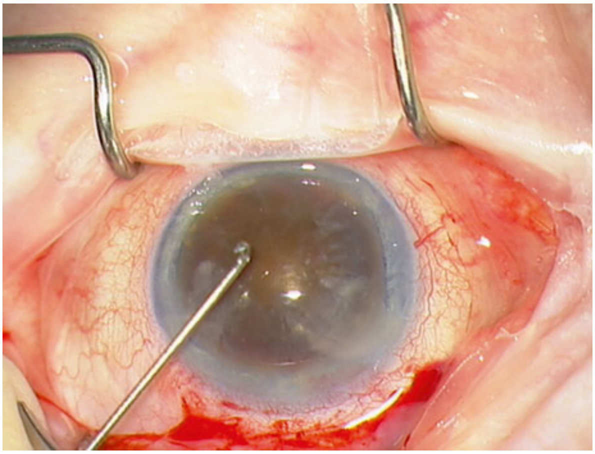


Fig. 4.133 Then grasp the cannula at the top with the needle holder, and bend the cannula approximately 30°

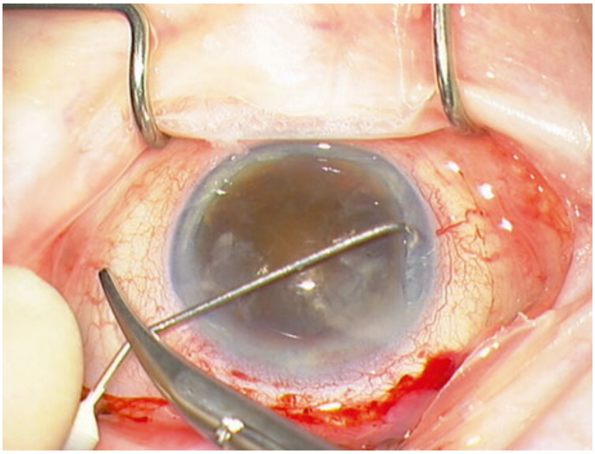


Fig. 4.134 Grasp the cannula again at the same place at the top, and bend the cannula approximately 30°

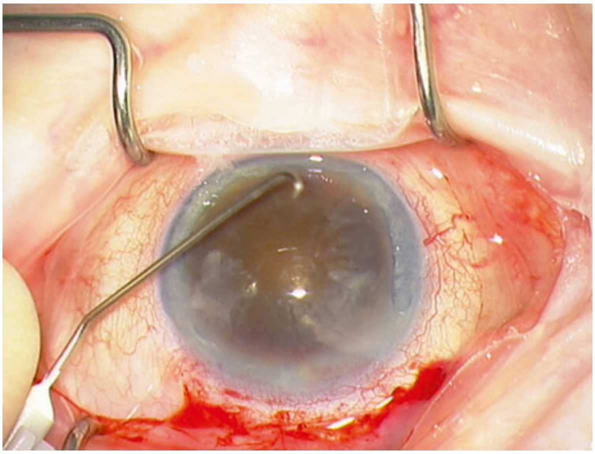


Fig. 4.135 This is the final and correct form of a fish hook

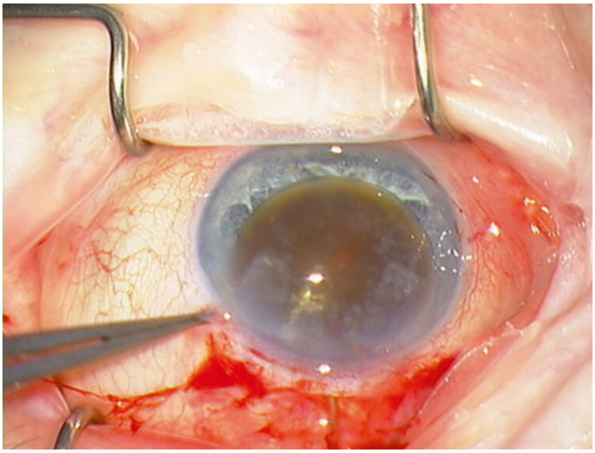


Fig. 4.136 Inject viscoelastics between the nucleus and the lens capsule and between the nucleus and the endothelium. Insert the fish hook with the hook facing to the right. If you reach the extraction position (see Fig. 4.123), then turn the cannula so that the hook faces the nucleus

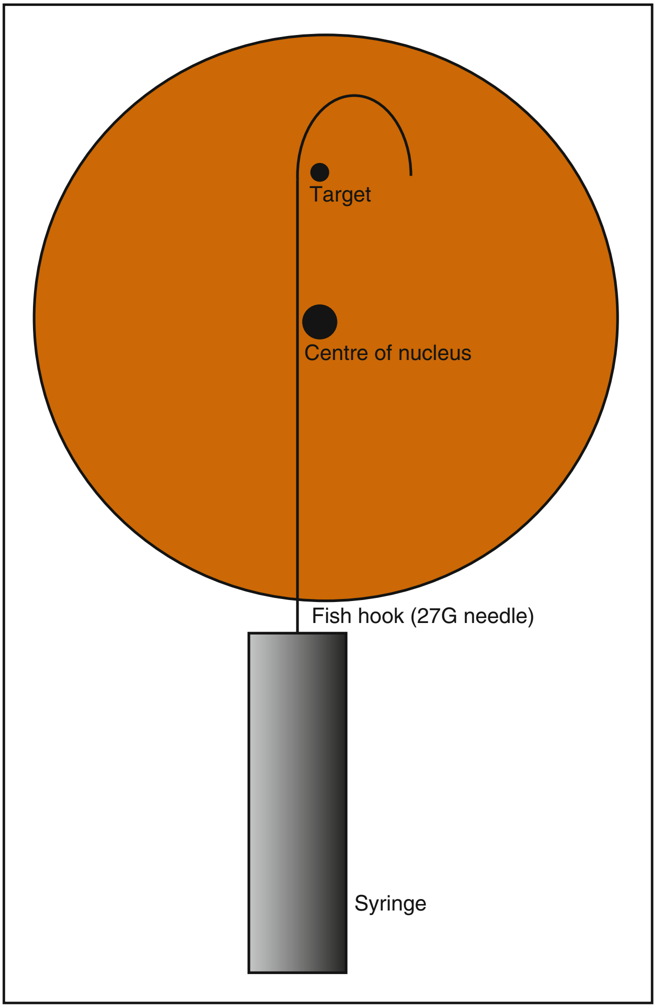


Fig. 4.137 Drawing: Position the fish hook behind the nucleus as depicted

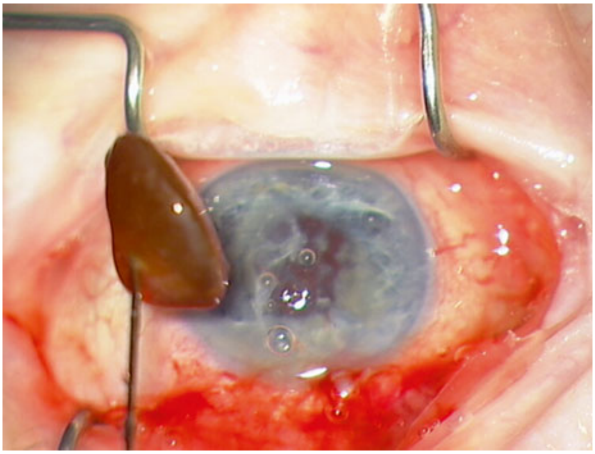


Fig. 4.138 Remove the nucleus

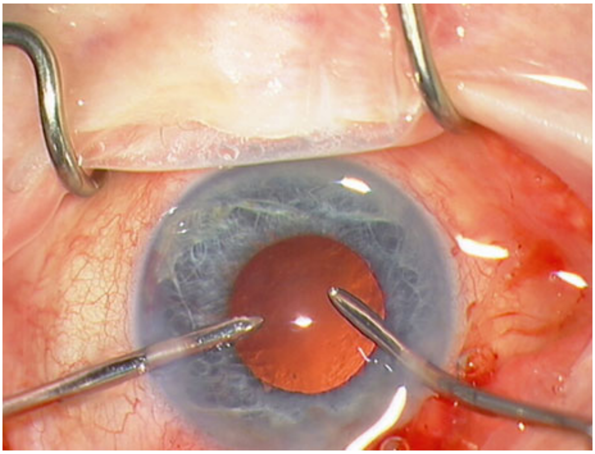


Fig. 4.139 Perform I/A

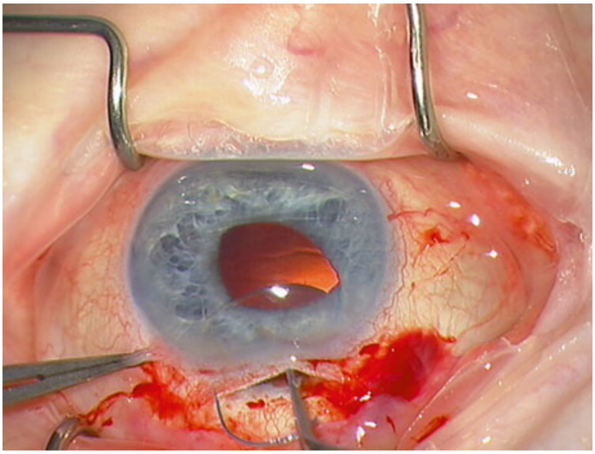


Fig. 4.140 Implant a 3-piece IOL. An injector is not necessary

4.7 Summary

If you encounter a (major) complication, then take a pause and think. Do I master this complication? Have I assisted once during this complication? Do I know each surgical step to solve this complication? The SICS technique is a very useful technique, which will help you out many times. But if you are insecure, then stop the operation. Congratulations! It is harder to stop an operation than to continue.

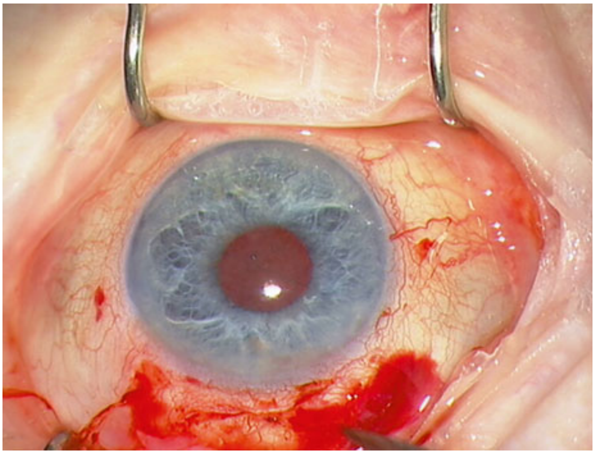


Fig. 4.141 A good frown incision requires no suture, but we like to close the frown incision with a Vicryl 8-0 cross-stitch

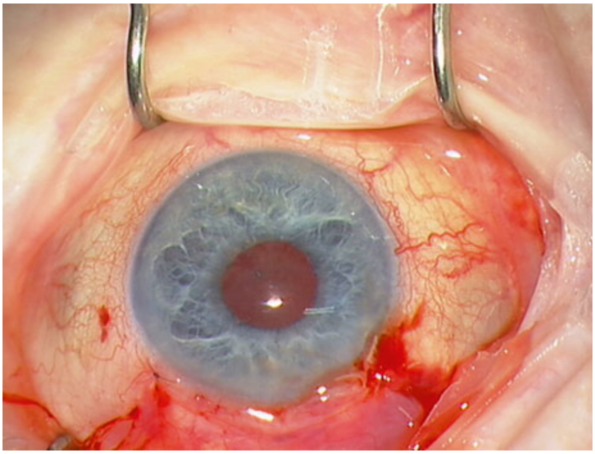


Fig. 4.142 Close the conjunctiva with a Vicryl 8-0 interrupted stitch

Special IOL Fixation Techniques

5

Contents

The benefits of an iris-claw IOL implantation are a short surgical time, a sutureless implantation, an excellent centration without risk of tilting and a short learning curve (approx. 5 surgeries). The disadvantage is that the IOL is fixated into the iris tissue, and a too traumatic implantation may lead to an inflammation. This postoperative inflammation with cellular proliferation of the IOL is induced by macrophages. This occurs, however, only in the learning curve. In addition, sufficient iris tissue is required for implantation. See Sect. 5.1.

The advantages of the intrascleral IOL fixation (Scharioth technique) are a sutureless implantation, an excellent centration of the IOL with a low inflammation risk and less problems with the ciliary body in comparison to scleral fixation. The disadvantage is a longer learning curve (10–15 surgeries). See Sect. 5.2.

The advantages of scleral fixation are a relatively short learning curve (5–10 operations). The disadvantages are a possible lens tilt (unstable position of the lens), discomfort with the ciliary body (due to the haptic) and (depending on the technique) discomfort due to the knot.

Electronic supplementary material Supplementary material is available in the online version of this chapter at http://dx.doi.org/10.1007/978-3-642-54449-1_5. Videos can also be accessed at http://www.springerimages.com/videos/978-3-642-54448-4.

U. Spandau, G. Scharioth, *Complications During and After Cataract Surgery*,
DOI 10.1007/978-3-642-54449-1_5,

We prefer intrascleral or iris-claw implantations in order to avoid a knot or an IOL tilt which is more common with scleral-fixated implantations. See Sects. 5.3 and 9.2.2.

5.1 Iris-Claw IOL Implantation

Video 5.14: IOL extraction and implantation of an iris-claw IOL 1

Video 5.15: Iris-claw implantation and artificial pupil IOL

Video 5.16: Subluxated IOL operated with one trocar

We will demonstrate the implantation of an iris-claw IOL. The iris-claw IOL can be implanted before the pupil or behind the pupil (Figs. 1.14 and 1.15). If you implant the IOL retropupillary, then it has to be done “upside down” (= on the back) because the haptics are then bent upwards (Fig. 5.4).

I will demonstrate the retropupillary method, which is quite easy to learn. I recommend starting with an aphakic eye which underwent an anterior vitrectomy. The pupil should be constricted before surgery. We recommend retrobulbar anaesthesia.

There are different A-constants for antepupillar and retropupillar IOL implantations; contact the companies.

The most difficult part of the surgery is the dissection of the scleral tunnel, which is the same as for the SICS technique. This tunnel is 6-mm wide. Why? Because the iris-claw IOL is 6-mm wide. What may happen if the tunnel is 8-mm wide? The wider the tunnel, the more you risk a choroidal detachment.

5.1.1 Standard Instruments for Iris-Claw IOL Implantation

Instruments for Iris-Fixated IOL

The required instruments for the implantation of an iris-fixated IOL (Artisan®, Verisyse®) can be acquired from the company (Ophtec, AMO; Fig. 5.1). In addition you need:

Caliper (Fig. 2.21)

Indication: Marking of main incision and sclerotomy. The main incision for the implantation of an iris-fixated PMMA IOL is 6-mm wide. Caliper by Castroviejo, Geuder 19135

Enclavation Spatula

Indication: Retropupillar fixation of IOL claws in iris tissue (Fig. 5.2). Sekundo enclavation spatula, Geuder-32724. Alternatively: Iris spatula, angled, 1.0-mm wide. Geuder-31975

5.1.2 Iris-Claw IOL Implantation Surgery

Instruments

1. Crescent bevel up knife (Fig. 2.7)
2. 15° knife (Fig. 2.6)

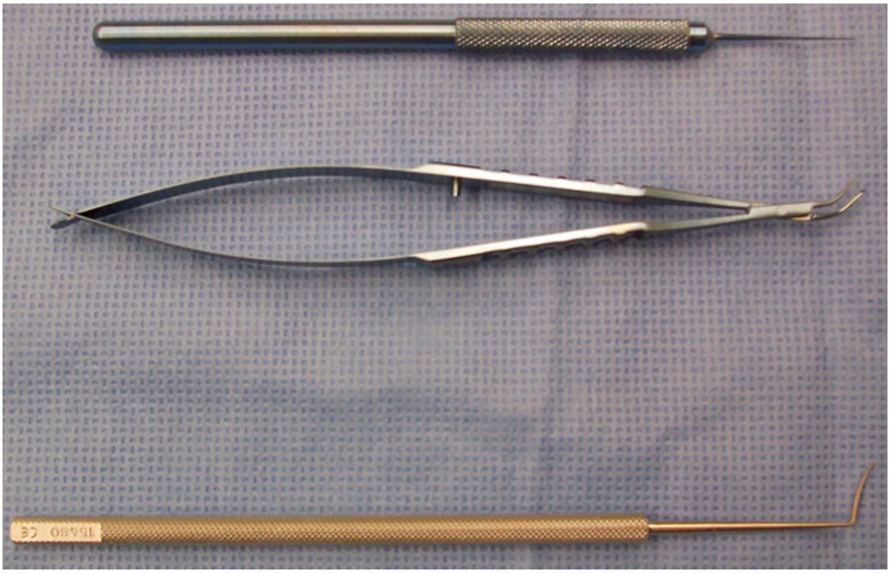


Fig. 5.1 Instrument set for Verisyse® implantation (AMO). A Sinskey hook (Geuder), an IOL implantation forceps (AMO) and an enclavation spatula (Geuder)

Fig. 5.2 Enclavation spatula after Sekundo. Indication: Enclavation of iris-fixated IOL. Geuder 32724

3. 2.4-mm tunnel knife (Fig. 2.5)
4. Instruments for iris-fixated IOL (AMO) (Fig. 5.1)
5. Caliper (Fig. 2.21)
6. Maybe: Vitreous cutter

Material
Acetylcholine (Miochol) (Fig. 5.3)
Iris-claw IOL (Artisan®, Verisyse®) (Fig. 5.4)
Maybe: Triamcinolone (Fig. 2.28)

Individual Steps
1. Paracentesis at 3 and 9 o'clock
2. Anterior vitrectomy
3. Frown incision
4. Injection of Miochol
5. Implantation of iris-fixated IOL
6. Closure of the frown incision and conjunctiva

The Operation Step by Step
1. Paracentesis at 3 and 9 o'clock
2. Anterior vitrectomy
3. Frown incision

   Begin with a paracentesis incision at 3 and 9 o'clock.

   Note: The location of the IOL is determined by the position of the frown incision. If the claws are located at 3 and 9 o'clock, then the frown incision must be located at 12 o'clock. In case of an iris defect at 3 o'clock or a filtration bleb at 12 o'clock, you have to choose the position of the IOL and frown incision accordingly.

   Continue with the frown incision. Perform a limbal peritomy from 11 to 1 o'clock with Westcott scissors and cauterise the bleeding vessels. Then mark a 6-mm-wide incision (not wider!) with a caliper (Fig. 5.5). The incision should be 1–1.5 mm behind the limbus. Make a 0.3-mm-deep limbus-parallel incision with a 15° knife (Fig. 5.6). Then dissect a scleral tunnel with the crescent-angled bevel up knife (Fig. 5.7) and at the end with the 2.4-mm blade (Fig. 5.8). If necessary continue with the anterior vitrectomy. This step is of course easier when performed from pars plana (Fig. 5.9). See Sect. 6.2.

   Caution: The frown incision in SICS surgery has a "V" shape. The scleral (frown) incision in iris-claw implantation surgery has the shape of a "U".
4. Injection of Miochol
5. Implantation of iris-fixated IOL

   Instrumentation

   Dominant hand: IOL implantation forceps (Abbott)

   Nondominant hand: Enclavation spatula

   Before implantation of an iris-claw IOL, the pupil must be constricted (Fig. 5.10). Inject Miochol. Centre the IOL with a manipulator (e.g. push pull) inside the anterior chamber. Grasp the IOL in the middle with an IOL implantation

Fig. 5.3 Acetylcholine (Miochol, Novartis). Indication: Pupil constriction

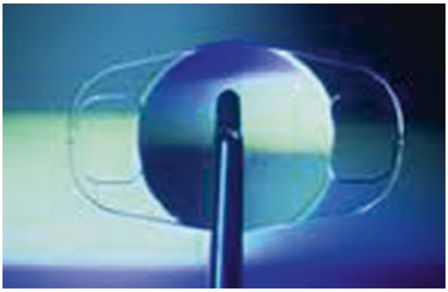


Fig. 5.4 Iris-claw IOL. Available as PMMA and foldable acryl IOL (Ophtec, AMO)

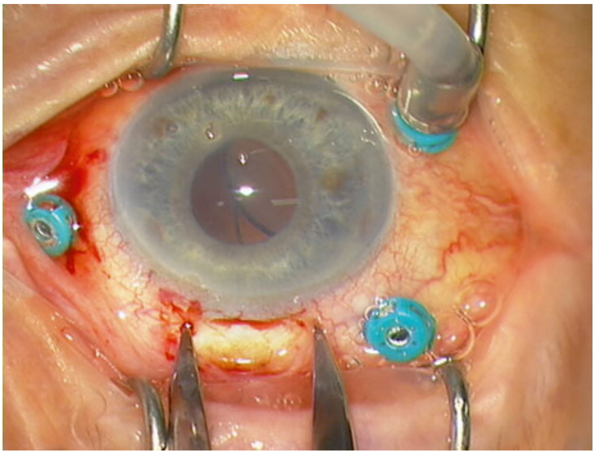


Fig. 5.5 Perform a limbal peritomy at 12 o'clock, and mark a 6-mm incision with the caliper

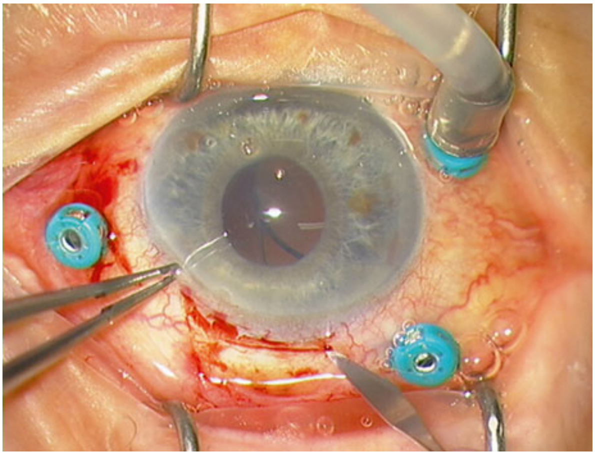


Fig. 5.6 Perform a 50 % scleral thickness straight incision with the 15° knife

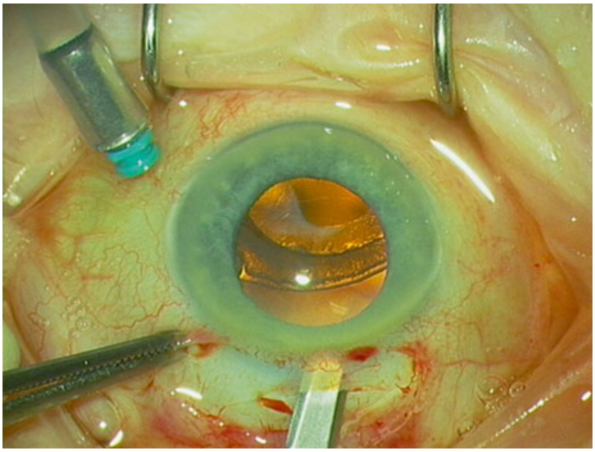


Fig. 5.7 Dissect a scleral flap with the crescent bevel up knife

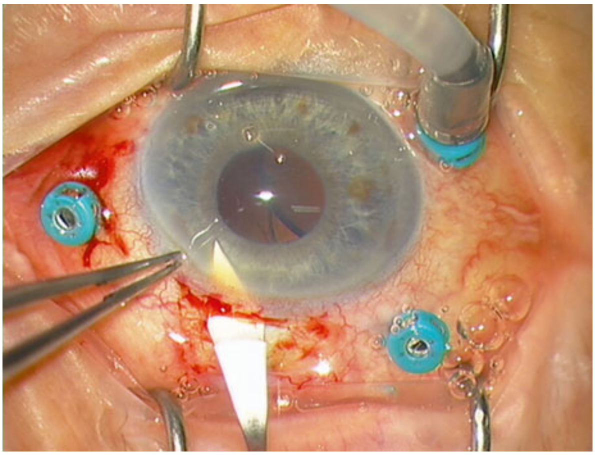


Fig. 5.8 Open the anterior chamber with the 2.4-mm blade. The main incision has a "U" shape

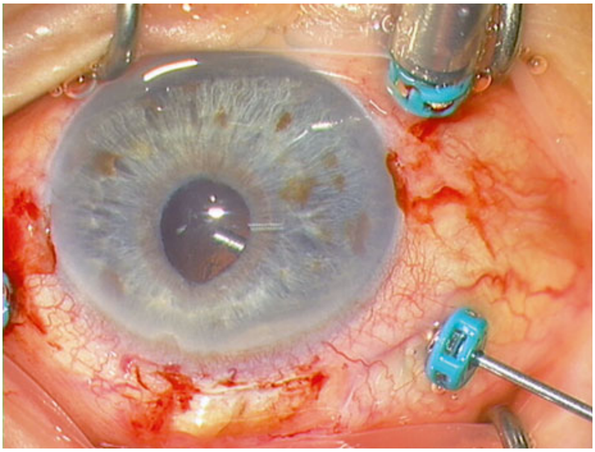


Fig. 5.9 Perform an anterior vitrectomy in order to avoid vitreous traction when removing the IOL

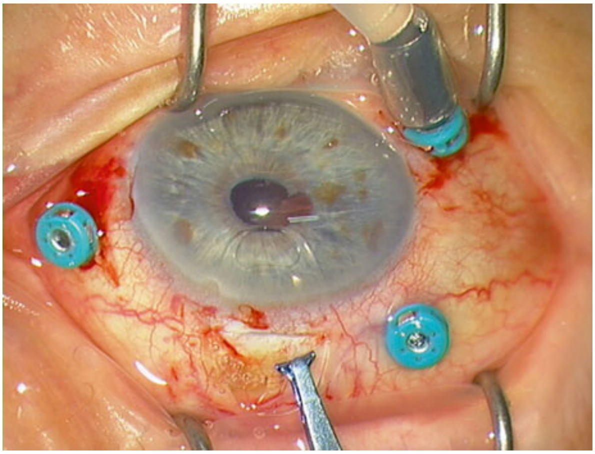


Fig. 5.10 Insertion of the IOL (*upside down*) with the IOL implantation forceps (AMO) into the anterior chamber

forceps (Abbott) (Fig. 5.11). Flip the IOL to the right (Fig. 5.12) so that the IOL is behind the iris, and then to flip it to the left so that the IOL is completely behind the iris. Hold the IOL centrated in the middle of the pupil, and only turn it. Do not move it to the left or right.

Then you take the enclavation spatula in your left hand. Lift the IOL a little bit up, so that the iris claws are visible behind the iris tissue. Then insert the spatula in the 3 o'clock paracentesis, and clamp the iris tissue between the iris claws (Fig. 5.13). Then the hand of the implantation forceps has to be changed. This manoeuvre should be thoroughly practised preoperatively. Then you take the enclavation spatula in your right hand, and perform the same manoeuvre at 9 o'clock (Fig. 5.14). Remove finally the implantation forceps, and stabilise the anterior chamber with BSS. A retropupillary implantation requires no iridectomy (Fig. 5.15).

Pits and Pearls No. 15
Enclavation of Iris-Claw IOL: Instead of enclavating the IOL from both paracenteses, you can enclavate the IOL from one paracentesis. The tip of the enclavation spatula is long enough to reach both iris claws.

6. Closure of the Frown Incision and Conjunctiva

Suture the frown incision with a Vicryl 8-0 cross-stitch and the conjunctiva with a Vicryl 8-0 interrupted stitch. Inject cefuroxime (Zinacef®) intracameral as endophthalmitis prophylaxis.

5.2 Intrascleral IOL Implantation (Scharioth Technique)

Video 5.17: Intrascleral fixation: aphakia

Video 5.18: Intrascleral fixation with DORC forceps 1

Video 5.19: Intrascleral fixation DORC forceps 2

This sutureless technique for fixation of a posterior chamber intraocular lens is using permanent incarceration of the haptics in a scleral tunnel parallel to the limbus. The intrascleral haptic fixation technique is the best choice for aniridia or eyes with damaged iris.

A standard three-piece IOL suitable for sulcus fixation should be used for this technique. An implantation with injector through the main incision is possible. For PC-IOL calculation the SRK-T formula and the same A-constant as for in-the-bag implantation are recommended. Surgery lasts about 30 min and is performed in local or general anaesthesia.

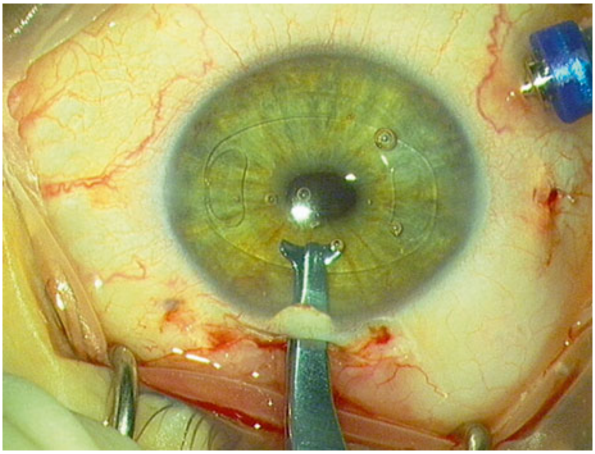


Fig. 5.11 Centre the IOL with a manipulator (AMO), and then grasp the IOL in the middle with the IOL implantation forceps (AMO)

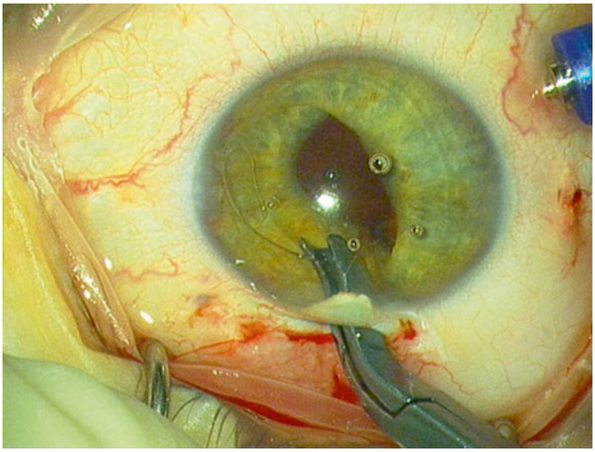


Fig. 5.12 Flip the right half of the IOL behind the iris, and then flip the left half of the IOL behind the iris

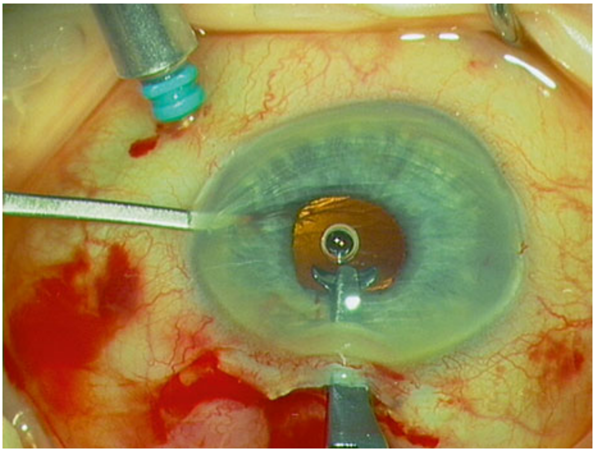


Fig. 5.13 Lift up the IOL so that the claws can be seen through the iris tissue. Take the enclavation spatula in the left hand, and press the iris tissue between the iris claws

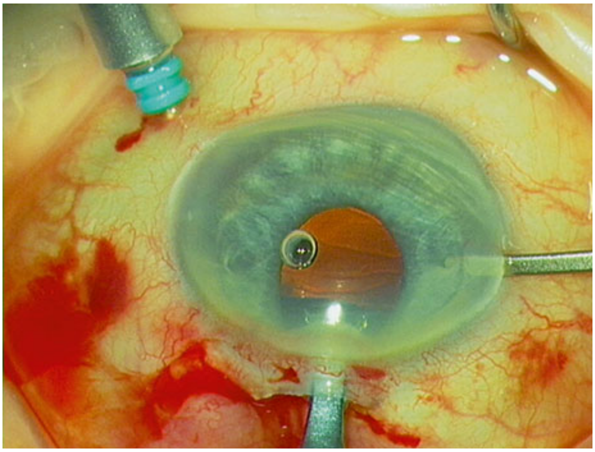


Fig. 5.14 Change hands and perform the same manoeuvre at the other side

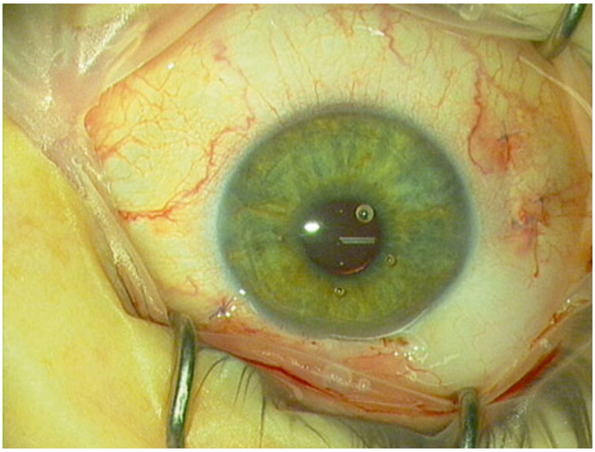


Fig. 5.15 Immediate postoperative status. Close the conjunctiva with Vicryl 8-0

5.2.1 Standard Instruments for Intrascleral IOL Implantation

1. Scharioth IOL Scleral Fixation Set 2×25G forceps, straight and curved. Indication: Intrascleral insertion of IOL. DORC 1286.SFD (Fig. 5.16)
2. Sinskey hook. Indication: Manipulation of IOL. Geuder: 16167 (Fig. 5.17)

5.2.2 Intrascleral IOL Implantation Surgery

Instruments

1. Anterior chamber maintainer or pars plana infusion
2. Vitrector
3. Scharioth IOL fixation forceps set
4. 23-G cannula
5. 15° knife
6. 2.8-mm main incision knife
7. Sinskey hook

Individual Steps

1. Insertion of permanent infusion.
2. Superior and inferior limbal peritomy.
3. Ciliary sulcus sclerotomies and limbus-parallel intrascleral tunnel.
4. Paracentesis at 3 and 9 o'clock, main incision.
5. Deep anterior vitrectomy.
6. Insertion of IOL.
7. Haptic externalisation and intrascleral fixation.
8. Close conjunctiva and remove infusion.

The Operation Step by Step

1. Insertion of permanent infusion
2. Superior and inferior limbal peritomy
3. Ciliary sulcus sclerotomies and limbus-parallel intrascleral tunnel

   After peritomy the eye is stabilised either by pars plana infusion (i.e. 25G) or by anterior chamber maintainer. We try to prevent any diathermy of episcleral vessels to reduce the risk for scleral atrophy. Two straight sclerotomies ab externo are prepared with a sharp 23-G cannula or 23-G MVR blade about 1.5 mm postlimbal exactly 180° from each other and directed towards the centre of the globe (Fig. 5.18). A toric marker could be used to mark exactly 180°, or the cannula is placed over the centre of the cornea to estimate position of the second sclerotomy (Figs. 5.19 and 5.20).

   Then new cannulas are used to create a limbus-parallel tunnel at about 50 % of scleral thickness, starting from inside the ciliary sulcus sclerotomies and ending with externalisation of the cannula after 2.0–3.0 mm (Figs. 5.21 and 5.22).
4. Paracentesis at 3 and 9 o'clock, main incision
5. Deep anterior vitrectomy
6. Insertion of IOL

   It is very important that the intraocular pressure is maintained during this step to prevent collapse and dislocation of the haptic out of the corneal incision. A

Fig. 5.16 Scharioth forceps for intrascleral IOL fixation, straight and curved. Indication: Intrascleral insertion of IOL. DORC 1286.SFD

Fig. 5.17 Sinskey hook. Indication: Manipulation of IOL. Geuder: 16167

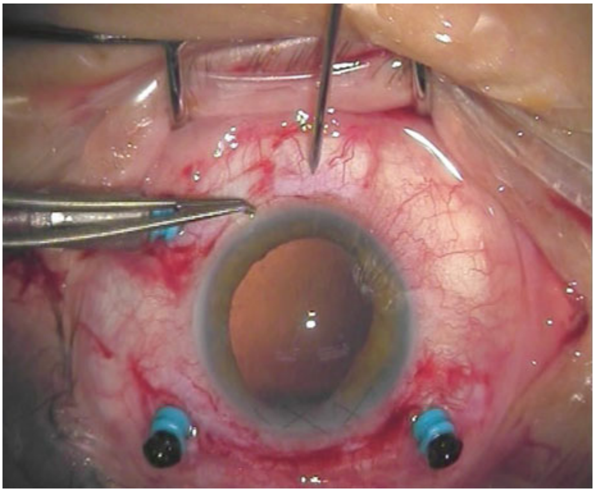


Fig. 5.18 After peritomy, a ciliary sulcus sclerotomy 1.5–2.0 mm postlimbal is created with a straight sharp 23-G cannula

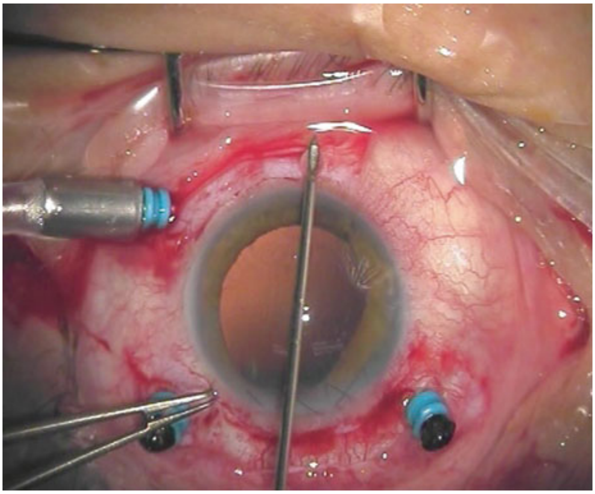


Fig. 5.19 Marking 180°, alternatively a toric marker could be used; continuous infusion via pars plana or as anterior chamber maintainer via side port incision is installed

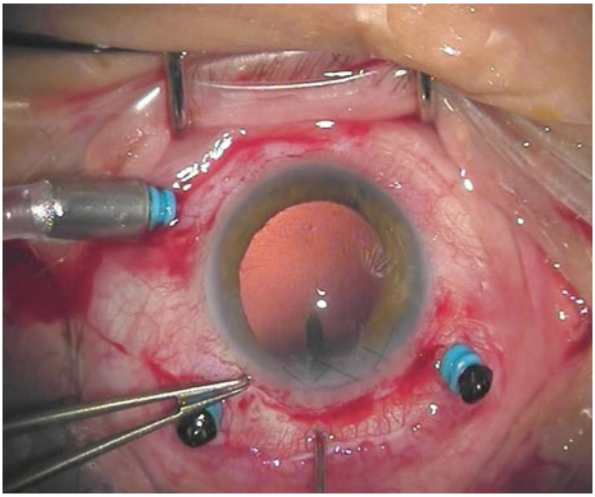


Fig. 5.20 Second ciliary sulcus sclerotomy is performed with straight sharp 23-G cannula

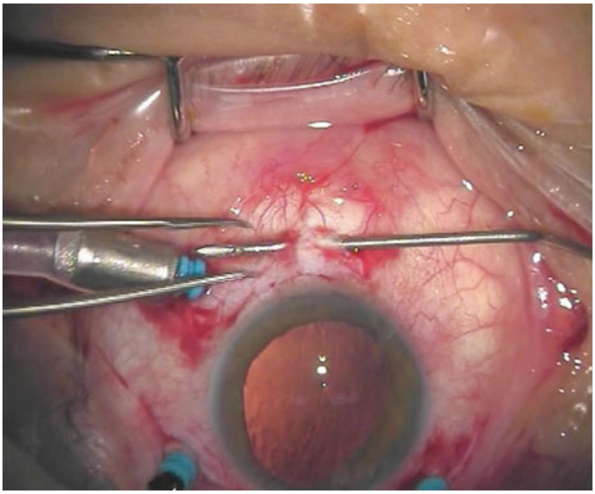


Fig. 5.21 Starting from the ciliary sclerotomy, a limbus-parallel intrascleral tunnel is created with a bended sharp 23-G cannula; the tip of this cannula is externalised after 2–3 mm

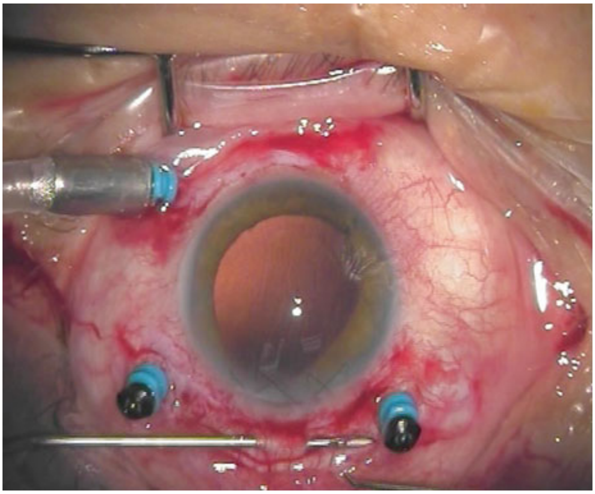


Fig. 5.22 Similar an intrascleral tunnel is created from the opposite sclerotomy; both tunnels are directed counterclockwise

standard 3-piece IOL with a haptic design fitting to the diameter of ciliary sulcus is implanted with an injector, and the tailing haptic is fixated in the corneal incision. Some might prefer to place the leading haptic on top of the iris. But the leading haptic could also be directed immediately in the posterior chamber. In case of a large corneal incision (e.g. after ECCE/ICCE or explantation of a dislocated IOL), the IOL could be implanted with a forceps. This might be also easier for the first cases.

7. Haptic Externalisation and Intrascleral Fixation
   The leading haptic is then grasped at its tip with a special straight 25-G forceps (Fig. 5.23) (Scharioth IOL fixation forceps), pulled through the sclerotomy and left externalised (Figs. 5.24 and 5.25). It is very important to grasp the very tip of the haptic to prevent damage to the haptic. For intraocular manipulations (hand shake technique) it is useful to use two intraocular forceps (e.g. straight and curved Scharioth forceps). With the curved Scharioth forceps, then the haptic is grasped at its tip, pushed a little back into the vitreous cavity, introduced into the intrascleral tunnel and pushed through (Figs. 5.26 and 5.27). Then the haptic is released (Fig. 5.28), the forceps is turned, closed and pulled back leaving the haptic in the sclera (pushing technique). Alternatively one can introduce the Scharioth forceps from the distal end of the intrascleral tunnel until it becomes visible in the sclerotomy, and then the haptic tip is grasped and pulled in the scleral tunnel (pulling technique). The same manoeuvres are performed with the tailing haptic. The ends of the haptic are left in the tunnel to prevent foreign body sensation, erosion of the conjunctiva, and to reduce the risk for inflammation. The IOL should be well centred and without tilt (Figs. 5.29 and 5.30). If needed IOL could be centred ab interno with a Sinskey hook.
8. Close Conjunctiva and Remove Infusion
   Some young patients with floppy iris showed postoperative recurrent iris capture which disappeared after NdYAG laser iridotomy. If this condition is anticipated (e.g. extreme deepening of the AC during hydration of the side port incisions), an intraoperatively iridectomy with the vitreous cutter is helpful. The sclerotomies are checked for leakage and if necessary sutured with absorbable suture (e.g. Vicryl 8-0). Finally, the infusion is removed, corneal incisions are hydrated, and conjunctiva is closed.

Pits and Pearls No. 16

Intrascleral IOL Fixation

1. It is very important to perform sclerotomies symmetrically 180° from each other and about the same distance to the limbus to prevent decentration or tilt. If surgeon is not satisfied with IOL position, minimal adjustment could be performed intraoperatively by positioning the IOL with the help of a Sinskey hook. In case of major misplacement, new sclerotomies should be created.
2. IOL haptic has to be fully covered by the sclera. Subconjunctival placement will cause conjunctival erosion and other complications.
3. In case of haptic dislocation in the early postoperative period, intrascleral fixation can be repeated. We have not seen late dislocations.

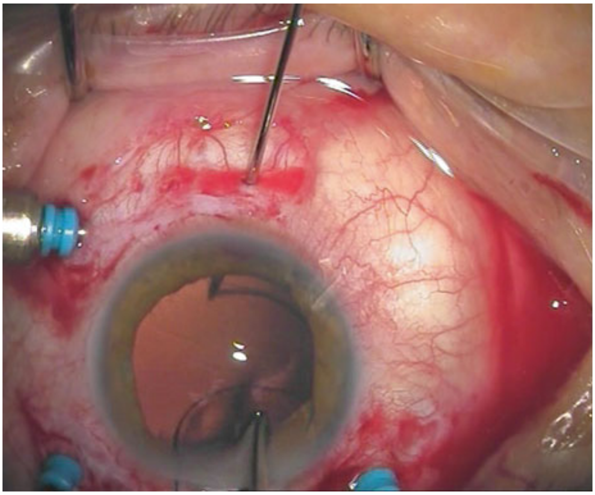


Fig. 5.23 IOL is inserted through the main incision and held with a forceps, while the leading haptic is grasped at its tip with the straight 25-G Scharioth forceps; alternatively the IOL could be injected through cartridge. If one feels more secure, the leading haptic could be placed first on the iris surface

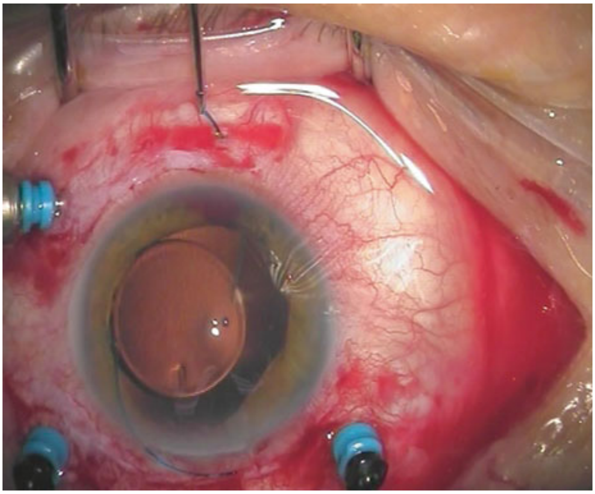


Fig. 5.24 Leading haptic is externalised via ciliary sulcus sclerotomy; trailing haptic is fixed in the main incision; continuous infusion is on

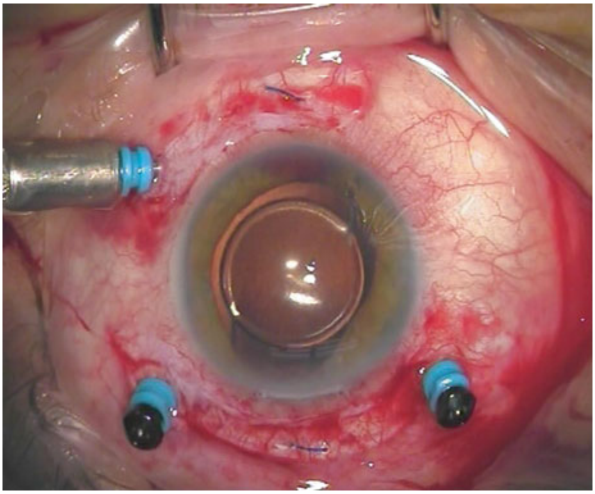


Fig. 5.25 Trailing haptic is inserted, grasped at its tip with straight Scharioth forceps and externalised via second ciliary sulcus sclerotomy

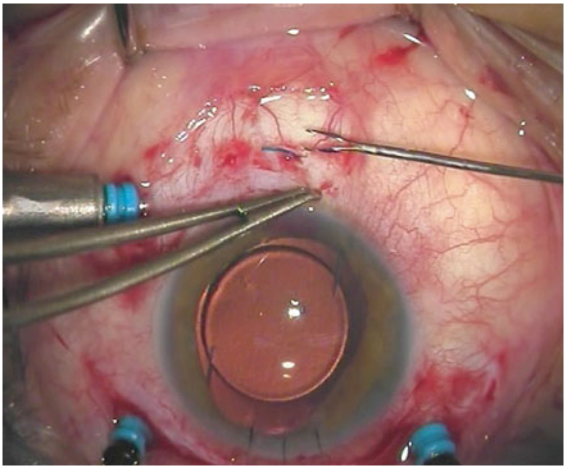


Fig. 5.26 Externalised haptic is grasped at its tip with curved Scharioth forceps, then pushed back into the sclerotomy and inserted into the intrascleral tunnel

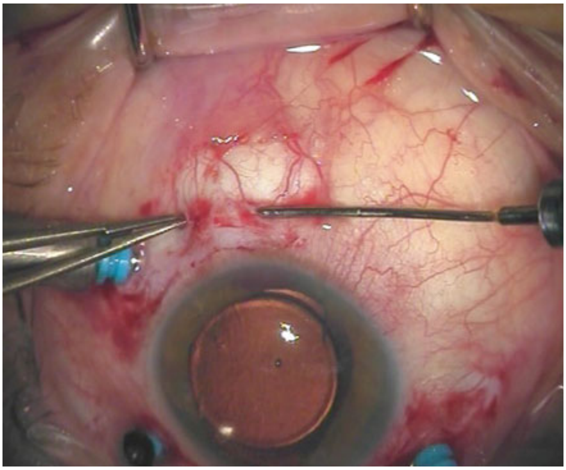


Fig. 5.27 Haptic is pushed through the intrascleral tunnel and externalised on the opposite site

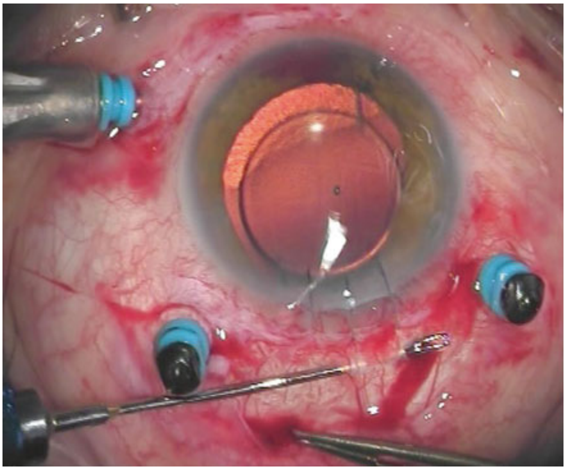


Fig. 5.28 Second haptic is introduced into the intrascleral tunnel, then the forceps is opened, turned and retracted

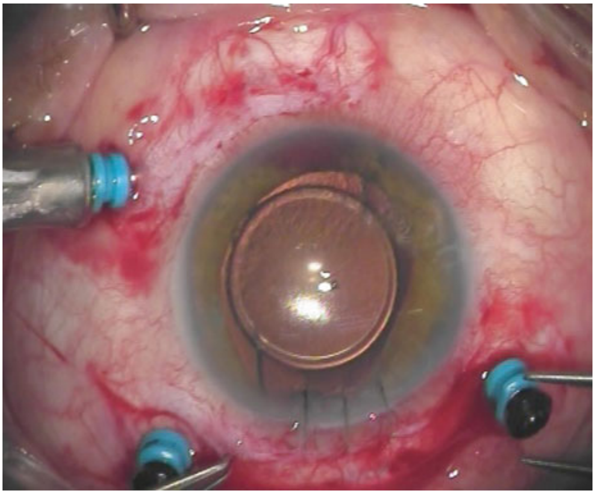


Fig. 5.29 Both haptics are implanted; note that the haptic is completely buried intrascleral, IOL is well centred without tilting, finally trocars are removed; incisions are checked for leakage and sutured if needed

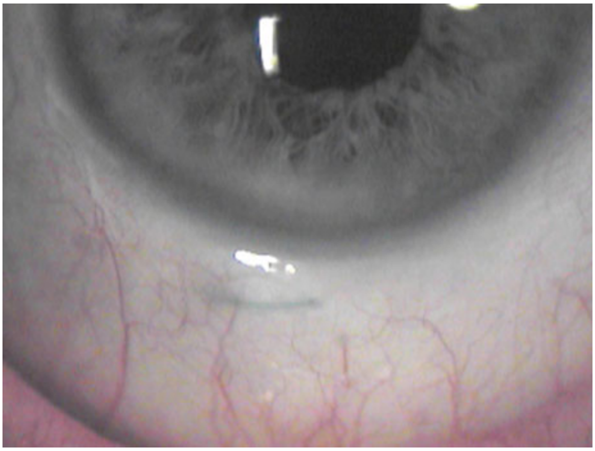


Fig. 5.30 Five-year post OP. The blue haptic at 6 o'clock is intrasclerally located. After 5 year follow-up, the IOL is centred, and there is no sign of inflammation, erosion or dislocation of the haptics

5.3 Scleral IOL Fixation

Video 5.20: Scleral fixation of a luxated IOL

Video 5.21: Scleral fixation of IOL

This surgery is usually performed due to a dislocated IOL (Fig. 5.31). The IOL is recovered (Sect. 9.2.2), and the same IOL is sutured to the sclera. The suture is fastened to the haptic and then to the sclera. If you use the same IOL, then externalise the haptics at the sclerotomies and suture the haptics. If you do not use the same IOL, then implant a 3-piece IOL. You can either (1) implant the IOL, externalise the haptics through the sclerotomies and fasten the sutures to the haptics or (2) fasten the sutures to the IOL and then implant the IOL (see Sect. 10.6.3). For the sclera there are many different suture techniques.

Sutures for Scleral-Fixated IOL

1. Two curved needles. Alcon. Polypropylene, blue monofilament, double armed. 8,065.307.601.

    Indication: Scleral fixation of a dislocated IOL.

    or

2. One needle straight, one curved needle. Alcon. Polypropylene, blue monofilament, double armed. 8065304901.

    Indication: Secondary implantation and scleral fixation of an IOL secondary to aphakia.

Instruments

1. 2x intravitreal forceps, e.g. serrated jaws forceps (Fig. 2.13)
2. Polypropylene 10-0 suture with curved needle (i.e. Alcon. Polypropylene, blue monofilament, double armed. 8065307601)

Individual Steps

1. Focal peritomy at 3 and 9 o’clock.
2. Two sclerotomies (1.5 mm posterior to the limbus) at 3 and 9 o’clock.
3. Extraction of a haptic at 3 o’clock, place a suture onto the haptic and push it back into the eye, the same procedure at 9 o’clock.
4. Suture the haptic suture in a snake shape to the sclera.
5. Close the conjunctiva, removal of the trocars.

Operation Step by Step

1. Focal peritomy at 3 and 9 o’clock.
2. Two sclerotomies (1.5 mm posterior to the limbus) at 3 and 9 o’clock.

    Open the conjunctiva at 3 and 9 o’clock to make space for one sclerotomy and a scleral suture, i.e. approximately from 2 to 4 o’clock and from 8 to 10 o’clock. Then cauterise the bleeding vessels.

3. Two sclerotomies (1.5 mm posterior to the limbus) at 3 and 9 o’clock.
4. Extraction of a haptic at 3 o’clock, place a suture onto the haptic, and push it back into the eye, the same procedure at 9 o’clock.

    In case of a 3-piece IOL, fasten the suture in the middle of the haptic and in case of an 1-piece IOL at the end of the haptic.

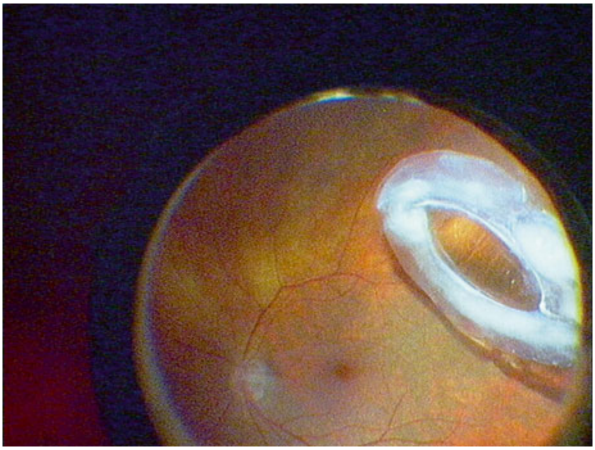


Fig. 5.31 A posteriorly dislocated bag-IOL complex (With courtesy of the Kaden Verlag)

In the area of the sulcus, 1.5 mm posterior to the limbus, perform an approx. 1.3-mm sclerotomy (Fig. 5.32). The sclerotomy must be perpendicular (i.e. approximately 90° to the sclera), in order not to harm the anterior chamber. Via the sclerotomy at 3 o'clock, grasp a haptic with an Eckardt forceps (Fig. 5.33) and pull it out of the eye. Cut a polypropylene 10-0 suture with two curved needles in two halves. Then suture one half (suture) to the haptic (Fig. 5.34), and insert the haptic back into the eye. Perform the same manoeuvre at the 9-o'clock sclerotomy. After the haptic has been pushed back, centre the IOL by pulling carefully on both sutures.

5. Suture the haptic suture in a snake shape to the sclera.
   Different techniques are now possible. You can place five U shapes in a shape snake to the sclera, and then cut off the suture without a knot. A knot can cause a disturbing foreign body sensation to the patient (Fig. 5.35). Alternatively, you can prepare a scleral flap, fasten the suture to the sclera and place the knot under the scleral flap.
6. Close the conjunctiva, removal of the trocars.
   The conjunctiva is closed with a Vicryl 8-0 interrupted stitch. The sclerotomies do not need to be sutured.

5.4 Summary

In case of an absent lens capsule, there are three main possibilities to fixate the IOL into the posterior chamber.

1. Fixation of haptics (3-piece IOL) into scleral tunnels (Scharioth technique)
2. Scleral suturing of haptics (3-piece or 1-piece IOL)
3. Iris fixation (iris-claw IOL)

A phacoemulsification machine is sufficient for all fixation methods. We prefer an iris fixation or an intrascleral fixation because the IOL does not tilt and a suture is avoided.

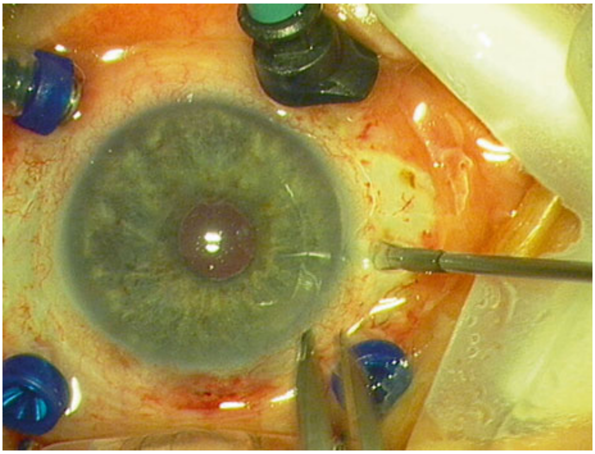


Fig. 5.32 Perform a focal peritomy at 3 and 9 o'clock. Perform then a sclerotomy 1.5 mm behind the limbus with the V-lance (With courtesy of the Kaden Verlag)

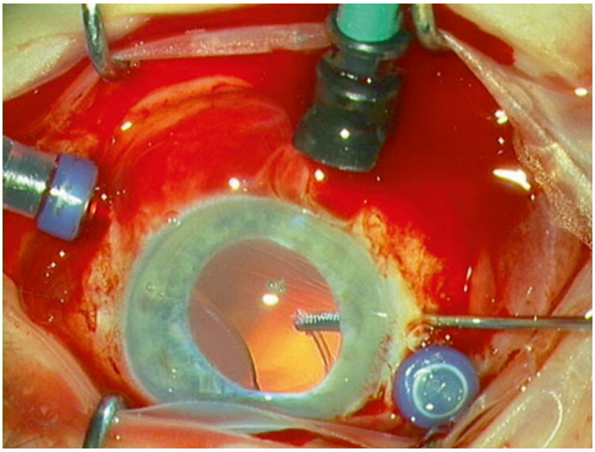


Fig. 5.33 Insert the intravitreal forceps through the sclerotomy, grasp the tip of the haptic and pull it through the sclerotomy (With courtesy of the Kaden Verlag)

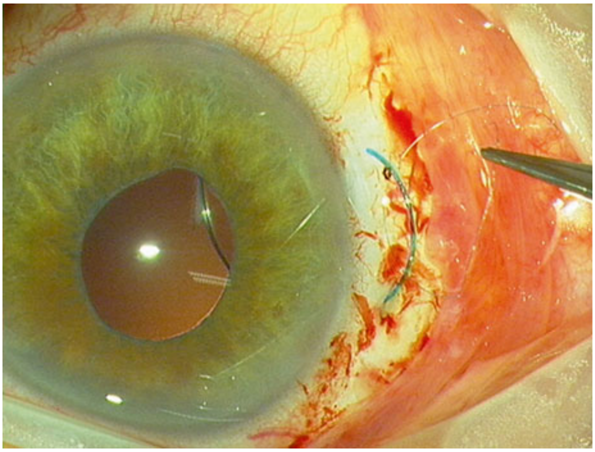


Fig. 5.34 Knot a polypropylene 10-0 suture (two curved needles) to the haptic and reinsert the haptic into the eye. Perform the same manoeuvre at the other side (With courtesy of the Kaden Verlag)

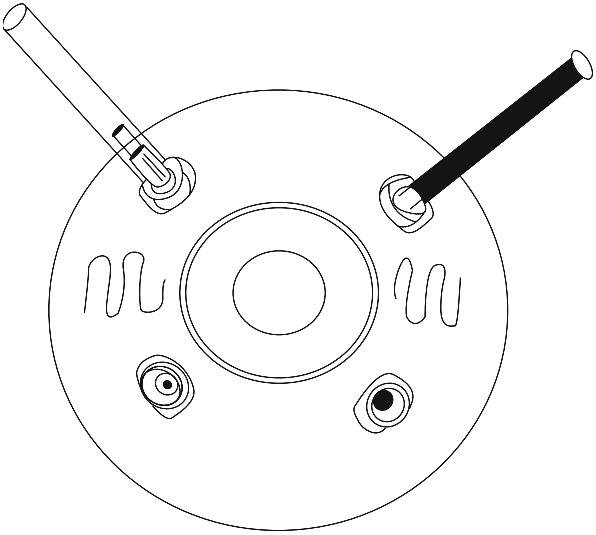


Fig. 5.35 Then perform a snake-formed suture on each side; four rounds are sufficient; a knot is not necessary

Possible Surgeries After Insertion of a Trocar at Pars Plana

6

Contents

6.1 Introduction

In the following, we will demonstrate a new technique for cataract surgeons which increases your surgical spectrum immensely. Cases, which you sent to a retinal specialist, can be solved by yourself.

Insert a trocar into the sclera. That's all. Now you can perform an anterior vitrectomy from pars plana, which enables you to remove the anterior vitreous completely and reducing the risk of damaging the lens capsule. Secondly, you can recover a subluxated IOL by elevating the IOL from pars plana. Thirdly, you can rescue a dropping nucleus by recovering it from pars plana. Fourthly, you can remove a posterior capsular opacification (PCO) from pars plana with the vitreous cutter, if it cannot be removed with laser.

Electronic supplementary material Supplementary material is available in the online version of this chapter at http://dx.doi.org/10.1007/978-3-642-54449-1_6. Videos can also be accessed at http://www.springerimages.com/videos/978-3-642-54448-4.

U. Spandau, G. Scharioth, *Complications During and After Cataract Surgery*
DOI 10.1007/978-3-642-54449-1_6,

6.2 Anterior Vitrectomy from Pars Plana

An anterior vitrectomy is usually performed with a 20-G vitreous cutter from the limbus (Fig. 6.15). The disadvantage of this technique is that it is difficult to perform a complete anterior vitrectomy because the iris and the lens capsule are in the way resulting sometimes in a residual vitreous prolapse.

The new technique enables an anterior vitrectomy from pars plana with a 23-G trocar, a 23-G vitreous cutter, a cutting speed of 2,500 cuts/min using a conventional phacoemulsification machine (Fig. 6.16).

What is the advantage of an anterior vitrectomy from pars plana compared to a limbal approach? The advantage is that the anterior vitreous is much easier to remove from pars plana, because the iris and the lens capsule are not in the way (Figs. 6.15 and 6.16). In addition, the anterior vitreous can be completely removed from pars plana but only partially from the limbus.

6.2.1 Basics of Anterior Vitrectomy

A vitrectomy due to posterior capsule rupture is quite a rare event. This may be the reason why such an event causes so many disturbances in the OR; both for the surgical management as well for the technical aspect (machine settings and instruments).

Before operating on a complication on your own, you should have seen this complication by an experienced surgeon or in a surgical video. In addition, you have to know exactly the instrumentarium and the machine settings for a vitrectomy on a phaco machine. I will therefore add some technical details:

If you perform a phaco or an I/A or a vitrectomy, you remove the material and fluid and at the same time inject water to prevent hypotension. The phaco handpiece has both functions (emulsification and irrigation) integrated in one handpiece. This applies also for the monomanual I/A handpiece (= coaxial). But this is (of course) not the case for the bimanual I/A handpieces. And this is usually not the case for vitrectomy. If you perform an anterior vitrectomy, you work bimanual: The nondominant hand holds the irrigation and the dominant hand holds the vitreous cutter (like in bimanual I/A) (Fig. 6.15).

But there are also coaxial solutions, in which an infusion cannula is attached over the shaft of the vitrector (e.g. Bausch & Lomb).

There are a few more important details you need to know when performing vitrectomy with a phaco machine.

1. The vitreous cutter of a phaco machine is 20G, which is important because a 20-G cutter does not fit through a paracentesis incision. It fits only through a main incision.
2. It is very important to know the machine and foot pedal settings for vitrectomy with phaco machine:

The Infinity (Alcon) has a 20-G vitreous cutter with 800 cuts/min. The unit offers the following choices:

1. Cutting I/A
2. I/A cutting

I recommend the I/A-cutting mode. When you step on the foot pedal slightly, you are in the aspiration mode, when you step firmly on the pedal, you are in the cutting mode. You can cause serious damage during vitrectomy, which is not the case for the I/A mode. It is therefore prudent that a slight stepping on the foot pedal activates I/A (which causes little damage) and a firm stepping on the foot pedal activates vitrectomy (which can cause serious damage). What is the most serious damage? A retinal rupture with the vitreous cutter but that's unlikely. Which is the most common damage with the vitreous cutter? The anterior capsule. Try absolutely to avoid damaging the anterior capsule during anterior vitrectomy. You need an intact anterior capsule to implant a sulcus-fixated IOL.

In the following, we will demonstrate a new technique for anterior vitrectomy. An anterior vitrectomy is usually performed with a 20-G vitreous cutter from the limbus. The disadvantage of this technique is that it is difficult to perform a complete anterior vitrectomy because the iris and the lens capsule are in the way resulting sometimes in a residual vitreous prolapse.

The new technique enables an anterior vitrectomy from pars plana with a 23-G trocar, a 23-G vitreous cutter, a cutting speed of 2,500 cuts/min using a conventional phacoemulsification machine.

Pits and Pearls No. 17

You can upgrade the Alcon (Infinity) with a pump allowing the use of a far more effective and smaller *23-G vitreous cutter*. This results in a much higher cut rate of 2,500 cuts/min. In addition, this 23-G vitreous cutter fits through a paracentesis, whereas a regular 20-G vitreous cutter only fits through the main incision.

Regarding the Stellaris Anterior (Bausch & Lomb), you can attach a 20-G vitreous cutter and the cutting frequency is 1,000 cuts/min. The unit usually has the following setting for the vitrectomy: Light pedal pressure, irrigation, and increased pedal pressure, vitrectomy if vitreous cutter is activated and aspiration if vitreous cutter is switched off.

6.2.2 Special Instruments and Material for Anterior Vitrectomy

Anterior Vitrectomy from Pars Plana

Triamcinolone

Volon A®, Kenalog® and Squibb. Indication: staining of the vitreous after a posterior capsule rupture (Figs. 6.1, 6.2 and 6.3).

Fig. 6.1 Triamcinolone (Kenalog®, Squibb. Volon A®, Pfizer). Indication: Staining of the vitreous

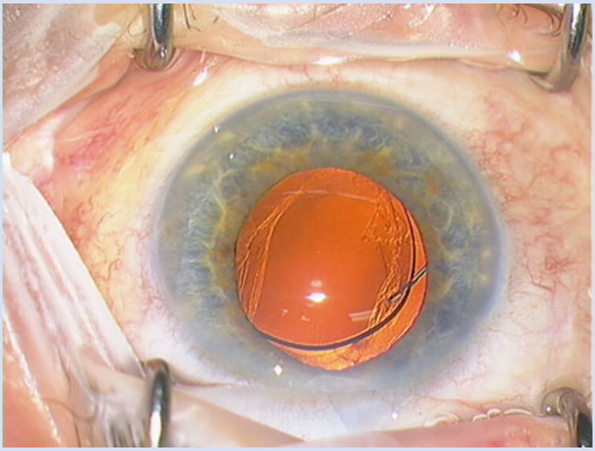


Fig. 6.2 An inferior vitreous prolapse after posterior capsular defect. The vitreous prolapse is difficult to detect under the operation microscope

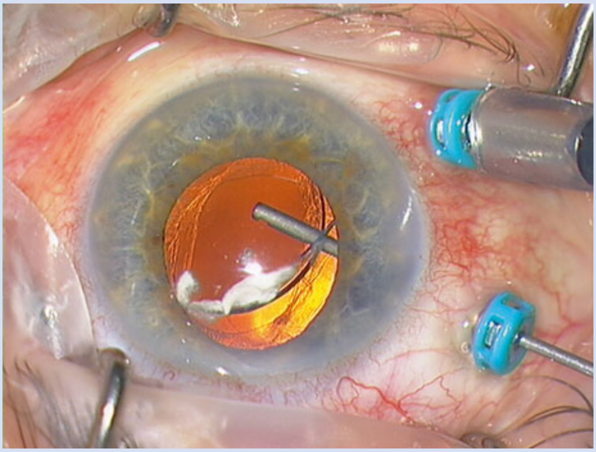


Fig. 6.3 After staining with triamcinolone the vitreous prolapse is easy to detect

Trocars

Trocars are simple to use. All modern 23-G trocars come in a one-step technique (Fig. 6.4) which includes a marker, a knife and the trocar. The 20-G trocars, however, are only available in a two-step technique (Fig. 6.5) and a three-step technique (Figs. 6.6, 6.7 and 6.8). The two-step technique includes a trocar with integrated marker and a separate knife. The three-step technique (Figs. 6.6, 6.7 and 6.8) comprises a separate marker, a separate sclerotomy knife and a separate trocar. See also Table 6.1.

Fig. 6.4 A one-step trocar from Alcon. The trocar is at the left side, the handpiece/inserter has a knife for the sclerotomy at the left side and a marker for the sclerotomy on the right side

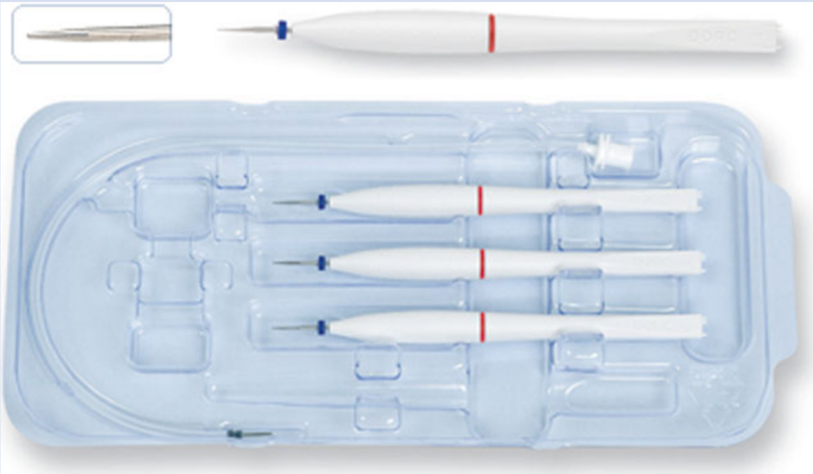


Fig. 6.5 A 20G two-step trocar system from DORC. The marker is integrated in the inserter. The knife is separate. DORC 12.ED09

Fig. 6.6 Caliper. Indication: Marking of main incision and sclerotomy. The main incision for the implantation of an iris-fixated PMMA IOL is 6 mm wide. Trocars are inserted 3.5–4 mm posterior to the limbus. Caliper by Castroviejo. Geuder 19135

Fig. 6.7 (**a**, **b**) 23-G 45° stiletto/MVR blade. Indication: Lamellar sclerotomy. Beaver Visitec

Fig. 6.8 A 20-G three-step trocar with handpiece. The trocar is the metal cannula with the blue valve and the handpiece is an inserter of the trocar and removed at the end. An extra knife for the sclerotomy is required. DORC

Table 6.1 Different trocar systems

Gauge	Marker	Sclerotomy knife	Trocar	Available
20G	X	X	X	Three-step system
20G, 23G		X	X	Two-step system
23G, 25G			X	One-step system

20-G three-step trocar system:

1. *Caliper*. Indication: Marking of sclerotomy (Fig. 6.6). Trocars are inserted 3.5–4 mm posterior to the limbus. Caliper by Castroviejo. Geuder 19135
2. *V-lance*, *MVR blade. Indication*: *Sclerotomy* (Fig. 6.7). *20-G. DORC. 51.5230*
3. *Trocar*. Indication: Anterior vitrectomy from pars plana (Fig. 6.8). 20-G trocars. DORC 1272.ED09

20-G two-step trocar system:

1. *V-lance*, *MVR blade. Indication*: *Sclerotomy* (Fig. 6.7). *20-G. DORC. 51.5230*
2. *Trocar*. Indication: Anterior vitrectomy from pars plana (Fig. 6.5). 20-G trocars. DORC 1272.ED09

23-G one-step trocar system:

1. *Trocar*. Indication: Anterior vitrectomy from pars plana (Fig. 6.4). 23-G trocars. DORC 1272.ED206, other suppliers: Alcon, Bausch & Lomb
   Vitreous cutter

Indication: Vitreous prolapse. 20-G or 23-G vitreous cutter (Figs. 6.8, 6.9, 6.10 and 6.11). Many suppliers: Depends on the phaco or vitrectomy machine you use

Fig. 6.9 A 20-G vitreous cutter (DORC)

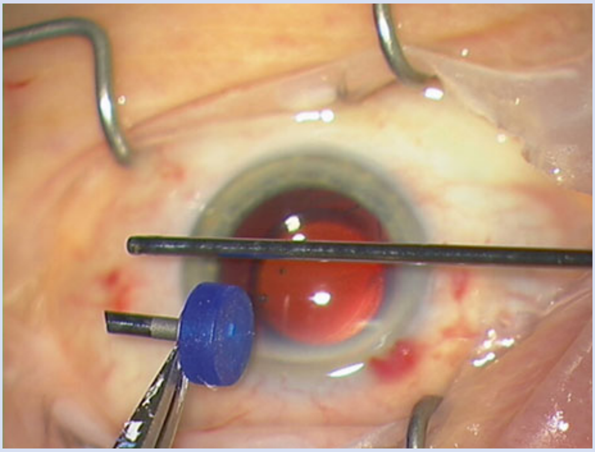


Fig. 6.10 A trocar with blue valve (DORC) and a vitreous cutter

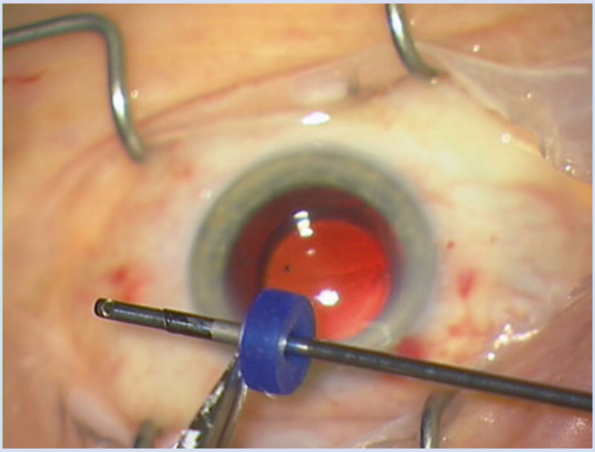


Fig. 6.11 The vitreous cutter fits very well in a 20G trocar (DORC). Most phaco machines work with a 20G vitreous cutter

Anterior Chamber Infusion

Anterior chamber maintainer

Indication: Stable infusion for anterior chamber, e.g. anterior vitrectomy (Figs. 6.12 and 6.13). DORC. 52_5061.

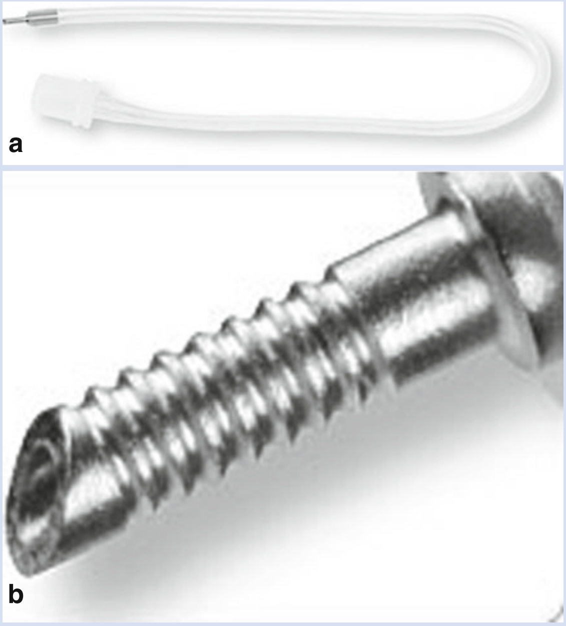


Fig. 6.12 (**a**, **b**) Anterior chamber maintainer. Indication: Stable infusion during anterior vitrectomy or for keeping the globe normotensive. The serrated tip allows a stable position in the limbus. DORC. 52.5061

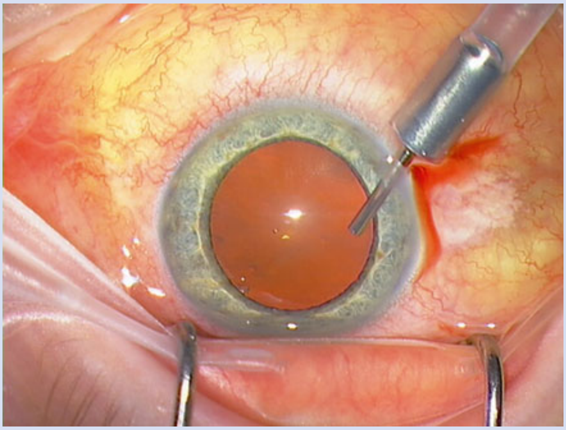


Fig. 6.13 Example for the use of an anterior chamber maintainer. Perform a paracentesis and insert the anterior chamber maintainer

Pits and Pearls No. 18

An *anterior chamber maintainer* can be used for a vitrectomy instead of a pars plana infusion, if there is sufficient flow between anterior and posterior chamber, e.g. aphakia.

It cannot be used in a phakic eye because there is no sufficient flow from the anterior to the posterior chamber.

6.2.3 Anterior Vitrectomy from the Limbus

A 20-G vitreous cutter fits through the tunnel incision but not through the paracentesis incision. A 23-G vitreous cutter fits through the paracentesis (Fig. 6.14). Normally the anterior vitrectomy is carried out bimanually (like the I/A). The vitreous cutter removes tissue and fluid, and an irrigation handpiece provides irrigation fluid, in order to avoid a hypotension. Hold the irrigation handpiece through the paracentesis into the anterior chamber and the vitreous cutter through the main incision in the anterior chamber (Fig. 6.15). Begin by removing the vitreous body prolapse in the centre of the capsule and then the vitreous body behind the posterior capsule. Rotate the vitreous cutter slowly in a circular fashion in order to remove as much vitreous behind the posterior capsule as possible. For details, see Sect. 7.1 (Posterior Capsule Rupture).

6.2.4 Anterior Vitrectomy from Pars Plana

Videos 6.22 and 6.23: Posterior capsular defect and anterior vitrectomy from pars plana

What is the advantage of an anterior vitrectomy from pars plana compared to a limbal approach? The advantage is that the anterior vitreous is much easier to remove from pars plana, because the iris and the lens capsule are not in the way (Figs. 6.16 and 6.17). In addition, the anterior vitreous can be completely removed from pars plana, but only partially from the limbus.

Another major advantage of the pars plana technique is the recovery of a subluxated IOL or nucleus (see Sects. 6.3 and 6.4).

The old 20-G technology without trocars is difficult to learn for an anterior segment surgeon. We will therefore demonstrate a technique that is easy to learn and easy to perform. This technique requires only a trocar. The trocar is inserted into the sclera with an inserter. After insertion of the trocar, the inserter is removed and the trocar remains in the sclera. The valve prevents outflow of intraocular fluid. The vitreous cutter is inserted through the trocar (Figs. 6.9, 6.10 and 6.11). The trocar enables, therefore, an easy insertion of the vitreous cutter and an easy postoperative wound closure.

Instruments

1. 20-G trocar with caliper and sclerotomy knife or 23-G trocar
2. 20-G or 23-G vitreous cutter

Individual Steps

1. Mark the sclerotomy
2. Insertion of trocar
3. Anterior vitrectomy from pars plana
4. Removal of trocar

The Operation Step by Step

1. Mark the sclerotomy
2. Insertion of the trocar

Measure and mark the sclerotomy with a scleral marker, a caliper or with the trocar 3.5–4 mm posterior to the limbus (Fig. 6.18). It is advisable to fixate the eyeball

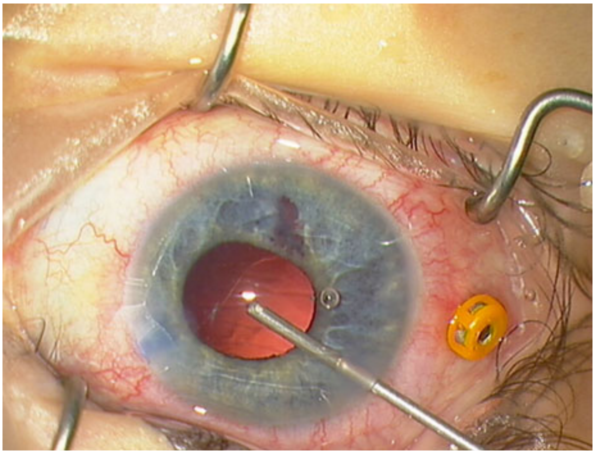


Fig. 6.14 A 23-G vitreous cutter from Alcon for an Infinity phaco machine. The vitreous cutter fits through a paracentesis

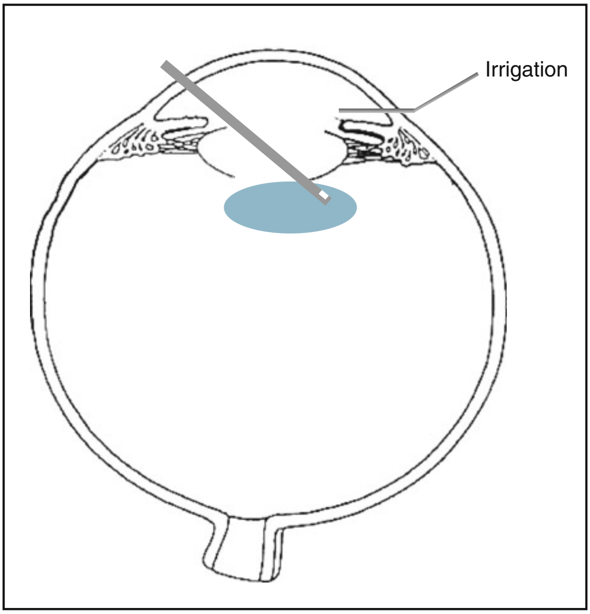


Fig. 6.15 Drawing of an anterior pars plana vitrectomy from the limbus. The disadvantage of this technique is that the anterior vitreous can only be incompletely removed. In addition, the lens capsule can be easily damaged

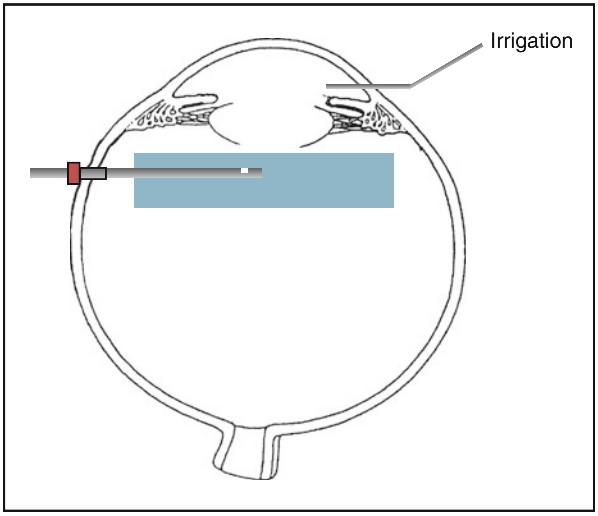


Fig. 6.16 Drawing of an anterior pars plana vitrectomy from pars plana. Insert a 20-G or 23-G trocar 3.5–4 mm behind the limbus. The advantage of this method is that the anterior vitreous can be completely removed, that the vitrectomy is easier to perform and a damage of the lens capsule is unlikely

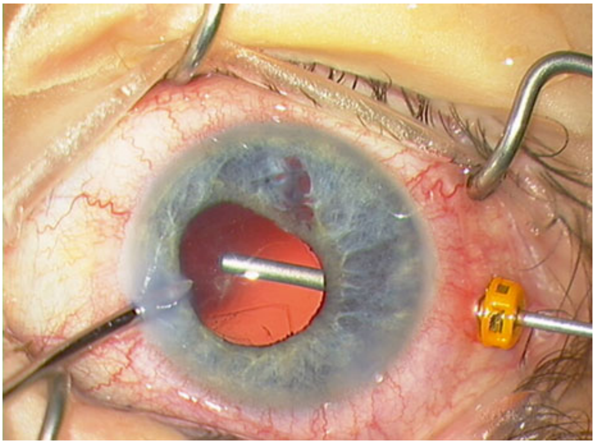


Fig. 6.17 An anterior vitrectomy from pars plana. Hold the infusion via a paracentesis in the anterior chamber. Then vitrectomise the anterior vitreous from pars plana

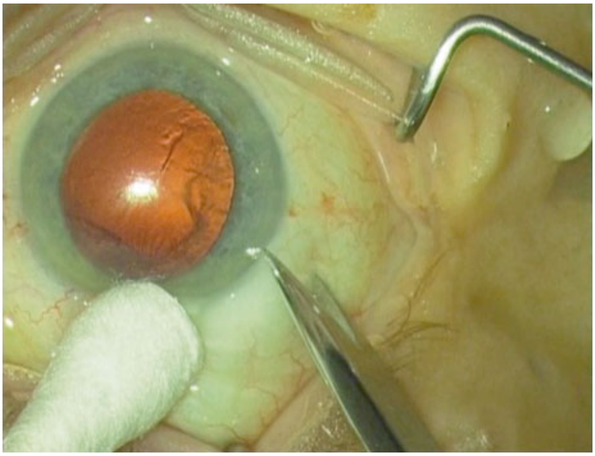


Fig. 6.18 Three-step trocar technique: Fixate the globe with a cotton swab. Mark the sclerotomy with a scleral marker (depicted), a caliper or with the trocar marker (3.5–4 mm)

simultaneously with a forceps or a cotton wool swab. Insert the stiletto knife in an angle of 15° to the limbus and stab the knife through the conjunctiva and the sclera (Fig. 6.19). Then insert the trocar with inserter into the bleeding sclerotomy (Fig. 6.20). If you are half way through, raise the inserter and stab the knife for the second half in direction of the centre of the eye (Fig. 6.21). Then fixate the trocar with an anatomic forceps or cotton swab and pull out the trocar inserter. The three-step technique is almost identical and demonstrated from Figs. 6.22, 6.23, 6.24 and 6.25.

Pits and Pearls No. 19

Insertion of Trocars: The insertion of a trocar is almost identical to an intravitreal injection. The only difference is that an injection is performed completely perpendicular (to the middle of the eye) whereas the trocar is inserted for the first half lamellar and the second half perpendicular.

3. Anterior vitrectomy from pars plana

Instrumentation

Nondominant hand: Irrigation

Dominant hand: Vitreous cutter

Begin by placing the irrigation cannula in the anterior chamber. Then insert the vitreous cutter in the trocar until you can view the tip behind the pupil. Turn the port of the vitreous cutter downwards and cut the anterior vitreous. Make circular movements along the edge of the pupil and stay at the same horizontal level (Fig. 6.26). You can also turn the port of the vitreous cutter sideways but not upwards, because you can easily damage the capsule. If you are unsure, if residual vitreous is present in the anterior chamber, then inject triamcinolone into the anterior chamber to stain the vitreous.

4. Removal of trocar

Remove the trocar with an anatomical forceps. Press on the sclerotomy with an anatomic forceps to avoid leaking (Fig. 6.27). Check for vitreous strand in the sclerotomy and remove it in case with the vitreous cutter. If the sclerotomy is leaking, then suture it with a Vicryl 8-0 interrupted stitch.

Pits and Pearls No. 20

Anterior Chamber Maintainer: Instead of holding an infusion through the paracentesis or using a pars plana infusion, you can use a limbal infusion (anterior chamber maintainer). Perform a paracentesis at 6 o'clock and insert the anterior chamber maintainer (Figs. 6.12 and 6.13).

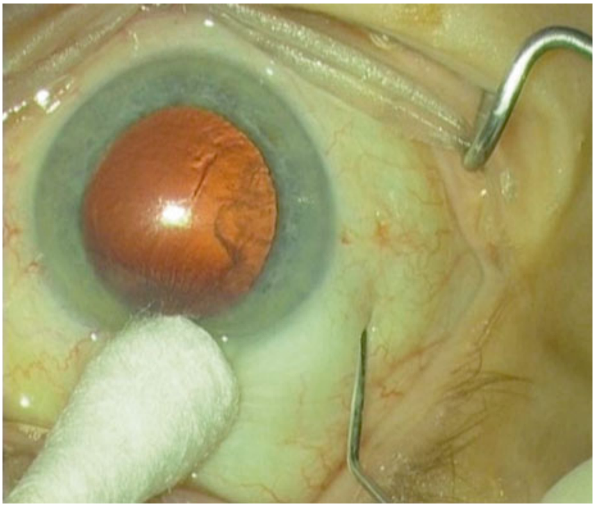


Fig. 6.19 Three-step trocar technique: Perform a lamellar (diagonal) sclerotomy with the 20-G stiletto

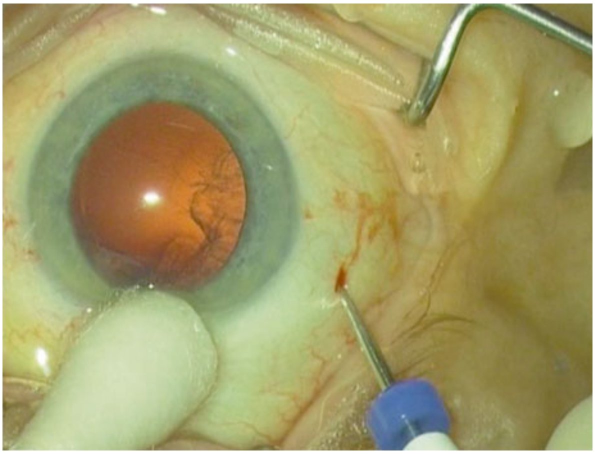


Fig. 6.20 Three-step trocar technique: Insert the inserter into the sclerotomy. The sclerotomy is marked by a faint conjunctival bleeding. Insert the first half with an approximately 20–30° angle

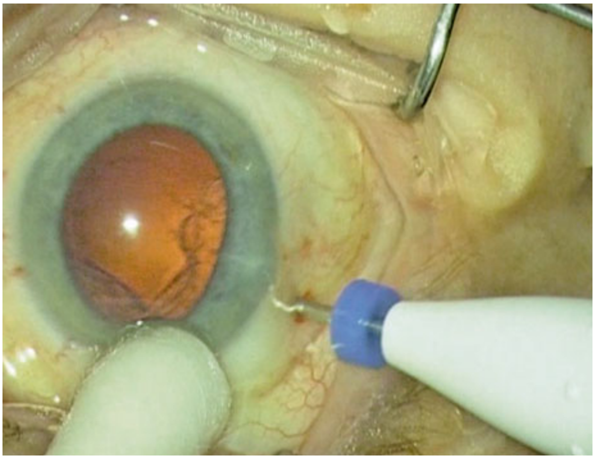


Fig. 6.21 Three-step trocar technique: Then insert the second half in direction of the middle of the eye. Remove the inserter, the trocar remains in the sclerotomy

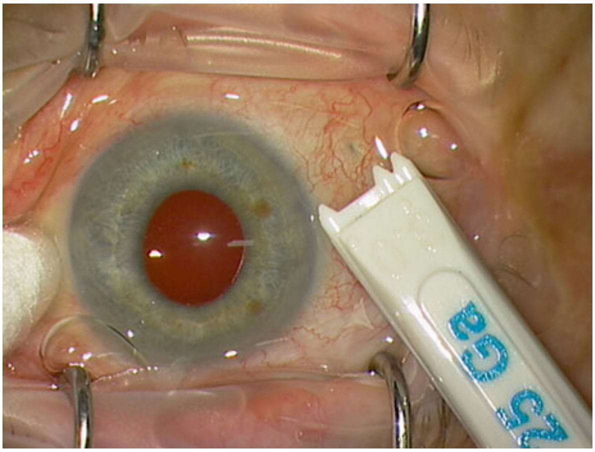


Fig. 6.22 One-step trocar technique: Mark the sclerotomy with a trocar marker (3.5–4.0 mm)

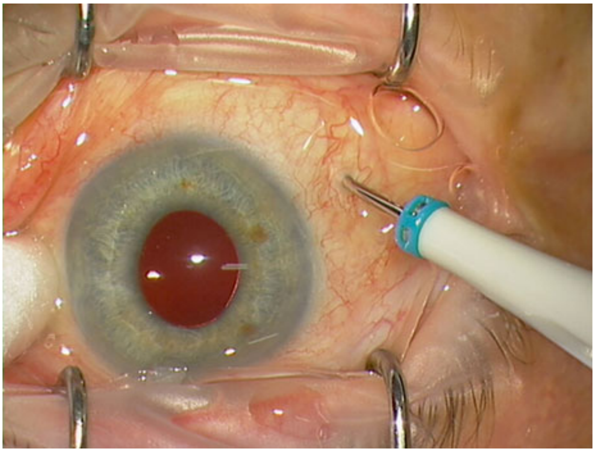


Fig. 6.23 One-step trocar technique: Insert the blade transconjunctivally in a steep angle (20–30°) to the sclera

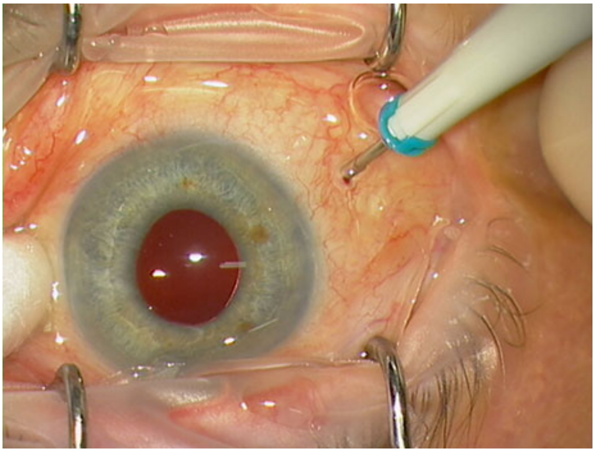


Fig. 6.24 One-step trocar technique: Then raise the trocar up and insert the trocar the next half in direction of the middle of the eye (perpendicular)

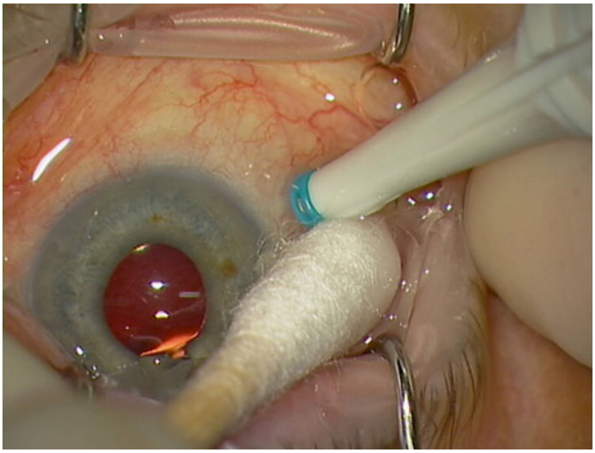


Fig. 6.25 One-step trocar technique: Fixate the trocar with a cotton swab or a forceps and remove the inserter

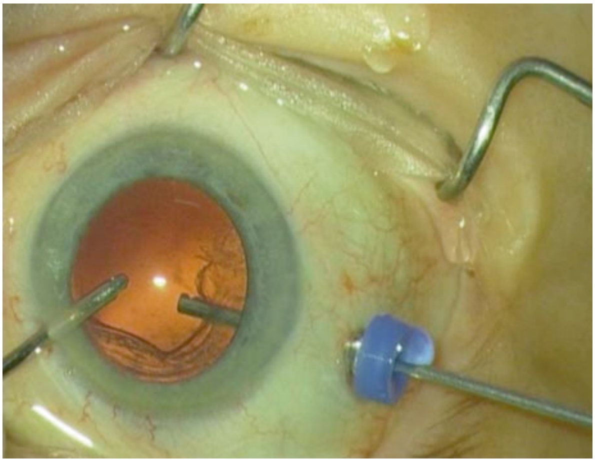


Fig. 6.26 The infusion is inserted through the paracentesis. The vitreous cutter is inserted through the trocar. Make circular movements along the edge of the pupil; hold the opening of the vitreous cutter towards the posterior pole

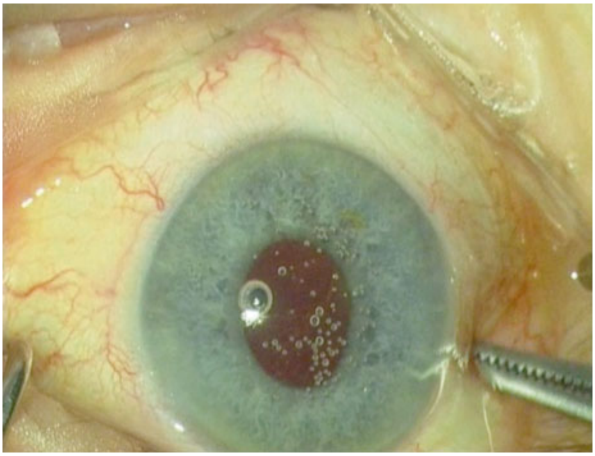


Fig. 6.27 Remove the trocar and close the sclerotomy by pressing it with an anatomic forceps

6.3 Recovery of a Subluxated Nucleus from Pars Plana

Another major advantage of the pars plana technique is the recovery of a subluxated nucleus (Fig. 6.28). A subluxated nucleus in most cases cannot be reached from the limbus, but from pars plana it is always possible (without BIOM). Why? Because you can access the backside of the nucleus from pars plana and then lift the nucleus easily into the anterior chamber.

> **Pits and Pearls No. 21**
> *Dropping Nucleus:* Attach a 27-G cannula to the viscoelastic syringe (Fig. 6.29), pierce the cannula through the sclera (4 mm behind the limbus) and inject viscoelastic behind the nucleus.

6.4 Recovery of a Subluxated IOL from Pars Plana

Video 6.24: Recovery of a dislocated IOL from pars plana

The same applies for a subluxated IOL (Figs. 6.30, 6.31, 6.32, 6.33, 6.34, 6.35, 6.36 and 6.37). A subluxated IOL in most cases cannot be reached from the limbus, but from pars plana it is easy to reach. Why? Because you can access the backside of the IOL from pars plana and then lift the IOL into the anterior chamber.

6.5 Removal of Posterior Capsular Opacification from Pars Plana

Video 6.25: Removal of PCO from pars plana

Insert a trocar 3.5 mm behind the limbus at 3 o'clock or 9 o'clock. Perform round circular movements with the vitreous cutter until a central and round opening is done (Figs. 6.38, 6.39 and 6.40). The settings are approximately 200 cuts/min with normal aspiration (400 mmHg).

6.6 Summary

Several surgical procedures are possible from pars plana. They increase the surgical spectrum of a cataract surgeon immensely. All procedures can be performed with a regular phacoemulsification machine. There are three different settings for the trocar and the infusion (Figs. 6.41, 6.42, 6.43 and 6.44). Insert the trocars always on the temporal side of the eye. The most simple one is the insertion of one trocar at pars plana and the irrigation handpiece inside the anterior chamber (Figs. 6.41 and 6.42). If you do not want to use an irrigation handpiece, then you can insert an anterior chamber maintainer into the anterior chamber (Fig. 6.43). The anterior chamber maintainer can also be inserted pars plana (Fig. 6.44).

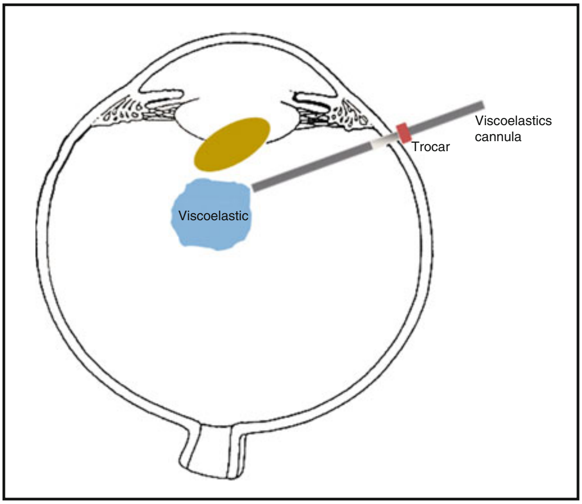


Fig. 6.28 A subluxated nucleus is difficult to elevate from the limbus because you have to access the nucleus from the back. The nucleus is easy to reach from pars plana. Insert a trocar, inject viscoelastics behind the nucleus and elevate it to the anterior chamber

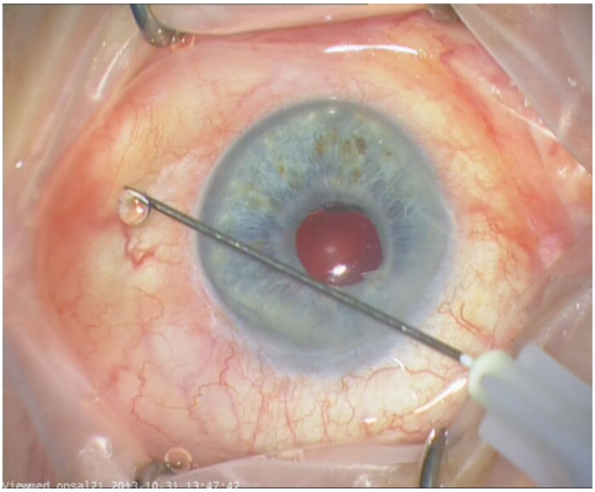


Fig. 6.29 If the nucleus drops and you have to act swiftly, then place a 27-G cannula on the Healon syringe, insert the cannula 4 mm behind the limbus and inject viscoelastic behind the dropping nucleus and lift it up into the anterior chamber

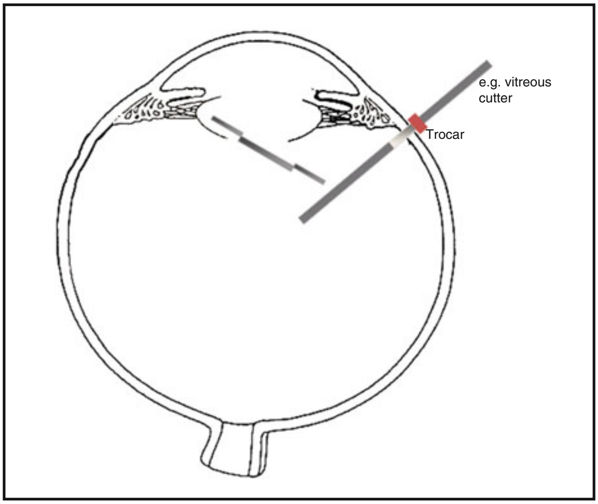


Fig. 6.30 A subluxated IOL is difficult to elevate from the limbus because you have to reach the backside of the IOL. This manoeuvre is, however, easy from pars plana. From pars plana it is no problem to reach the backside of the IOL and elevate it into the anterior chamber

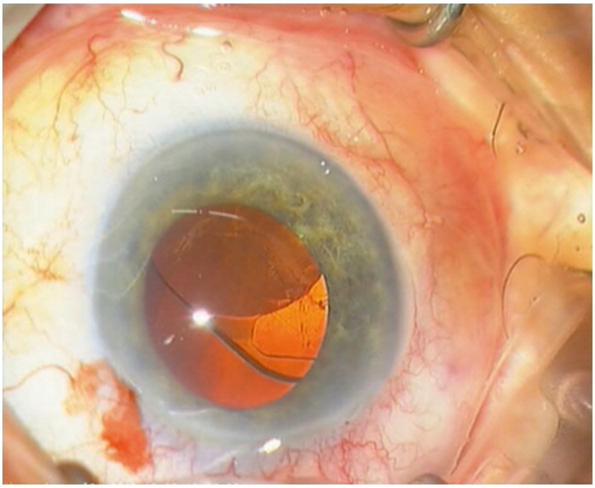


Fig. 6.31 A subluxated IOL after posterior capsular rupture. The IOL is difficult to elevate from the limbus into the anterior chamber

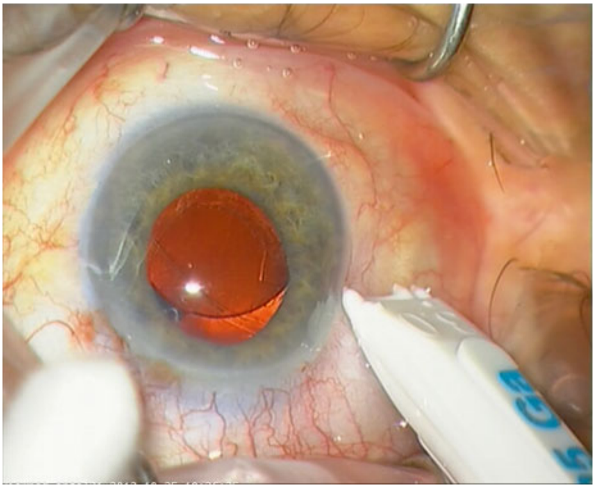


Fig. 6.32 Mark the sclerotomy 3.5 mm behind the limbus

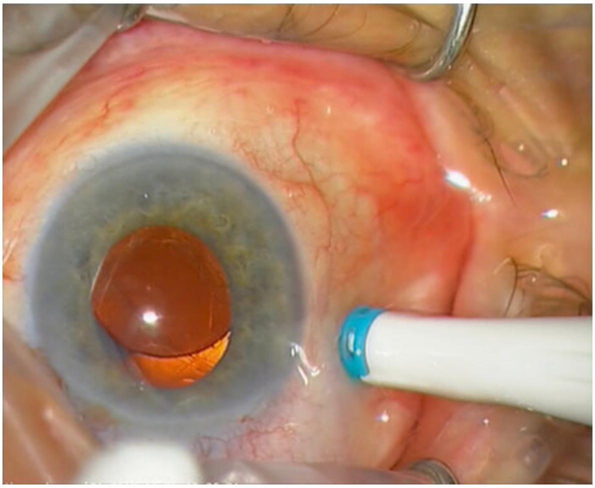


Fig. 6.33 Insert a trocar with valve (23G or 25G)

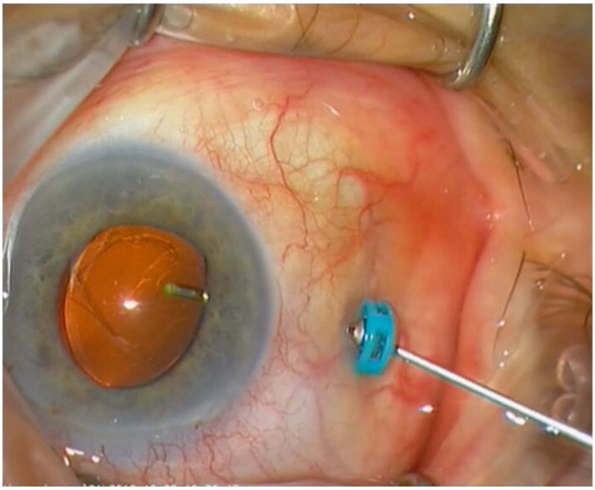


Fig. 6.34 Elevate the IOL with viscoelastic cannula into the anterior chamber

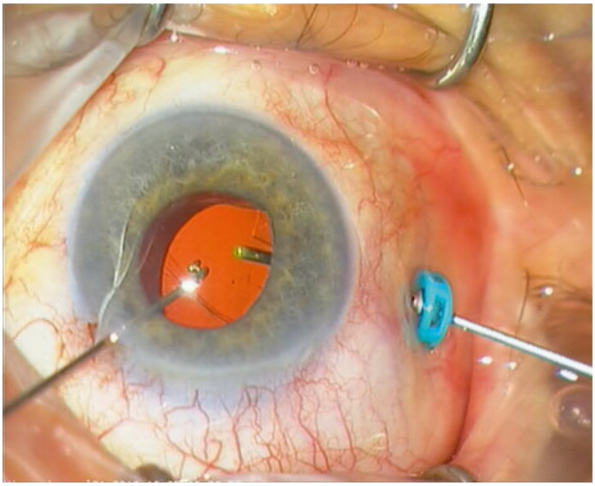


Fig. 6.35 Reposition the IOL into the sulcus

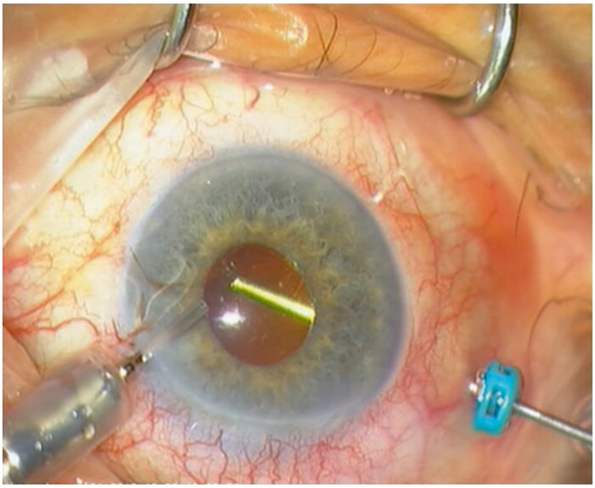


Fig. 6.36 If you need to remove a vitreous prolapse, then insert an anterior chamber maintainer and perform an anterior vitrectomy

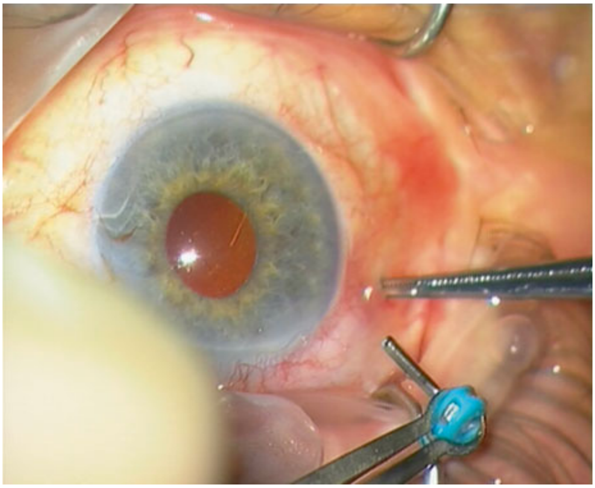


Fig. 6.37 Remove the trocar and compress the wedges of the sclerotomy with an anatomic forceps

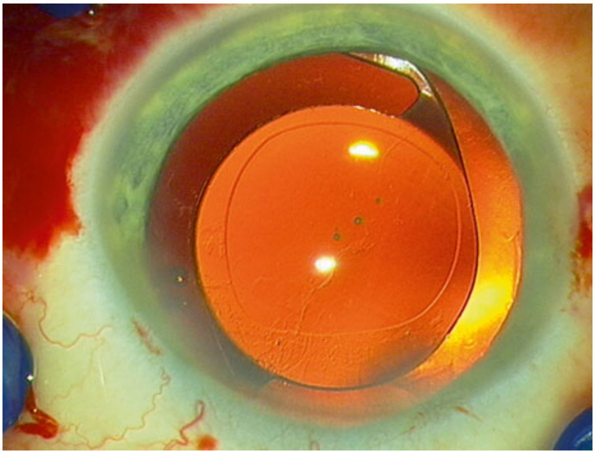


Fig. 6.38 A posterior capsular opacification can be easily removed from pars plana (With courtesy of the Kaden Verlag)

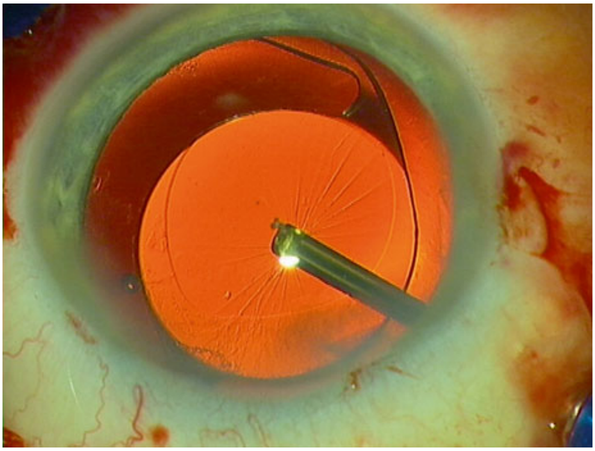


Fig. 6.39 Cut a round and central opening in the posterior capsule (With courtesy of the Kaden Verlag)

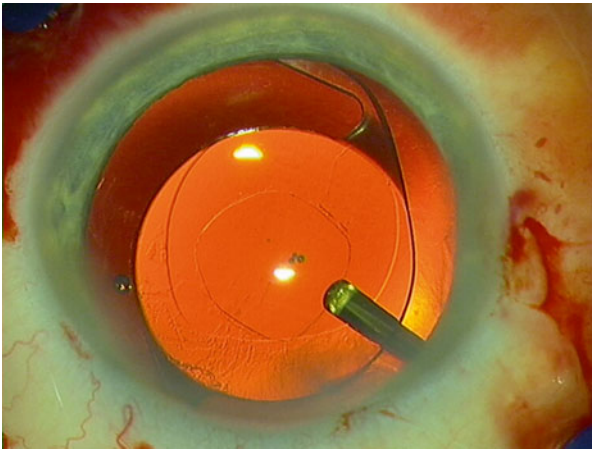


Fig. 6.40 A posterior capsular rhexis with the vitreous cutter never extends to the zonules (With courtesy of the Kaden Verlag)

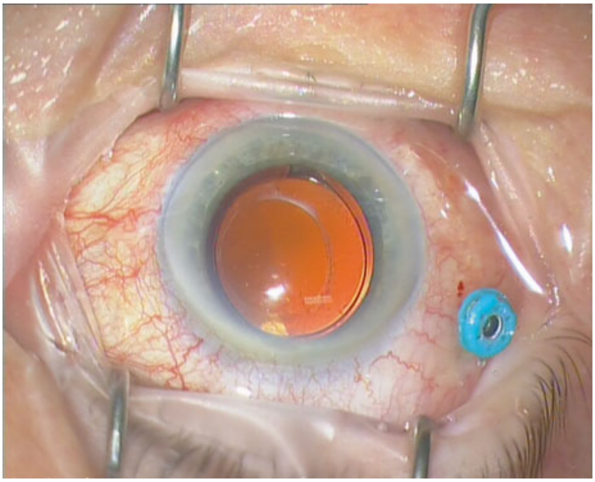


Fig. 6.41 After insertion of one trocar at pars plana. Always on the temporal side of the eye

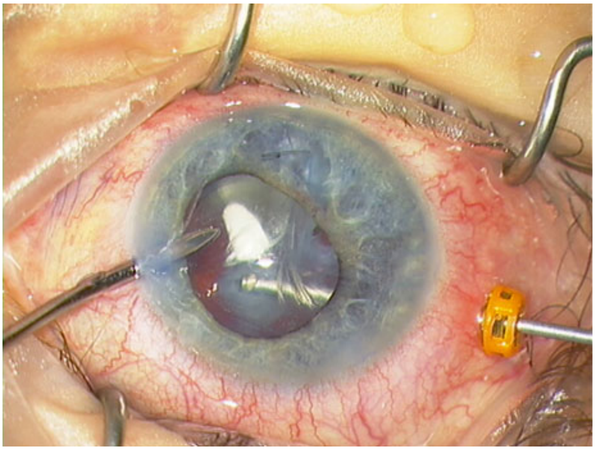


Fig. 6.42 The irrigation handpiece is inserted into the anterior chamber at 2 o'clock. An anterior vitrectomy is performed from pars plana

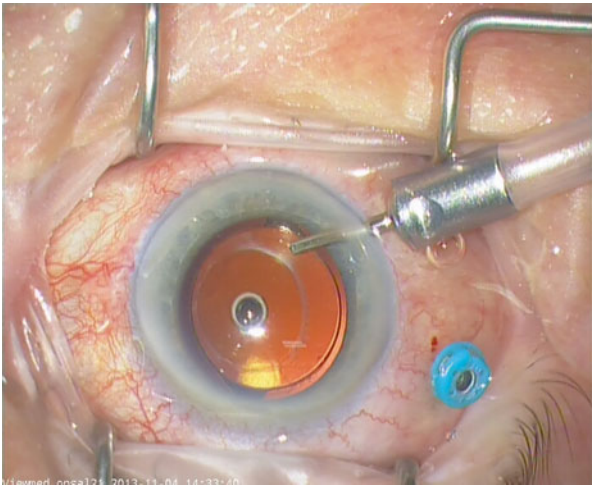


Fig. 6.43 An anterior chamber maintainer is inserted into the anterior chamber. It replaces the irrigation handpiece

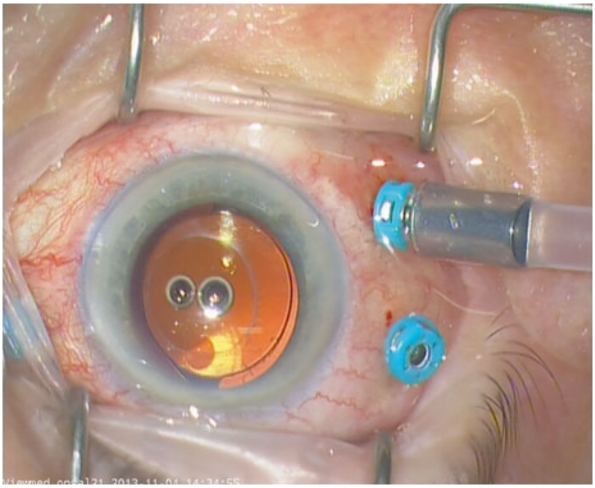


Fig. 6.44 An infusion line is inserted into a second trocar at pars plana

Complication Management for Anterior Segment Cases

7

Contents

7.1 Posterior Capsule Rupture

Video 7.22: Posterior capsular defect and anterior vitrectomy from pars plana

Video 7.23: Anterior vitrectomy from pars plana

For the subsequent surgical procedure, it is important during which step of the phaco the posterior capsule was ruptured. If the posterior capsule ruptured during phaco, then nuclear fragments remain, which have to be removed first. The nuclear fragments may fall through the posterior capsular rupture. You can prevent this by first injecting viscoelastic behind the posterior capsule and then by inserting a scaffold in form of a lens glide or an IOL (see Sect. 7.1.1). The fragments can then be removed with the fragment forceps or the phacoemulsification handpiece. If the

Electronic supplementary material Supplementary material is available in the online version of this chapter at http://dx.doi.org/10.1007/978-3-642-54449-1_7. Videos can also be accessed at http://www.springerimages.com/videos/978-3-642-54448-4.

U. Spandau, G. Scharioth, *Complications During and After Cataract Surgery*,
DOI 10.1007/978-3-642-54449-1_7, © Springer-Verlag Berlin Heidelberg 2014

posterior capsule ruptured during I/A, then only residual cortex has to be removed. This is best done with the vitreous cutter.

Instruments

1. Vitreous cutter for phaco machine
2. Trocar (Figs. 6.4 and 6.5)
3. Fragment forceps (Fig. 7.1)
4. Lens glide (Fig. 7.2)

Dye

Triamcinolone (Fig. 6.1)

Individual Steps

1. Viscoelastics in the anterior chamber
2. Extraction of nuclear fragments
3. Triamcinolone into the anterior chamber
4. Anterior vitrectomy and removal of cortex
5. Exclusion of a vitreous strand
6. IOL implantation
7. IOL capture
8. Removal of trocar

The Operation Step by Step

1. Viscoelastic in the anterior chamber
2. Extraction of nuclear fragments

Inject viscoelastic into the capsular bag, so that the vitreous prolapse is pushed back (Fig. 7.3). If nucleus fragments are still present in the anterior chamber, I recommend extending the main incision and extracting the nucleus fragments with the fragment forceps. If you continue with phaco, you risk loosing these nuclear fragments.

Alternatively you can insert a lens glide into the bag and place it behind the lens fragments (Fig. 7.4). The lens glide prevents the lens fragments to fall into the posterior chamber (Fig. 7.4). Extract the lens fragments with the lens fragment forceps, or emulsify the fragments with the phaco handpiece. If you do not have a lens glide on-site, then you can use an IOL as scaffold (Agarwal technique, see Sect. 7.1.1).

3. Triamcinolone in the anterior chamber
4. Anterior vitrectomy and removal of cortex

Inject approximately 0.1 ml of triamcinolone into the anterior chamber. The triamcinolone crystals visualise the vitreous very well (Figs. 6.2 and 6.3). The anterior vitrectomy can be performed from the limbus or as described above from pars plana. Insert a trocar now and start with the anterior vitrectomy (Figs. 7.5, 7.6, 7.7 and 7.8). Regarding vitrectomy, the machine settings are important (see above). First remove the vitreous prolapse inside the anterior chamber (vitrectomy mode), and then gently aspirate the remaining cortex (aspiration mode) (Fig. 7.9) with I/A handpieces or vitrector (Fig. 7.10). Be careful that you do not accidentally activate the vitrectomy mode during removal of the cortex because you will destroy the anterior capsule. In this manoeuvre you have to switch between vitrectomy and aspiration back and forth. Remove next the vitreous behind the capsular rupture. Rotate the vitreous cutter port slowly in a circular fashion in order to remove as much vitreous body as possible (Fig. 7.11). As a

Fig. 7.1 A fragment removal forceps after Gaskin. Indication: Removal of nuclear fragments during a complicated cataract surgery. Geuder, 31624

Fig. 7.2 A lens glide. Indication: Scaffold to prevent dislocation of nuclear fragments into the vitreous cavity. The lens glide is placed over the posterior capsular defect. BD Visitec 581033

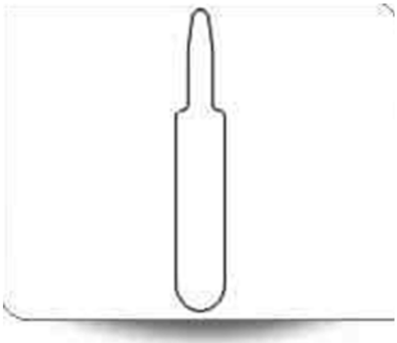
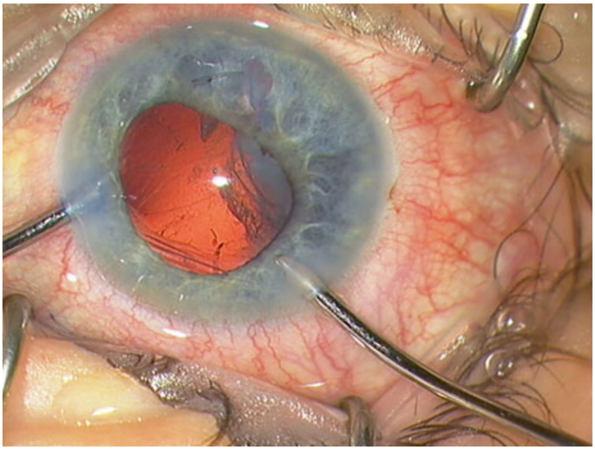


Fig. 7.3 Posterior capsular defect during I/A. The anterior capsule is intact. A sulcus implantation is possible. The residual cortex has to be removed



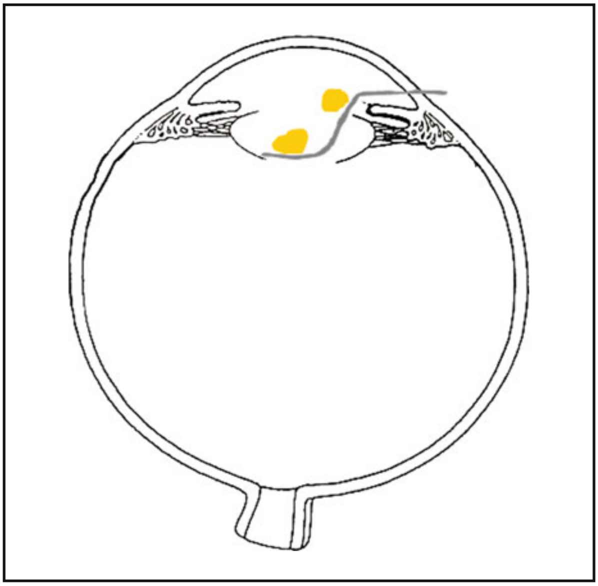


Fig. 7.4 Drawing for use of lens glide. The lens glide is placed as a scaffold inside the bag in order to prevent the dislocation of nuclear fragments into the vitreous cavity. Alternatively an IOL can be used (Agarwal technique, see Sect. 7.1.1)

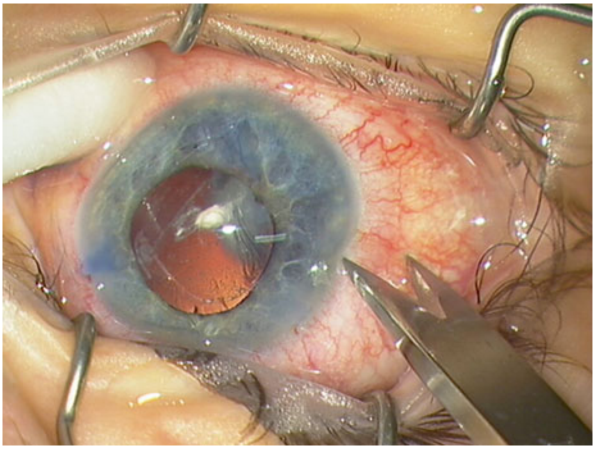


Fig. 7.5 Mark the sclerotomy 3.5–4 mm behind the limbus

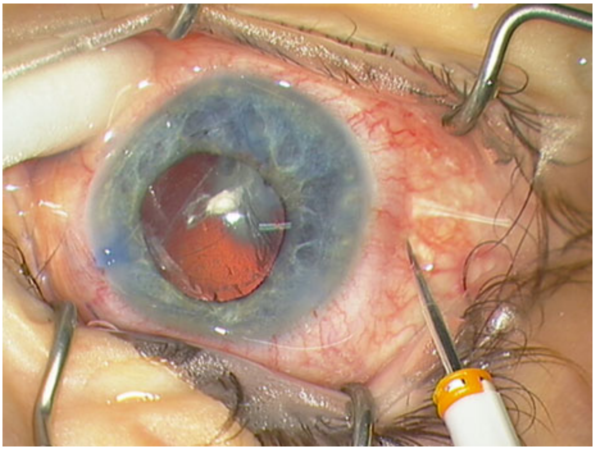


Fig. 7.6 Fixate the trocar with a cotton swab and remove the inserter

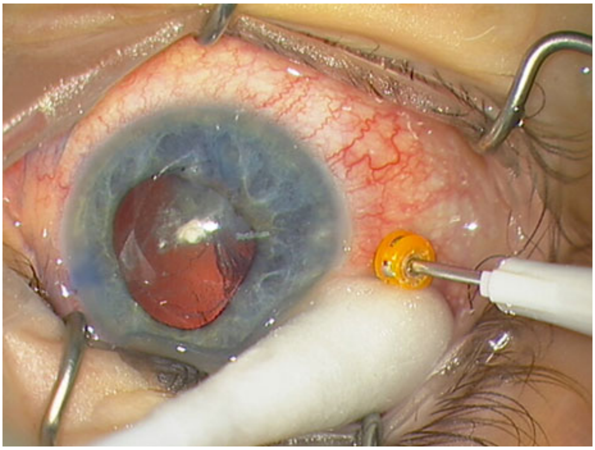


Fig. 7.7 Insert the trocar (lamellar sclerotomy)

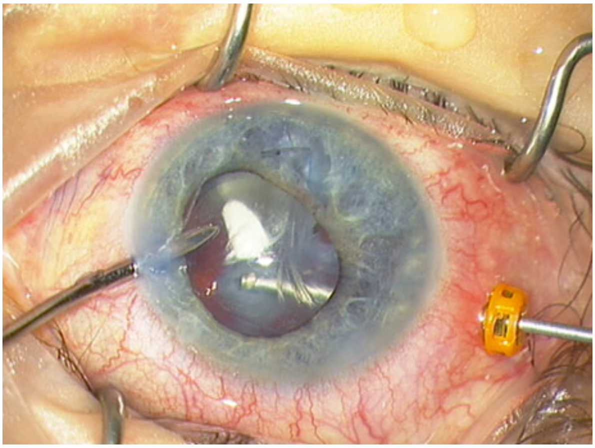


Fig. 7.8 Place the infusion in the anterior chamber and begin with the anterior vitrectomy from pars plana

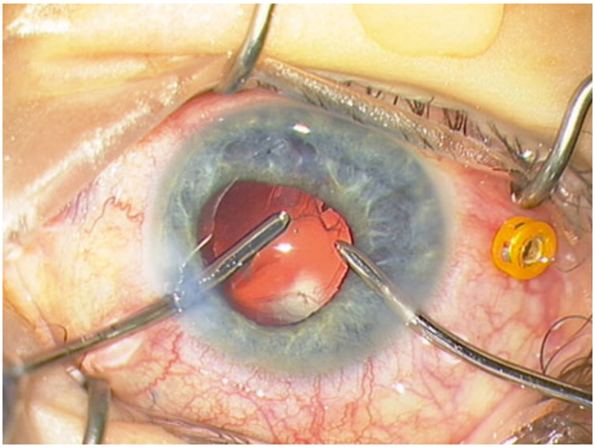


Fig. 7.9 Remove the residual cortical cortex. You can use the vitreous cutter (*Caution*: aspiration mode!) or the aspiration handpiece. It happens often that the aspiration handpiece aspirates the vitreous (11 o'clock). In this case you stop the removal of cortical cortex and continue with removal of the vitreous. It is therefore easier to remove the cortical cortex with the vitreous cutter because you do not need to change instruments

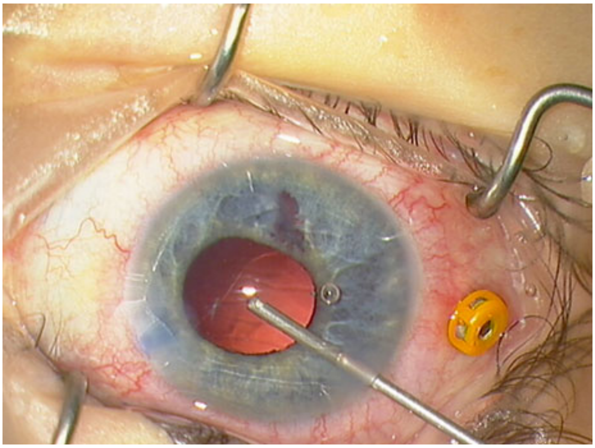


Fig. 7.10 A 23-G vitreous cutter fits through a paracentesis. Then continue with the removal of cortical cortex. *Caution*: Do not damage the anterior capsule with the vitreous cutter. You need the anterior lens capsule for the sulcus implantation

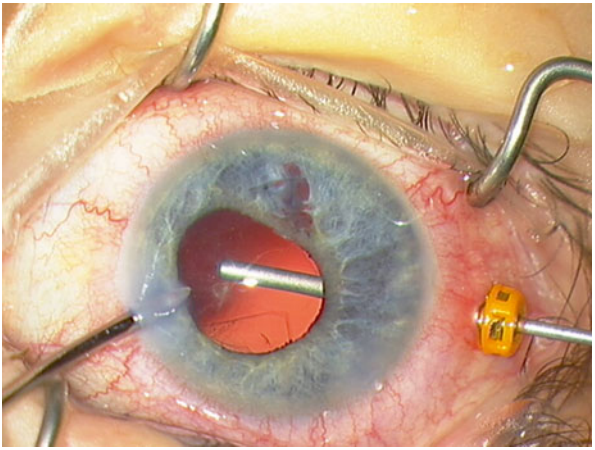


Fig. 7.11 The tip of the vitreous cutter should always be visible when it moves behind the pupil

beginner, you tend to remove too little anterior vitreous; take therefore your time for this manoeuvre. The visualisation of the vitreous with triamcinolone is a good help.

5. Exclusion of a Vitreous Strand

Check with a push-pull instrument or an iris spatula, if the vitreous is completely removed. The vitreous strands are incarcerated into the corneal wounds (paracentesis or main incision) and can be identified by a distorted pupil. If necessary inject again triamcinolone. Insert a push-pull instrument through a paracentesis, and rotate it in a circular fashion in the complete anterior chamber, and check especially the incision sites. Perform the same manoeuvre from the second paracentesis but not from the main incision. If you detect vitreous strands, then remove them with the vitreous cutter.

6. Implantation of the IOL

Inject viscoelastics into the anterior chamber and into the sulcus. Implant best a 3-piece IOL and make sure during implantation that the first haptic is positioned in the sulcus. Then rotate the second haptic into the sulcus, and clamp the IOL behind the rhexis (IOL capture). Alternatively, you can place the IOL first on the iris, and rotate it then into the sulcus.

7. IOL capture

In case of a posterior capsule tear, the best position for an IOL is "optic in, haptic out" (lens capture). The haptics are in the sulcus and the optic behind the rhexis of the anterior capsule (Figs. 7.12, 7.13 and 7.14). The IOL is well centred, the iris-lens diaphragm is stabilised, and the IOL is less myopic than in the sulcus. Another advantage relates to retinal surgery; a tamponade in the vitreous cavity cannot enter the anterior chamber.

Instrumentation

1. 2x manipulators (e.g. push-pull, Kuglen hook), Fig. 4.7

Procedure: Two paracentesis at an angle of about 90° to the haptics. If the haptics are located at 12 and 6 o'clock, then place the paracentesis at 3 and 9 o'clock. Take two push pulls; one push pull presses one side of the IOL behind the anterior capsule, while the other push pull stabilises the IOL (Fig. 5.46), then the same manoeuvre on the other side. Then examine with the push-pull instruments whether the rhexis margins are located before the IOL. When properly performed the rhexis takes an oval shape.

8. Removal of trocar

If the main incision was extended for the extraction of nuclear fragments, you should suture it with an Ethilon 10-0 cross-stitch. Hydrate the side incisions and inject cefuroxime antibiotics. Remove finally the trocar (Figs. 7.15 and 7.16).

Pits and Pearls No. 22

Postoperative distorted pupil with *incarcerated vitreous strand*. A vitreous strand should be removed because it causes a distorted pupil, a vitreous wick syndrome with an increased risk of infection and vitreous dragging with Irvine Gass syndrome or retinal tears.

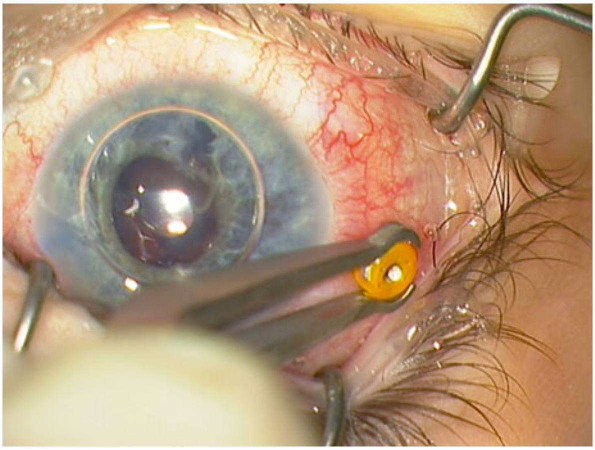


Fig. 7.12 A view from above on a lens capture. The haptics are located in the sulcus; the optic is buttonholed behind the rhexis. The round rhexis takes an almond shape

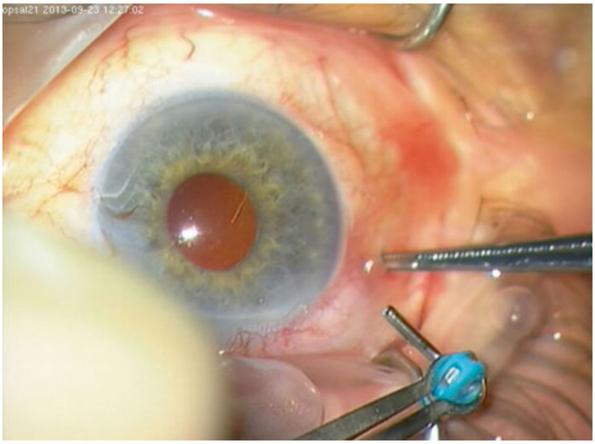


Fig. 7.13 Lens capture manoeuvre. Work bimanually with two push pulls or iris spatulas, and press the optic at one side behind the rhexis while stabilising the optic at the other side. Then the same manoeuvre at the other side

Fig. 7.14 Inject an air bubble to stabilise the anterior chamber if necessary, and remove finally the trocar with an anatomic forceps or a trocar forceps

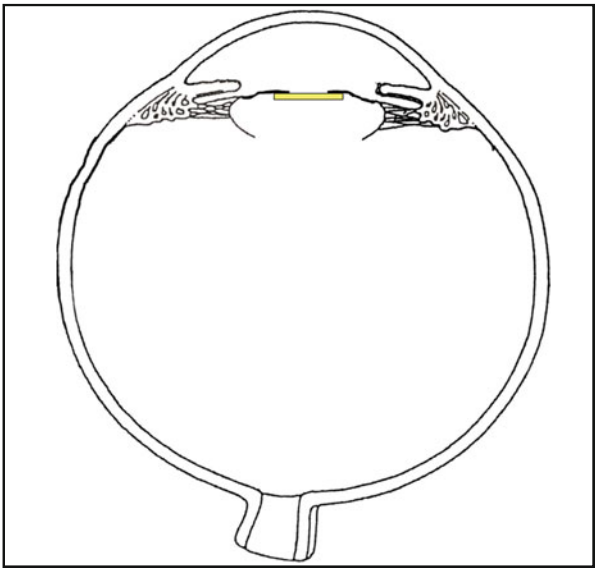


Fig. 7.15 Compress the wedges of the sclerotomy with the forceps for a few seconds

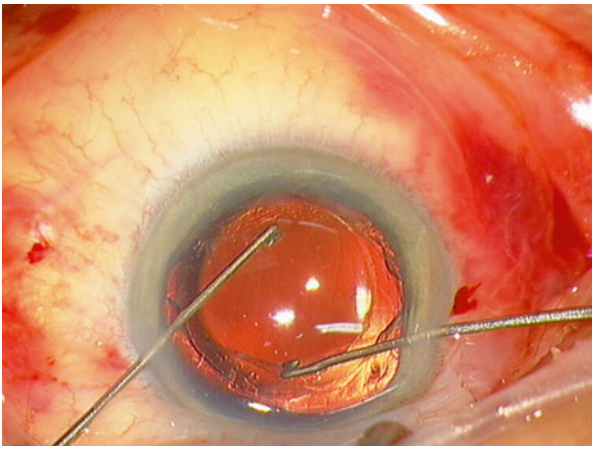


Fig. 7.16 Drawing of a lens capture. The posterior capsule is defective. The IOL is first placed in the sulcus, and the optic is buttonholed behind the rhexis. The haptics remain in the sulcus

You cannot relieve the vitreous strand from the same corneal incision. You have to remove it from a second incision. (1) Insert a manipulator (e.g. iris spatula) into a second paracentesis, and remove the vitreous strand with a circular movement. The strand remains in the anterior chamber but causes no traction. (2) YAG laser treatment. Especially if the vitreous strand is pigmented, you may succeed with a laser treatment. (3) Anterior vitrectomy. Remove the vitreous strand with the vitreous cutter.

7.1.1 IOL Scaffolding for Residual Lens Pieces in Capsular Rupture (Agarwal Technique)

Video 7.26: IOL scaffold

In case of a large posterior capsule defect during phacoemulsification with remaining larger nuclear fragment, IOL scaffolding is a good technique to prevent loss of this piece into vitreous cavity.

Individual Steps

1. Placing lens fragment in safe position.
2. Stabilising lens fragment with OVD or second instrument.
3. Implantation of IOL in the posterior chamber and behind the lens fragment.
4. Refill the anterior chamber with OVD.
5. Phacoemulsification of remaining lens fragments in the anterior chamber.
6. Removal of OVD.

The Operation Step for Step

1. Placing lens fragment in safe position.
2. Stabilising lens fragment with OVD or second instrument.

If a larger posterior capsule break occurs during phacoemulsification, remaining lens fragments could be lost into the vitreous cavity (Fig. 7.17). The surgeon should stop without retracting the phaco tip from the anterior chamber and analyse the situation. It is important to move the remaining lens fragment to a safe area (e.g. anterior chamber angle) (Fig. 7.18). This could be done with a second instrument and/or OVD. The OVD is injected through the side port incision and should be placed also behind the capsular defect to create a barrier. This will not work in vitrectomised eyes. Here a bimanual irrigation handpiece placed through the side port incision could be helpful (Fig. 7.19).

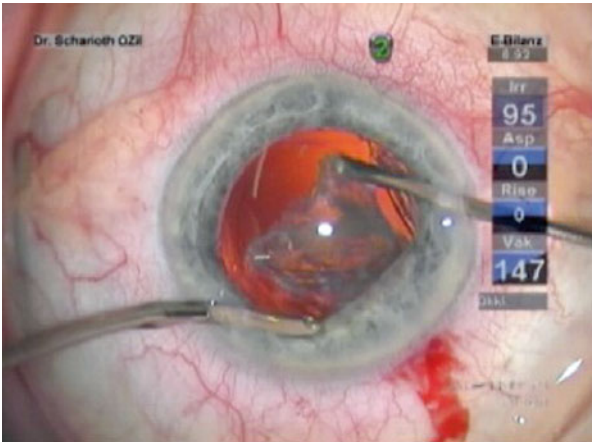


Fig. 7.17 Large posterior capsule defect with remaining retroiridal nuclear fragment is manipulated bimanually

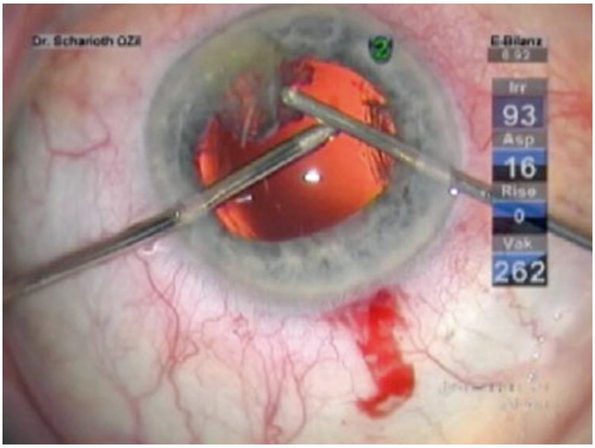


Fig. 7.18 The nuclear fragment is safely positioned in the anterior chamber angle; the eye is already vitrectomised; therefore, manipulations are performed with bimanual I/A handpieces

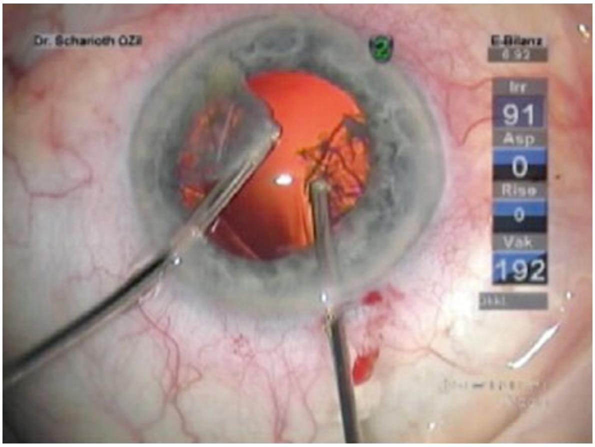


Fig. 7.19 Nuclear fragment is stabilised with the irrigation handpiece, while the aspiration is used to remove residual cortex

3. Implantation of IOL in the posterior chamber and behind the lens fragment

After the lens fragment is secured, the phaco tip could be withdrawn from the anterior chamber. Now, preferably, a three-piece IOL is placed into the ciliary sulcus and behind the remaining lens fragment to prevent posterior loss of the pieces (Figs. 7.20, 7.21 and 7.22). In case of an anterior capsule tear, the IOL haptic could be placed in the anterior chamber angle.

4. Refill the anterior chamber with OVD.
5. Phacoemulsification of remaining lens fragments in the anterior chamber.
6. Removal of OVD.

The anterior chamber is refilled with OVD to prevent excessive endothelial cell loss. Phacoemulsification of the remaining lens pieces is performed in front of the IOL (Fig. 7.23). Anterior segment is checked for vitreous prolapse, and if necessary anterior vitrectomy is performed. If IOL was not perfectly positioned, it is placed now in the ciliary sulcus and centred (Fig. 7.24). If anterior capsulorhexis is intact, a posterior optic capture should be performed. OVD is removed. Finally incisions are hydrated and checked for leakage.

Pits and Pearls No. 23

IOL scaffolding could be used for any size of remaining lens fragments in case of posterior capsule break. It reduces the risk for loss of lens fragments into the vitreous cavity. Before IOL implantation the remaining lens fragment should be placed in the anterior chamber angle.

7.2 Zonular Lysis

A cataract with zonular lysis is the most difficult cataract to operate. If you are a beginner, you should rather send the patient to a hospital with retinal backup (Figs. 7.25 and 7.28). The nucleus may luxate; you should therefore be capable to convert to a SICS (see Sect. 4.6) and to save a dropping nucleus from pars plana (see Sect. 6.3). Always check during the preoperative assessment, if a phacodonesis is present or not. If you realise a zonular lysis after starting your cataract case, then first assess the extent of the zonular lysis.

If the zonular lysis is moderate (2/5–3/5), we prefer to implant a capsular tension ring after hydrodissection (Surgery I). The risk of zonular lysis is that you may aspirate the loose part of the capsular bag during phaco or during I/A. In order to prevent an aspiration, you must stabilise the capsular bag with a capsular tension ring. Then luxate the nucleus into the pupillary planet, and perform here a phacoemulsification. If you perform the phacoemulsification in the capsular bag, you press with the phaco tip on the capsular bag and increase the zonular lysis. If the lens capsule is very loose during phaco, then insert iris hooks into the rhexis edge to stabilise the lens capsule. If you realise later on that you cannot save the lens capsule, then you have to extract the lens capsule and perform a scleral- or iris-fixated IOL implantation (Surgery I Continued).

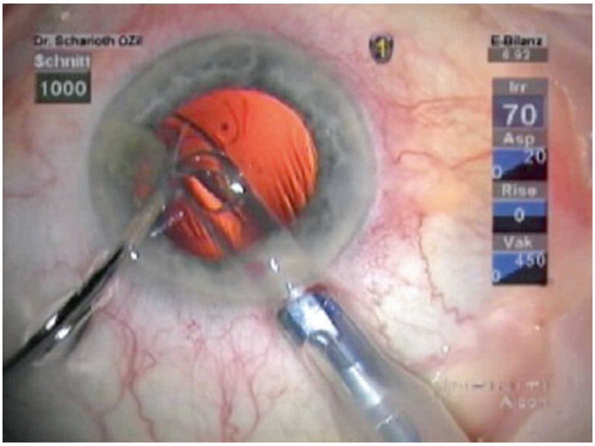


Fig. 7.20 Irrigation handpiece is "locking" the nuclear fragment in the anterior chamber angle, while a three-piece IOL is implanted in the ciliary sulcus

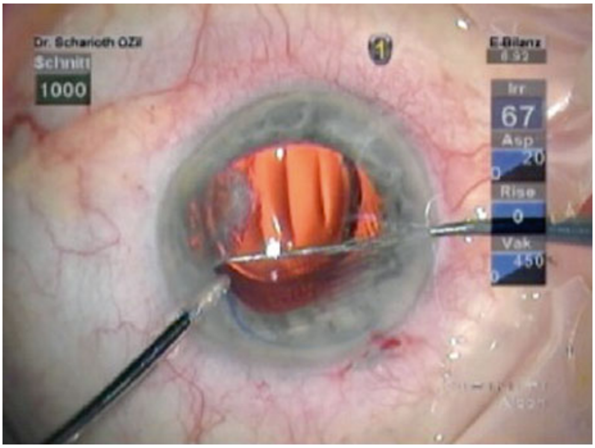


Fig. 7.21 Trailing haptic is implanted; lens fragment is in the anterior chamber and cannot luxate into the vitreous cavity

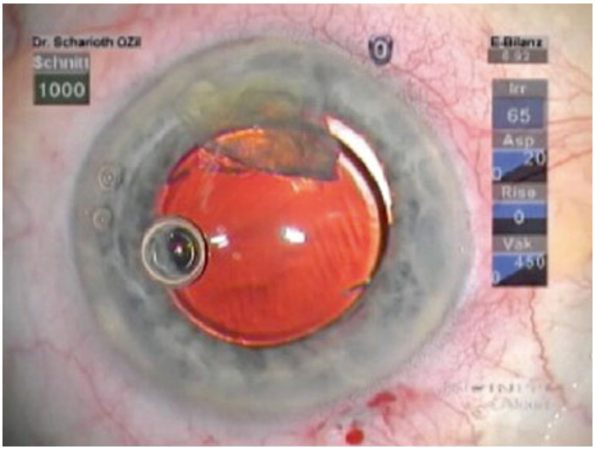


Fig. 7.22 IOL scaffolding (Agarwal technique), the anterior chamber is filled with OVD; lens fragment is in front of the IOL

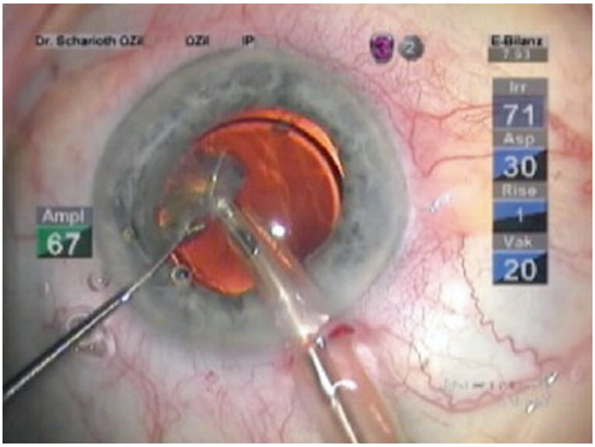


Fig. 7.23 Phacoemulsification is performed in the anterior chamber; corneal endothelium is protected with OVD

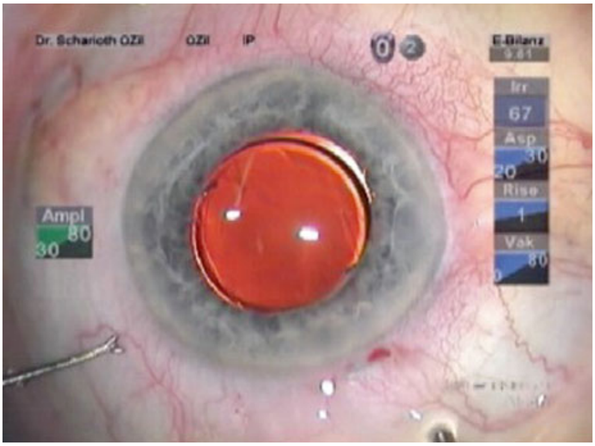


Fig. 7.24 IOL is placed in the ciliary sulcus and well centred

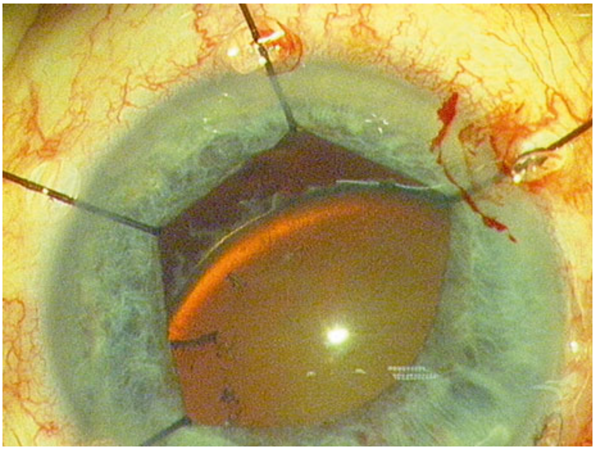
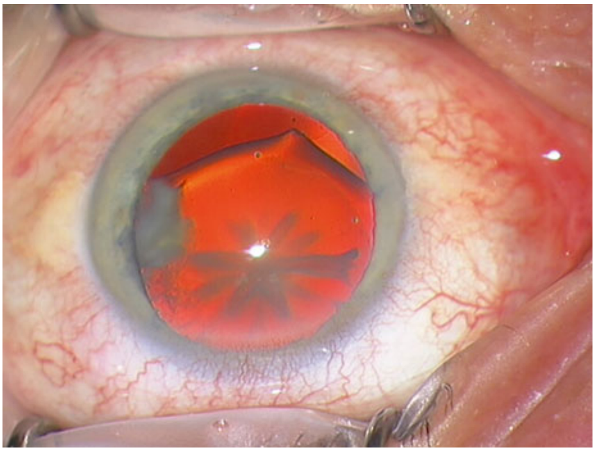


Fig. 7.25 After insertion of iris hooks, the extent of the zonular lysis is visible

Fig. 7.26 Iris hook (blue) with a silicone stopper (transparent). The iris hook grasps the pupillary edge, and the silicone stopper fixates the hook. Indication: Small pupil

Fig. 7.27 A preloaded capsular tension ring. Indication: Zonular lysis, croma

Fig. 7.28 A traumatic cataract with inferior zonular lysis



If the zonular lysis is very advanced (4/5), we prefer to perform a SICS (Surgery II). As additional instruments a crescent bevel up knife and a vitreous cutter are required. You may perform the surgery at once. But if you run into time problems, it is wise to postpone the surgery for a week. Similarly, you can perform the secondary IOL implantation at a later date. The secondary implantation of an iris-fixated IOL is even easier in an eye with a small pupil and removed anterior vitreous.

7.2.1 Surgery I: Phaco and Capsular Tension Ring

Video 7.27: Traumatic cataract and inferior zonular lysis

Video 7.28: Zonular lysis and phacoemulsification

Instrumentation

1. Iris retractors (Fig. 7.26)
2. Capsular tension ring (Fig. 7.27)

Individual Steps

1. Rhexis
2. Hydrodissection
3. Implantation of capsular tension ring
4. Maybe: Implantation of iris hooks in rhexis edge
5. Phacoemulsification
6. Implantation of IOL in capsular bag

The Operation Step by Step

1. Rhexis
2. Hydrodissection
3. Implantation of capsular tension ring

Pits and Pearls No. 24

Capsular Tension Ring: Indication: Zonular lysis. Two possible *timings*: (1) As soon as you notice the zonular lysis. The advantage is a stable capsular bag. The disadvantage of an early implantation is that the cortex is difficult to remove because the capsular tension ring presses against the cortex. (2) After removal of the cortex. Advantage: Easy removal of cortex.

We recommend implanting the capsular tension ring at an early time point.

Procedure: Inflate the capsular bag with viscoelastics. Inject the capsular tension ring with an injector (Figs. 7.27 and 7.30). Be cautious that you place the tip in the capsular bag and not in the sulcus.

Begin with a rhexis, perform a hydrodissection (Fig. 7.29), and then implant a capsular tension ring (Fig. 7.30). Operate with as little stress on the zonular apparatus as possible. Be prepared to perform an anterior vitrectomy, ideally from pars plana.

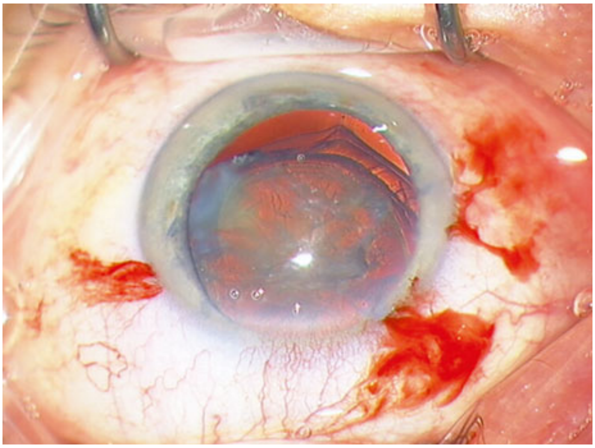


Fig. 7.29 Perform a rhexis and then a hydrodissection

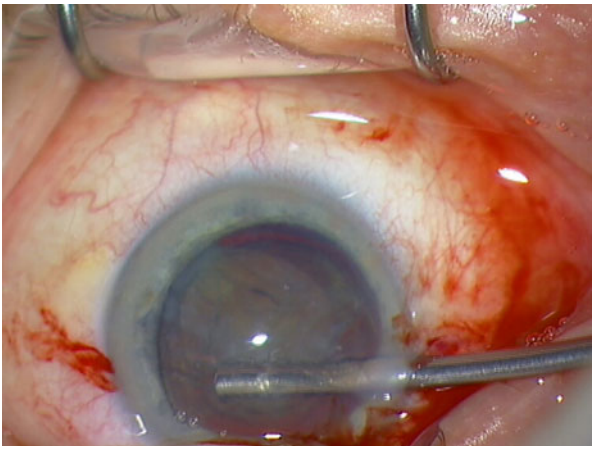


Fig. 7.30 Implant a capsular tension ring

4. Maybe: Implantation of iris hooks in rhexis edge
5. Phacoemulsification
6. Implantation of IOL in capsular bag

The following phacoemulsification is a little bit like dancing on a volcano. Adjust your settings at the phaco machine: Reduce irrigation (low bottle), and change to sculpting mode. Try to loosen the quadrants with BSS or viscoelastics and a manipulator but not by aspirating them with the phaco tip. If the lens capsule is unstable, then insert iris retractors into the rhexis edge (Figs. 7.31 and 7.32) and complete phacoemulsification (Fig. 7.33). Don't press during phaco on the capsular bag; you will cause stress to the zonules. Elevate the fragments from the capsular bag, and remove them with the phaco tip in the pupillary plane. Continue with I/A (Fig. 7.34). If the lens capsule remains stable, then remove the iris hooks, and implant the IOL into the capsular bag (Fig. 7.35). If you do not succeed, then proceed with extraction of the lens capsule or even an ICCE.

7.2.2 Surgery I Continued: Lens Capsule Extraction and Implantation of Scleral- or Iris-Fixated IOL

Video 7.29: Small pupil and phacodonesis

Instruments

1. Phaco set
2. 15° knife (Figs. 2.5)
3. 2.4-mm tunnel knife (Fig. 2.6)
4. Crescent bevel up knife (Fig. 2.7)
5. Caliper (Fig. 2.21)
6. 20-G or 23-G trocar (Figs. 2.23 and 2.24)
7. Vitreous cutter
8. Instruments for iris-fixated IOL (AMO, Fig. 5.1)

Material

Possibly: Triamcinolone (Fig. 6.1)
Acetylcholine (Miochol) (Fig. 5.3)
Iris-claw IOL (Artisan®, Verisyse®) (Fig. 5.4)

Individual Steps

1. Frown incision
2. Extraction of the lens capsule
3. Anterior vitrectomy
4. Injection of Miochol
5. Implantation of an iris-fixated or scleral-fixated IOL
6. Closure of the frown incision and conjunctiva

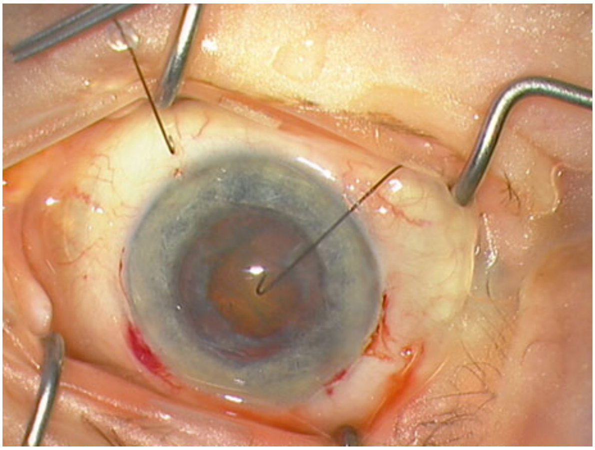


Fig. 7.31 If the nucleus is unstable (phacodonesis), then insert in addition iris retractors

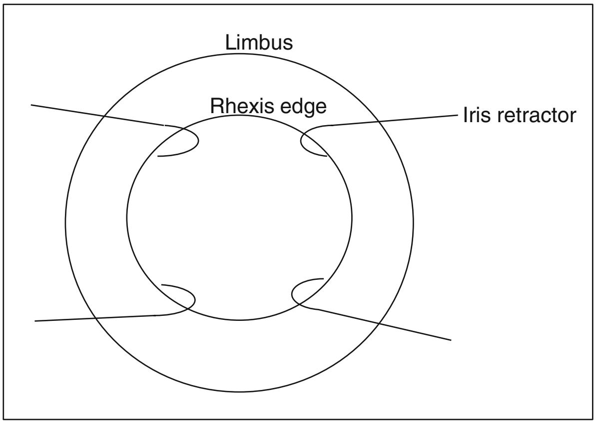


Fig. 7.32 Drawing of the implantation of iris hooks in the rhexis edge in case of a zonular lysis

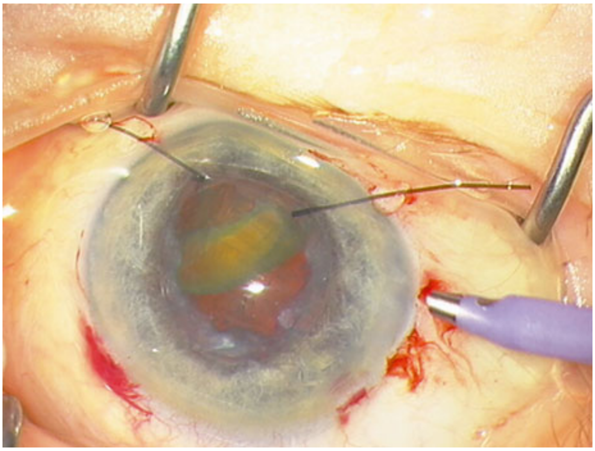


Fig. 7.33 The two iris hooks are placed in the rhexis edge. Proceed now with the phaco

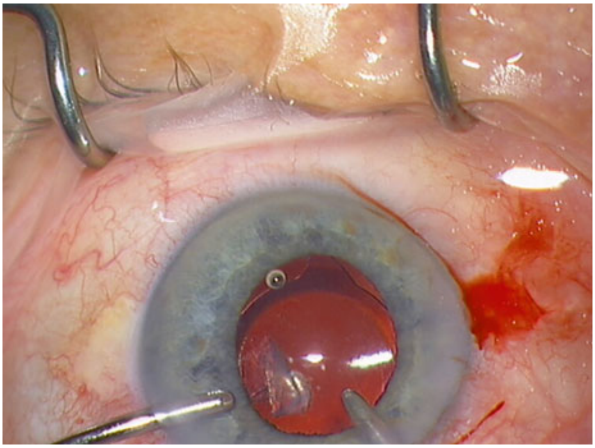


Fig. 7.34 Continue with I/A

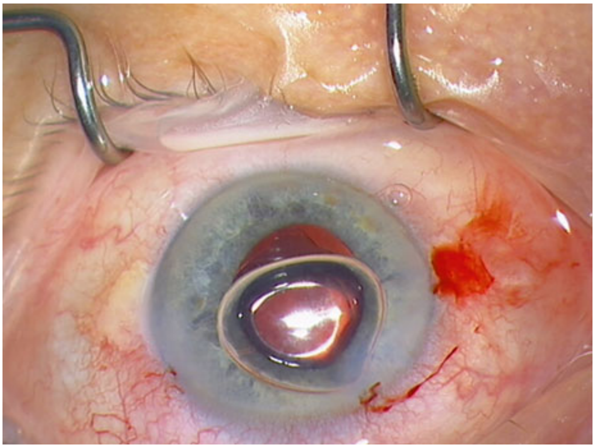


Fig. 7.35 Insert an air bubble to stabilise the anterior chamber, and prevent a vitreous prolapse

The Operation Step by Step

1. Frown incision
2. Extraction of the lens capsule

In case of a posterior capsular defect (Fig. 7.36) or an enlargement of the zonular lysis, you have to remove the lens capsule. Decide which IOL you want to implant. In case of a PMMA iris-claw IOL, mark a 6 mm broad scleral incision with the caliper (Fig. 7.37). Then remove the lens capsule with an intravitreal forceps (i.e. serrated jaws forceps) or a capsulorhexis forceps (Fig. 7.38).

3. Anterior vitrectomy
4. Injection of Miochol
5. Implantation of an iris-fixated or scleral-fixated IOL
6. Closure of the frown incision and conjunctiva

Mark the sclerotomy 3.5–4 mm behind the limbus (Fig. 7.39). Insert the trocar (Figs. 7.40, 7.41 and 7.42). Perform an anterior vitrectomy from pars plana (Fig. 7.43). Hold the infusion inside a side incision, or insert an anterior chamber maintainer.

Then constrict the pupil with Miochol and implant an iris-claw IOL (Fig. 7.44).

7.2.3 Surgery II: ICCE and Implantation of an Iris-Claw IOL

Video 7.30: ICCE and iris-claw IOL

The conversion from phaco to SICS is an important technique because you will always encounter eyes with zonular lysis in your surgical career. Depending on the time point of surgery, you may need to remove the nucleus and/or the lens capsule.

If you have to remove the nucleus, then dissect a 6-mm frown incision, remove the nucleus and implant a non-foldable iris-claw IOL. If you only have to remove the lens capsule through a 2.4-mm main incision, then implant a foldable 3-piece IOL with the Scharioth technique, or suture it to the sclera.

Instruments

1. Caliper
2. 15° knife
3. 2.4-mm tunnel knife
4. Crescent bevel up knife
5. 20-G or 23-G trocar
6. Vitreous cutter
7. Lens extraction hook (Fig. 4.124), a*lternative:* 27-G grey cannula
8. Instruments for iris-fixated IOL (AMO, Fig. 5.1)

Material

Possibly: Triamcinolone (Fig. 6.1)
Acetylcholine (Miochol) (Fig. 5.3)
Iris fixation: Iris-claw IOL (Artisan®, Verisyse®)
Intrascleral fixation: 3-piece IOL

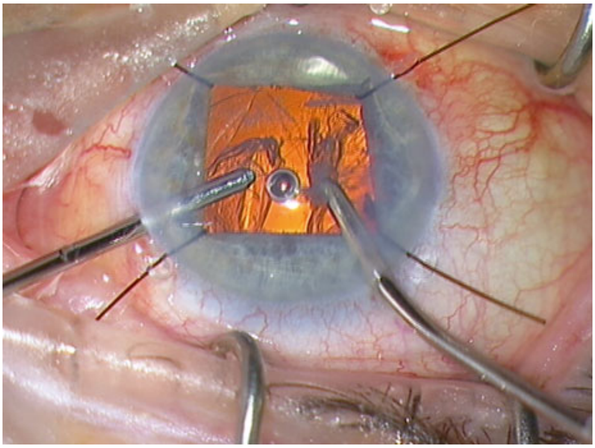


Fig. 7.36 A large inferior zonular lysis and a defect in the anterior and posterior capsule at 6 o'clock. An initial rift in the anterior capsule continued posterior because of the zonular lysis. In such a case the lens capsule cannot be used for a sulcus implantation and should therefore be removed

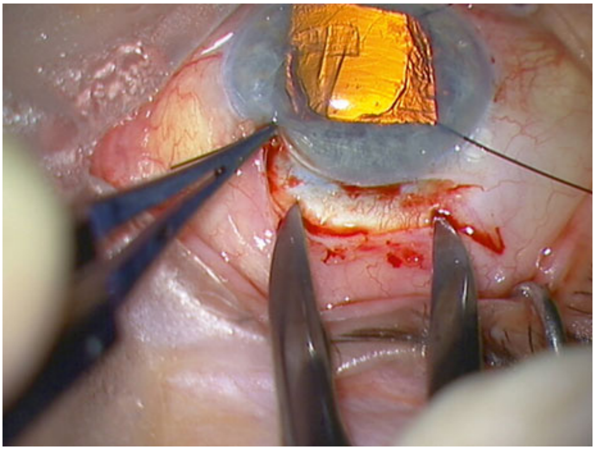


Fig. 7.37 If you plan to implant an iris-claw IOL, then perform a scleral main incision. Mark a 6 mm broad incision. If you plan an intrascleral implantation of a 3-piece IOL, then perform a clear cornea main incision

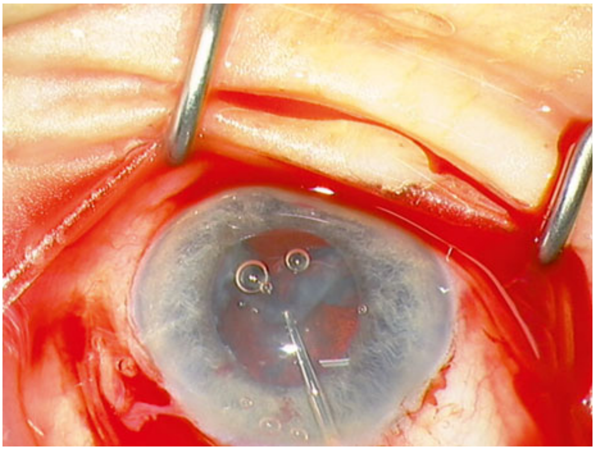


Fig. 7.38 The lens capsule is removed with an intravitreal forceps (serrated jaws forceps)

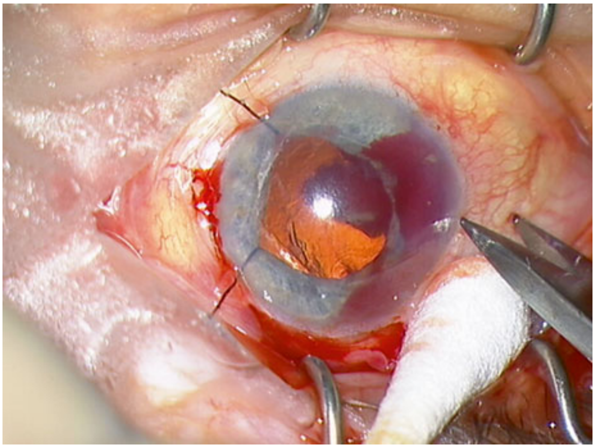


Fig. 7.39 Insertion of a trocar. Mark the sclerotomy 3.5–4 mm behind the limbus

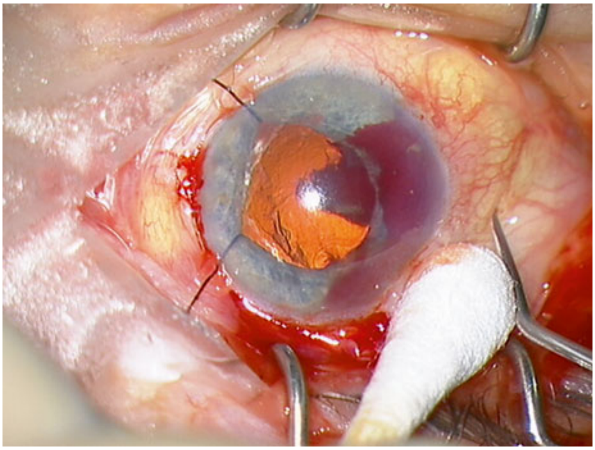


Fig. 7.40 Lamellar incision with an angled 20-G or 23-G blade (DORC, Beaver Visitec)

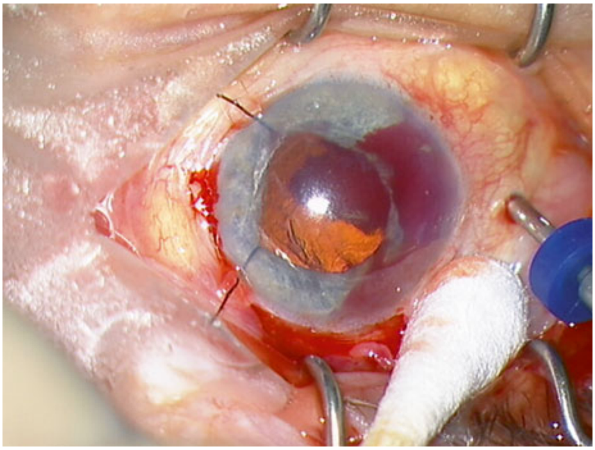


Fig. 7.41 Insertion of the trocar

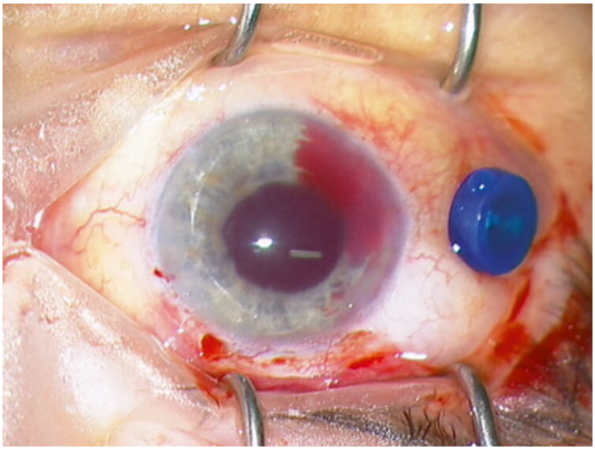


Fig. 7.42 Removal of the inserter. The trocar remains in the sclera. The blue valve prevents outflow from intraocular fluid

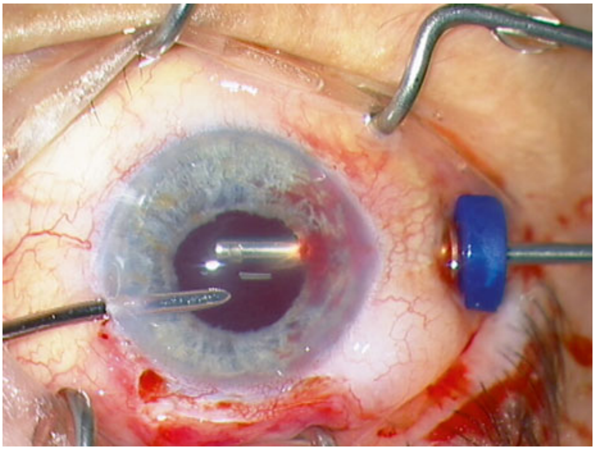


Fig. 7.43 Anterior vitrectomy. Hold the infusion inside the anterior chamber through the paracentesis. Hold the vitreous cutter behind the pupil through the trocar

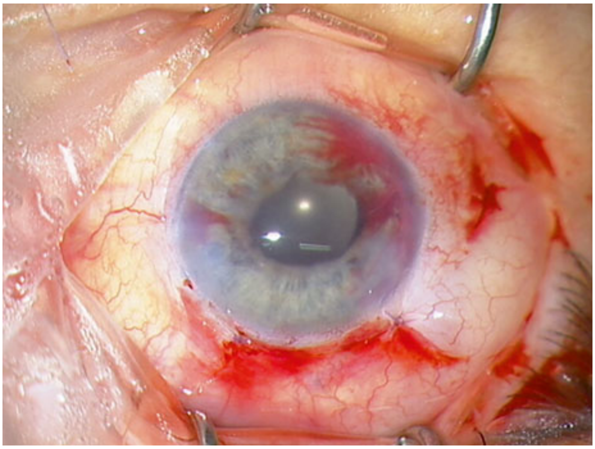


Fig. 7.44 The trocar is removed, an iris-fixated IOL implanted. If the sclerotomy is tight, then no suture is required. Suture otherwise the sclerotomy with a Vicryl 8-0 interrupted stitch

Individual Steps

1. Dislocation of the nucleus into the anterior chamber
2. Paracentesis at 3 and 9 o'clock
3. Frown incision
4. Extraction of the nucleus
5. Anterior vitrectomy
6. Injection of Miochol
7. Implantation of an iris-fixated or intrascleral-fixated IOL
8. Closure of the frown incision and conjunctiva

The Operation Step by Step

1. Dislocation of the nucleus into the anterior chamber
2. Paracentesis at 3 and 9 o'clock
3. Frown incision

Begin with the frown incision as described in Sect. 4.6. Perform a limbal peritomy from 11 to 1 o'clock with Westcott scissors, and cauterise the bleeding vessels. Then mark an 8-mm-wide incision with a caliper. The incision should be 1–1.5 mm behind the limbus. Make a limbus-parallel incision with a 15° knife (50 % scleral thickness). Then dissect a scleral tunnel with the crescent-angled bevel up knife (see Figs. 4.126, 4.127, 4.128 and 4.129).

The insertion of iris hooks is helpful for the nucleus luxation manoeuvre (Fig. 7.45). Continue by luxating the entire nucleus-bag complex bimanually with two manipulators (e.g. push-pull or Rosen chopper and viscoelastic cannula) into the anterior chamber. This step can only be performed from pars plana because you need to reach the posterior part of the lens (Fig. 7.46). This manoeuvre is difficult because the posterior surface of the nucleus is slippery.

If the nucleus dislocates to the posterior pole, you need to continue with a pars plana vitrectomy, injection of PFCL and subsequently lifting the nucleus up to the pupillary plane (Fig. 7.47).

Then you have to try again to luxate the nucleus into the anterior chamber (Fig. 7.48).

4. Extraction of the nucleus
5. Anterior vitrectomy

Remove first the iris retractors to constrict the pupil and stabilise the nucleus in the anterior chamber. Then bend a 27-G (grey) cannula to a fish hook, or use the lens extraction hook. For details see Sect. 4.6. Proceed by placing the tip of the cannula behind the centre of the nucleus (Fig. 7.49), and then extract the nucleus with the cannula (Fig. 7.50). If the nucleus gets stuck in the main incision, you have to extend it.

If the nucleus and the lens capsule are successfully removed, you can continue with vitrectomy. Check if the main incision is closed and the intraocular tension normotensive (digital palpation). If the main wound is open and IOP is low, then suture the main incision with a temporary Vicryl 8-0 cross-stitch. Then continue with an anterior vitrectomy from the limbus or pars plana. Hold the irrigation tip into the paracentesis and the vitreous cutter into an enlarged paracentesis incision. Do NOT use the frown incision; the risk for a choroidal detachment is high.

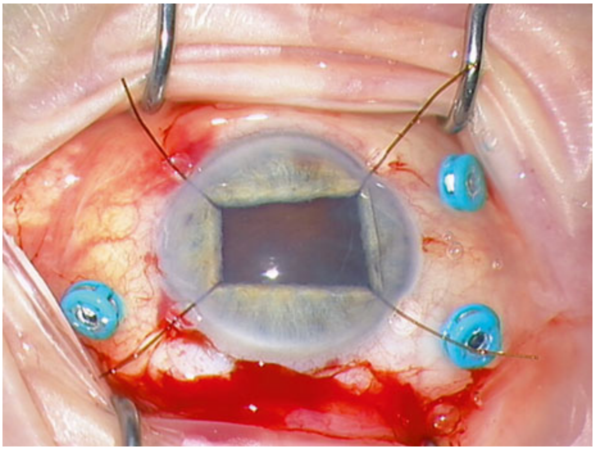


Fig. 7.45 An eye with a dense nucleus and extensive phacodonesis. An ICCE was planned from beginning. First iris retractors are inserted to enlarge the pupil

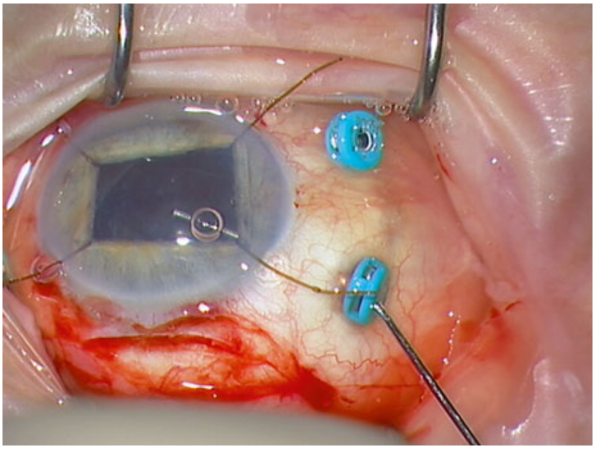


Fig. 7.46 Then trocars are inserted. An attempt is started to luxate the nucleus into the anterior chamber. This manoeuvre is difficult because the posterior side of the nucleus is slippery

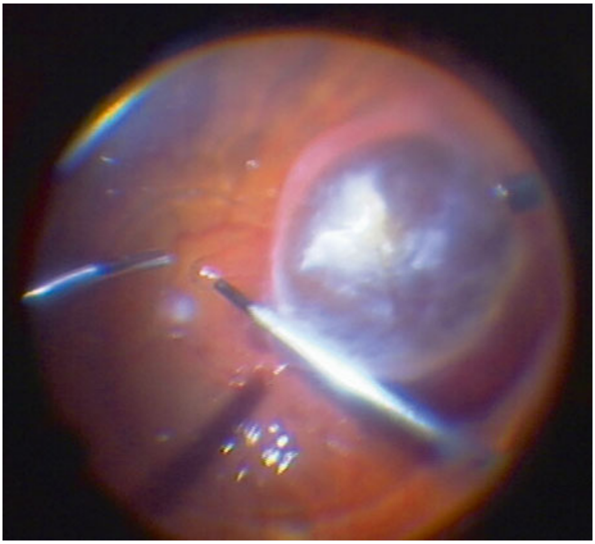


Fig. 7.47 The nucleus may dislocate into the vitreous cavity. The next step is a pars plana vitrectomy and injection of perfluorocarbon in order to lift up the nucleus

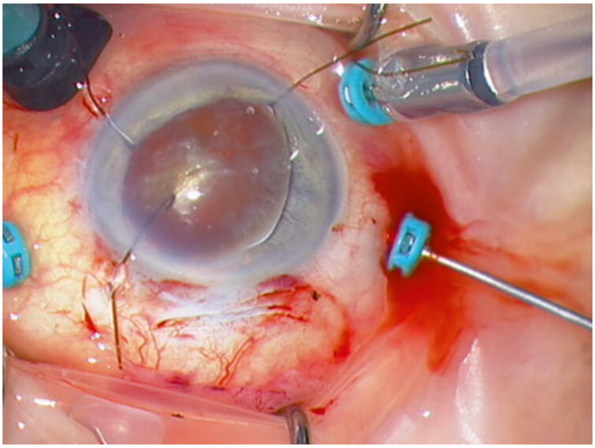


Fig. 7.48 In the next step the nucleus is luxated into the anterior chamber

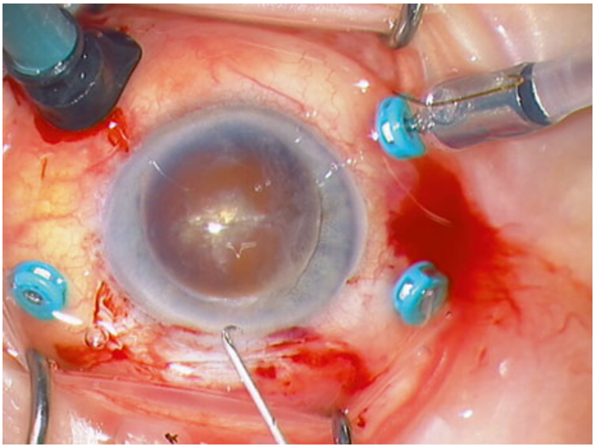


Fig. 7.49 The iris hooks have been removed in order to constrict the pupil and therefore stabilise the nucleus. Now a fish hook is inserted

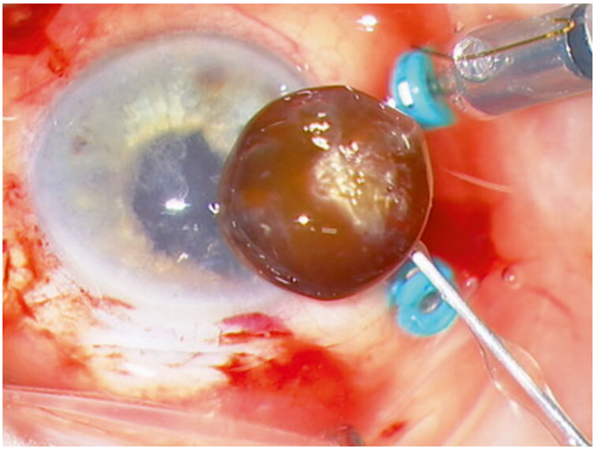


Fig. 7.50 The nucleus is extracted with the fish hook. In the next steps the PFCL is removed and an iris-fixated IOL implanted

6. Injection of Miochol
7. Implantation of an iris-fixated IOL

Constrict the pupil with Miochol and implant an iris-fixated IOL or alternatively an intrascleral-fixated IOL. For details see Sect. 5.1 (iris-fixated IOL) or Sect. 5.2 (Intrascleral-fixated IOL).

8. Closure of frown incision and conjunctiva

Suture the frown incision with a Vicryl 8-0 cross-stitch and the conjunctiva with a Vicryl 8-0 interrupted stitch. Inject cefuroxime (Zinacef®) intracameral as endophthalmitis prophylaxis.

7.3 Management of an Anteriorly Dislocated Intraocular Lens

The management of an anteriorly dislocated intraocular lens differs in dependence whether the entire bag-IOL complex dislocated secondary to zonular lysis or whether only the IOL is decentred and the capsular bag is intact. The management of a decentred IOL is demonstrated in Sect. 7.3.1. and the management of a dislocated IOL-capsular bag complex in Sect. 7.4.

The main symptoms of a dislocated IOL are reduction of visual acuity and an ocular hypertension secondary to a pupillary block glaucoma.

7.3.1 Management of a Decentred Intraocular Lens

Here again, the state of the capsular bag is crucial for the surgical procedure. Examine the status of the lens capsule at the slit lamp and under the surgical microscope (Figs. 7.51, 7.52, 7.53 and 7.54). Is the anterior capsule intact, then reposition the IOL in the sulcus. Are 2/3 of the anterior capsule and the inferior portion from 4 o'clock to 8 o'clock intact, then you can also implant the IOL into the sulcus. Alternatively, one has to make an iris- or sulcus-fixated implantation.

Instruments

1. Phaco set (Fig. 4.1)
2. Push-pull instrument (Fig. 4.7)
3. Vitreous cutter
4. Capsulotomy scissors (Fig. 4.65)

Dye

Triamcinolone (Fig. 5.1)

Individual Steps

1. Viscoelastics behind the IOL
2. Luxation of the IOL onto the iris
3. Triamcinolone into the anterior chamber

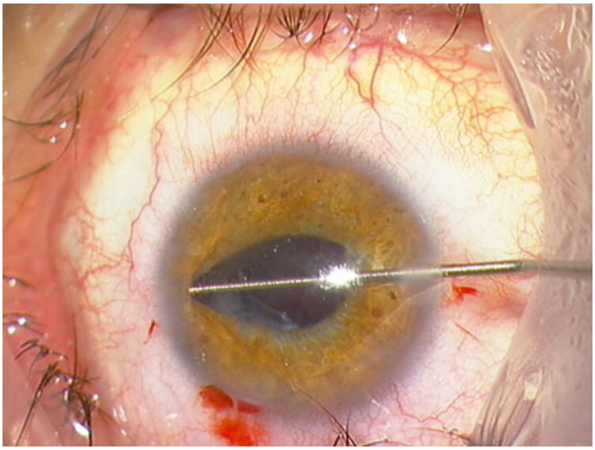


Fig. 7.51 An aphakic eye. A secondary implantation is planned. In order to plan the implantation site, the anterior capsule is examined

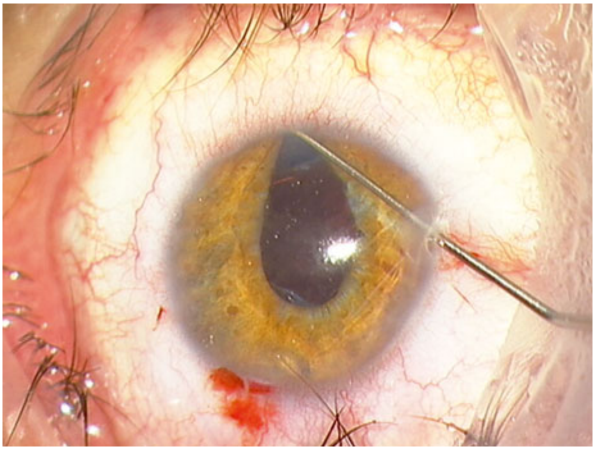


Fig. 7.52 The iris is pushed aside with a push-pull instrument. Only a little inferior anterior capsule is left

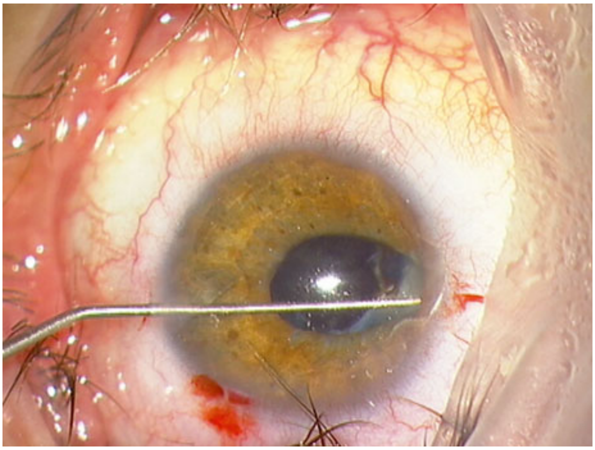


Fig. 7.53 Sufficient lateral anterior capsule is left

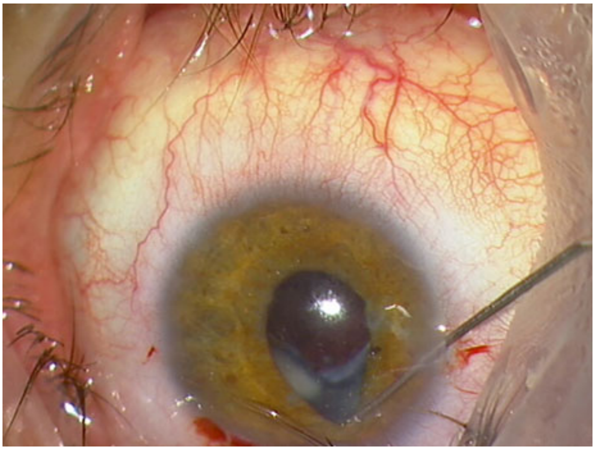


Fig. 7.54 Sufficient superior anterior capsule is left. A sulcus-implanted IOL should have sufficient support although the inferior capsule is not too broad

4. Anterior vitrectomy
5. Lens capture
6. Miochol into the anterior chamber
7. Search for vitreous strand
8. Hydration of paracentesis

The Operation Step by Step

1. Viscoelastics behind the IOL
2. Luxation of the IOL onto the iris

Inject viscoelastics into the anterior chamber and behind the IOL. Then rotate the IOL onto the iris with the push-pull instrument (Figs. 7.55 and 7.56). Examine now the anterior capsule with the push-pull instrument. Is the rhexis intact, is there a zonular lysis? Depending on the status of the capsule, the IOL can be repositioned in the sulcus or must be extracted and an iris- or intrascleral-fixated IOL implanted.

Pits and Pearls No. 25

IOL Extraction: Three methods: (1) Enlarge the main incision and extract the IOL. (2) Inject viscoelastics into the anterior chamber. Fold the IOL with an IOL implantation forceps (e.g. Geuder), and extract it (see Sect. 10.2). (3) Cut the IOL with the capsulotomy scissors (Geuder) into two halves, but leave 1 mm at the edge and then extract the IOL by drawing at the haptic (see also Sect. 10.3 for silicone IOL).

3. Triamcinolone in the anterior chamber
4. Anterior vitrectomy
5. Lens capture

Inject triamcinolone into the anterior chamber and remove the vitreous prolapse (see Figs. 6.2 and 6.3). Then proceed with an anterior vitrectomy. I recommend performing the vitrectomy from pars plana in order to remove as much anterior vitreous as possible. Insert a trocar 3.5 mm behind the limbus, and remove the anterior vitreous from pars plana (Fig. 6.17). If possible, perform a lens capture.

Pits and Pearls No. 26

Removal of Capsular Fibrosis: If the rhexis is too small to fit in the optic of the IOL, then extend the rhexis with the vitreous cutter. The machine settings are 200 cuts/min and 400 mmHg vacuum. The risk for a capsular tear is extremely low.

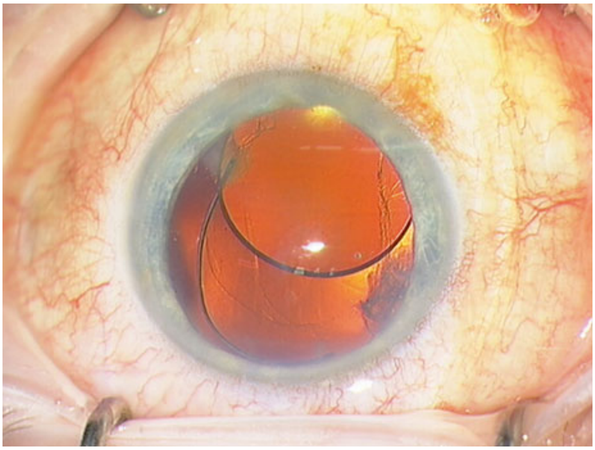


Fig. 7.55 A decentred IOL after a complicated cataract operation. The anterior capsule has an inferior defect, and a vitreous prolapse is present

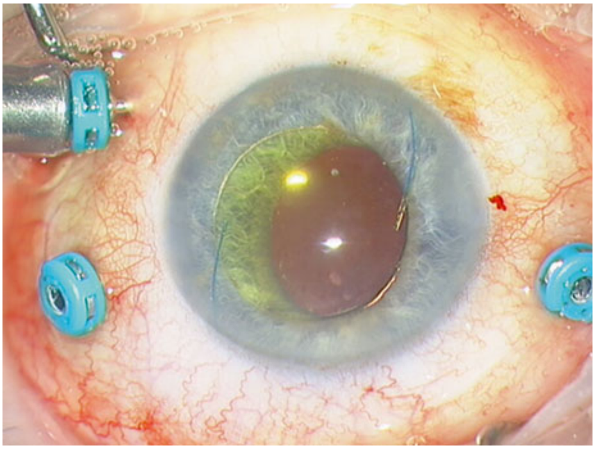


Fig. 7.56 The IOL is rotated into the anterior chamber

6. Miochol into the anterior chamber
7. Search for vitreous strand
8. Hydration of paracentesis

Inject acetylcholine to constrict the pupil, and test with the push-pull instrument if a vitreous strand pulls from the pupil to an incision (Fig. 7.57). Remove the vitreous strand with the vitreous cutter. Inject cefuroxime (Zinacef®) intracameral and hydrate the incisions (Fig. 7.58).

In the following we will demonstrate a few cases of decentred IOLs so that the reader gets a feeling of the huge variety of possible cases.

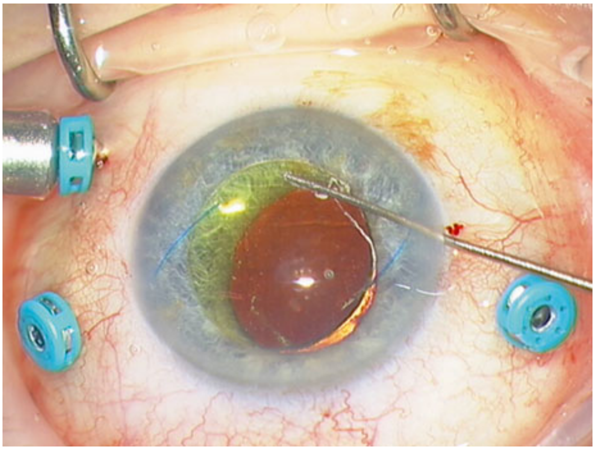


Fig. 7.57 The vitreous prolapse is visualised with triamcinolone and removed with a pars plana anterior vitrectomy. For this manoeuvre only one trocar is required. The trocar of the infusion line and the second instrument trocar are not needed

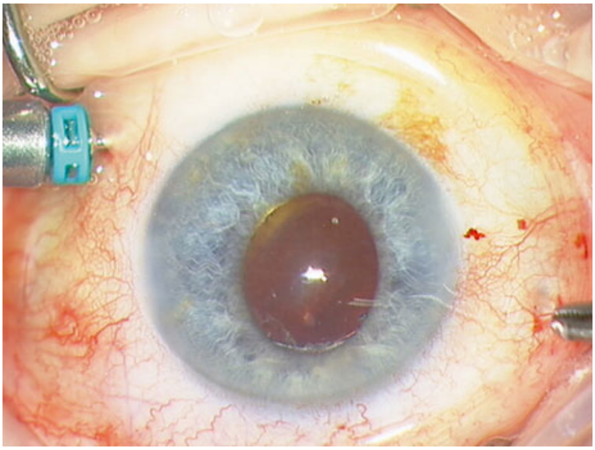


Fig. 7.58 The IOL is rotated back into the sulcus and the optic placed behind the rhexis (lens capture). The lens capture ensures a centration of the IOL

Case 1

An 82-year-old female patient with a decentred IOL (Fig. 7.59). 15 years ago she underwent a cataract surgery. An examination with the push-pull instrument demonstrates that the IOL is located in the sulcus (Fig. 7.60). A lens capture is performed, but the superior part of the anterior capsule tilts back due to superior zonular lysis (Fig. 7.61). Therefore, the bag-IOL complex is extracted (Fig. 7.62) and an iris-fixated IOL implanted. Alternatively, an intrascleral fixation after Scharioth can be performed.

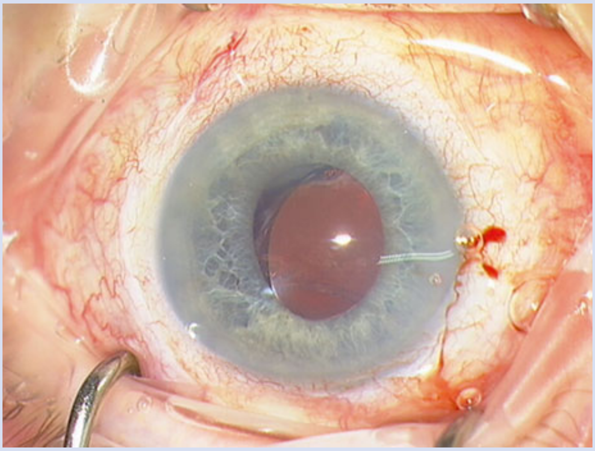


Fig. 7.59 A decentred IOL. The cataract surgery was performed a long time ago

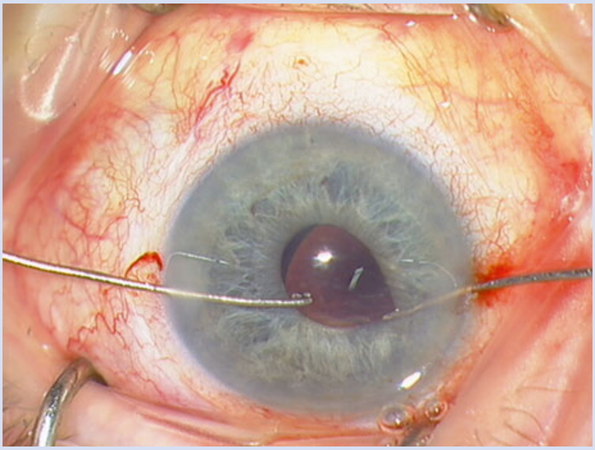


Fig. 7.60 An examination with two push-pull instruments does not deliver sufficient information about the status of the anterior capsule

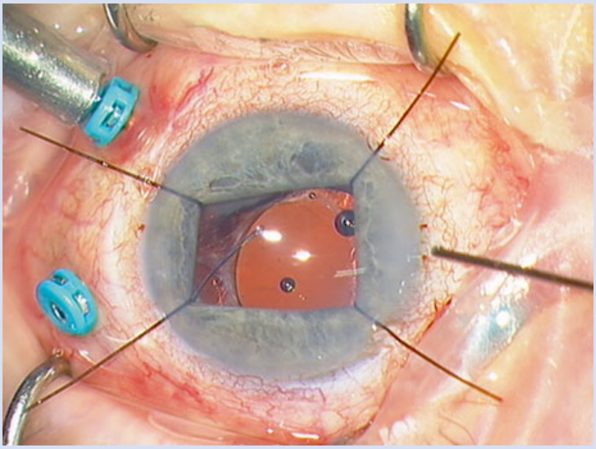


Fig. 7.61 Therefore lens retractors are inserted. The anterior capsule is intact. The rhexis is enlarged with the vitreous cutter and the optic buttonholed into the rhexis. After this manoeuvre the complete bag-IOL complex tilted backwards. The cause is a superior zonular lysis. Now three main techniques are possible: 1) Fixation of the bag (Hoffmann technique), 2) removal of bag and intrascleral implantation (Scharioth technique) or 3) IOL explantation and iris-claw IOL implantation

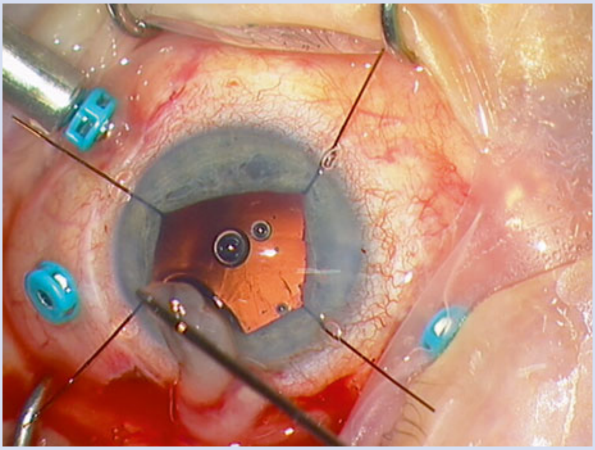


Fig. 7.62 The IOL was removed and an iris-fixated IOL implanted

Case 2

A 73-year-old female patient with an anteriorly dislocated IOL (Fig. 7.63). She had a corneal perforation 22 years ago and was operated with closure of the corneal wound, cataract removal and implantation of a sulcus IOL. Now, the anterior synechiae are removed (Fig. 7.64) and the IOL repositioned (Fig. 7.65). A slit lamp examination at the first postoperative day showed that the IOL was again decentred to the nasal side. The temporal haptic was therefore sutured to the sclera (Fig. 7.66). For details of this procedure, see Sect. 5.3.

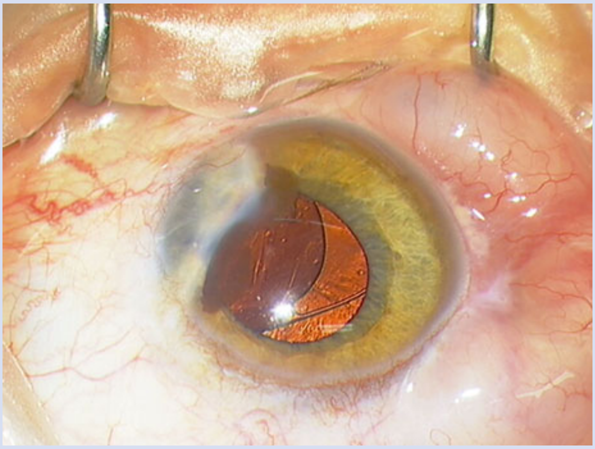


Fig. 7.63 A decentred IOL and a peripheral corneal scar with anterior synechiae. The eye experienced a trauma 20 years ago, and a cataract surgery was subsequently performed

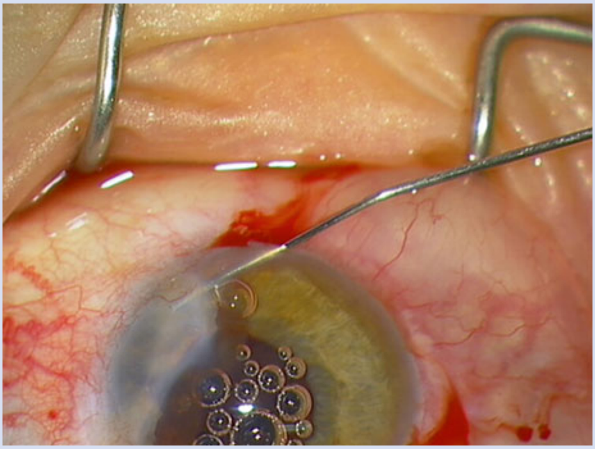


Fig. 7.64 In a first manoeuvre the anterior synechiae were released with a viscoelastic cannula and intravitreal scissors. Alternatively special capsulotomy scissors after Kampik can be used

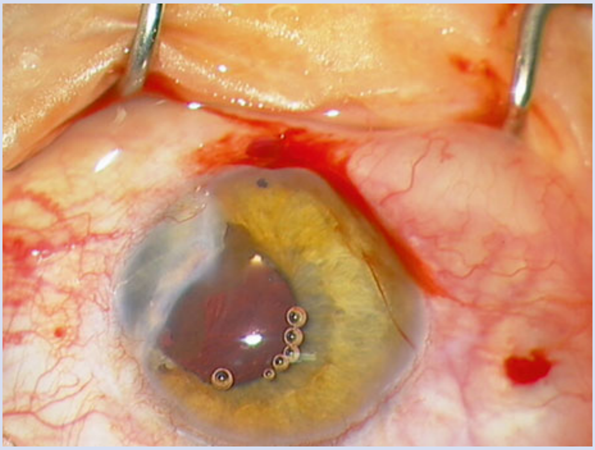


Fig. 7.65 Then the IOL was repositioned in the sulcus

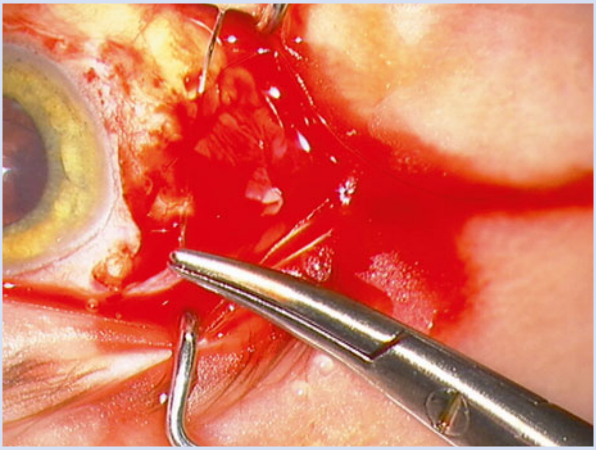


Fig. 7.66 At the first postoperative day, the IOL was again decentred to the temporal side. The nasal haptic was therefore sutured to the sclera (scleral fixated). This example shows once again that a sulcus-implanted IOL (without lens capture) can always decentre

Case 3

A 24-year-old male patient presents with a 5-year-old traumatic cataract (Fig. 7.67). The natural lens cannot be identified; only a central fibrosis and iris pigmentation can be seen. The central fibrosis is removed with a capsulorhexis forceps, and a round rhexis is cut with a vitrector (200 cuts/min) (Fig. 7.68). A three-piece IOL is implanted in the sulcus. An examination on the first postoperative day showed an inferiorly decentred IOL (Fig. 7.69). The cause of the decentration was an undetected inferior zonular lysis. The patient was reoperated. The IOL was then buttonholed into the anterior rhexis (lens capture manoeuvre) (Fig. 7.70). Postoperatively the IOL was centred without a tilt.

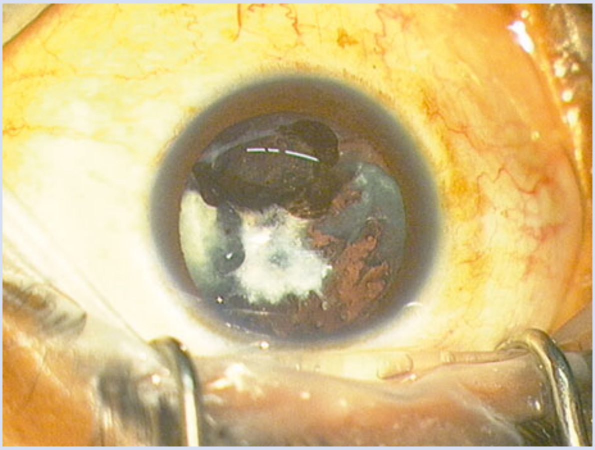


Fig. 7.67 A traumatic cataract of a young African patient

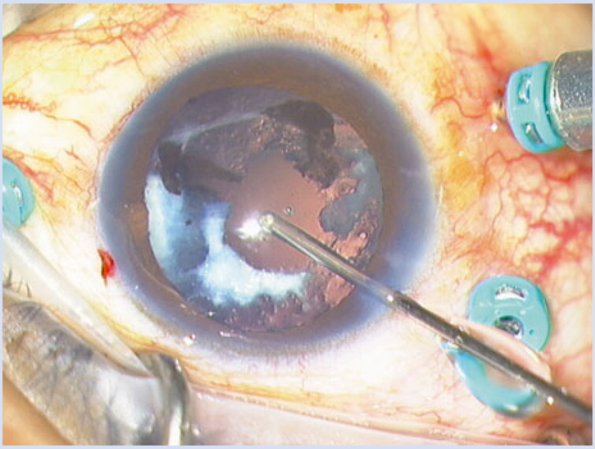


Fig. 7.68 The anterior capsule was stained with VisionBlue. Then a rhexis was performed with help of a capsulorhexis forceps and a capsulotomy scissors (Geuder). Then an anterior vitrectomy was performed and finally an IOL implanted in the sulcus

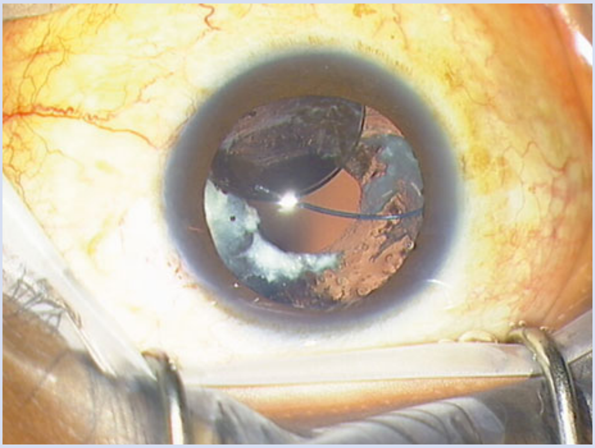


Fig. 7.69 At the first postoperative day, the IOL was inferiorly dislocated. The reason was an undetected inferior zonular lysis

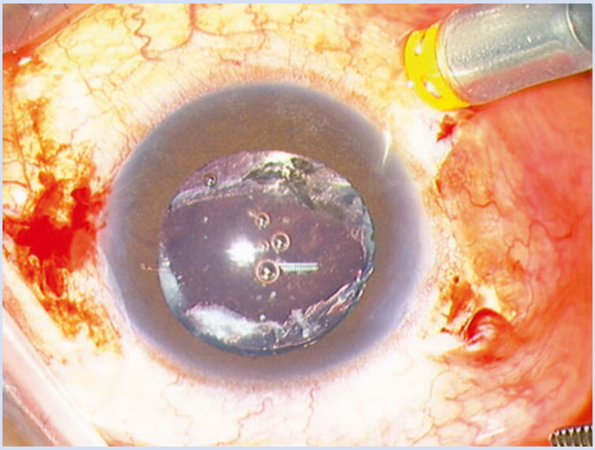


Fig. 7.70 In a second surgery the same IOL was repositioned. The optic was buttonholed, and the haptics remain in the sulcus (lens capture)

Case 4

An 86-year-old female underwent a complication-free phacoemulsification and an in-the-bag IOL implantation. The first postoperative examination 1 week later showed a subluxated IOL due a posterior capsular defect (Fig. 7.71), which was undetected at the primary surgery. An examination of the lens capsule showed a defect posterior capsule but an intact anterior capsule. The one-piece IOL was luxated into the anterior chamber, rotated into the sulcus, and finally the optic buttonholed into the intact anterior rhexis (Fig. 7.72).

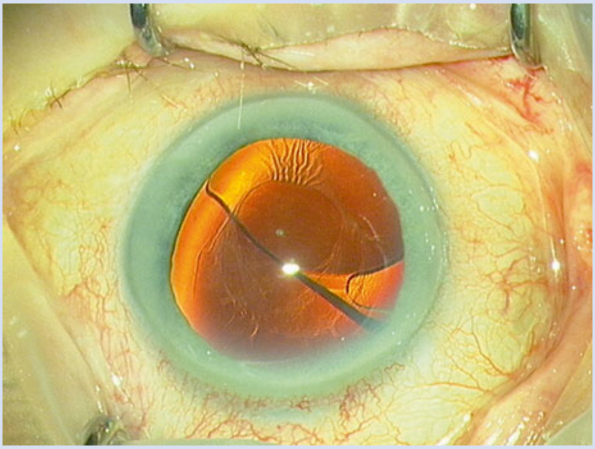


Fig. 7.71 A decentred IOL 1 week after an uneventful cataract surgery

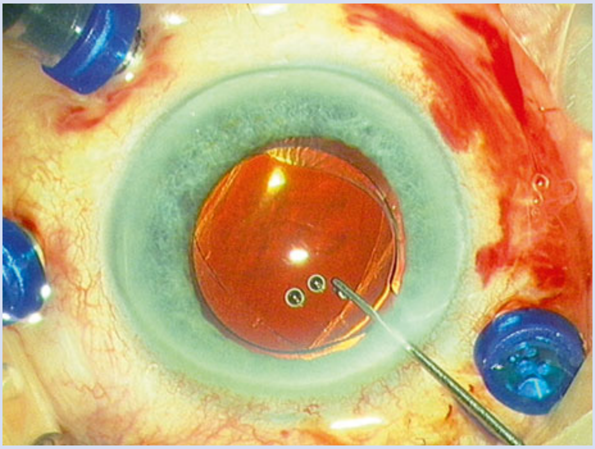


Fig. 7.72 The IOL was luxated into the anterior chamber, an anterior vitrectomy performed, then the IOL was rotated back into the sulcus and a lens capture performed

7.4 Management of an Anteriorly Dislocated Bag-IOL Complex

A dislocated bag-IOL complex has an increasing incidence due to the ageing population and the zonular stress during phacoemulsification surgery. There are several surgical options:

1. Scleral fixation of the bag-IOL complex (Hoffmann technique, Sect. 7.4.2).
2. Removal of the complete bag-IOL complex and implantation of a new IOL (iris fixation, intrascleral fixation or scleral fixation, see Sect. 7.4.1). This is the most common technique.
3. Removal of the capsular bag alone and then fixation of the same IOL (for scleral fixation see Sect. 9.2, and for intrascleral fixation see Sect. 5.2).

A phacoemulsification machine is sufficient for this surgery. We recommend to insert one or two trocars on the temporal side of the eye. One trocar is necessary for the instruments and the second one for the infusion; alternatively you can insert an anterior chamber maintainer at the limbus. The instrument trocar is required to luxate the bag-IOL complex into the anterior chamber. In addition, an anterior vitrectomy from pars plana is easier and more complete than from the limbus.

7.4.1 Removal of Bag-IOL Complex and Secondary Iris-Claw IOL Implantation

Videos 7.14 and 7.31: IOL extraction and implantation of an iris-claw IOL 1 and 2
Video 7.15: Iris-claw IOL implantation and artificial pupil
Video 7.16: Subluxated IOL operated with one trocar

The surgery lasts about 30 min; the main complication is a choroidal detachment due to an unstable and leaking main incision. It is therefore important that the main incision is not larger than 6 mm and does not leak. 6 mm is the size of the IOL. After removal of the bag-IOL complex, a secondary IOL implantation is performed. We prefer an intrascleral IOL implantation or an iris-claw implantation.

Instruments

1. 20-G or 23-G trocar (Figs. 6.4 and 6.5)
2. 20-G or 23-G vitrector
3. Serrated jaws forceps (Fig. 7.73)
4. Iris-claw IOL and implantation instruments (Fig. 7.74)
5. Marking caliper (Fig. 6.6)
6. 15° knife
7. Crescent-angled bevel up knife
8. 2.4-mm main incision knife

Individual Steps

1. Insertion of trocar
2. Paracentesis at 3 and 9 o'clock
3. Limbal peritomy and sclerocorneal incision at 12 o'clock
4. Extraction of the IOL with capsular bag

Fig. 7.73 Three instruments are required for the surgery of a subluxated IOL. 1) A 23-G intravitreal serrated jaws forceps (DORC). Indication: Extraction of the subluxated IOL from the anterior chamber

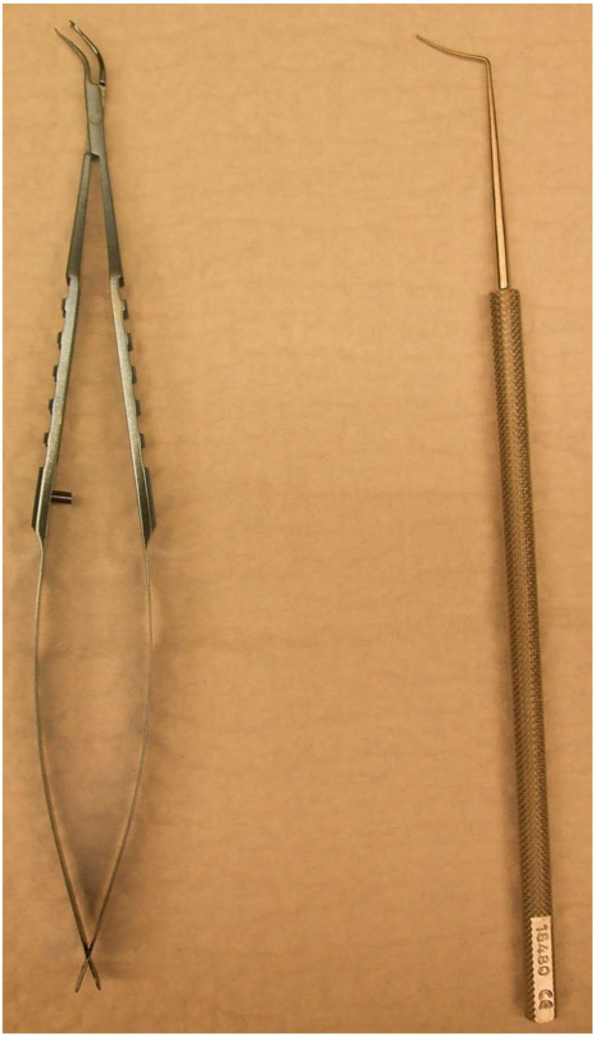


Fig. 7.74 2) An IOL implantation forceps (AMO) and 3) an enclavation spatula (Geuder) for implantation of an iris -claw IOL

5. Anterior vitrectomy
6. Injection of Miochol
7. Implantation of an iris-fixated IOL
8. Closure of main incision, removal of trocars

The Operation Step by Step

1. Insertion of trocars
2. Paracentesis at 3 and 9 o'clock
3. Limbal peritomy and sclerocorneal incision at 12 o'clock

Insert one trocar at 9 o'clock (right handed) or 3 o'clock (left handed). Perform a paracentesis and inject viscoelastic into the anterior chamber. Dissect a limbal peritomy from 11 to 1 o'clock with Vannas scissors, and if necessary cauterise bleeding vessels (Figs. 7.75 and 7.76). Mark a 6 mm broad incision with the caliper (Fig. 7.77). Perform a 6 mm broad limbus-parallel sclerocorneal incision with a 15° knife (Fig. 7.78). The limbal incision is located 1–1.5 mm behind the limbus. Dissect a scleral flap with the crescent bevel up knife (Fig. 7.79), and then open the main incision with a 2.4-mm blade (Fig. 7.80).

Caution with corneal incisions; they can easily generate an astigmatism up to 4D.

4. Extraction of the IOL with capsular bag
5. Anterior vitrectomy

Lift the IOL up at the 12 o'clock position in order to grab it with the serrated jaws forceps (Figs. 7.81 and 7.82). If this is not possible, then luxate the IOL first onto the iris before you remove it. Be cautious that the anterior chamber does not collapse during extraction, and inject viscoelastics in case. The infusion is closed during extraction of the IOL (Fig. 7.82). After removal open the infusion and vitrectomise the anterior vitreous from the limbus or from pars plana with the trocar (Fig. 7.83). A full vitrectomy is not necessary.

6. Injection of Miochol
7. Implantation of an iris-fixated IOL

Before implantation of an iris-claw IOL, the pupil must be constricted. Inject Miochol. If the pupil is distorted, check for vitreal strands and remove them (Fig. 7.84). Remember that the iris-claw IOL is implanted "upside down" (= on the back) (Figs. 7.85 and 7.86). Begin by centring the IOL in the anterior chamber with a lens rotator (e.g. push pull). Grasp next the IOL in the middle with the implantation forceps (Abbott), flip it to the right behind the iris, and then flip it to the left behind the iris. Then you take the enclavation spatula in your left hand. Lift the IOL a little bit forward, so that the iris claws are visible behind the iris tissue. Introduce the spatula through the paracentesis at 3 o'clock, and clamp (enclave) the iris tissue between the iris claws. Change then your hands at the implantation forceps. Take the enclavation spatula in your right hand, and perform the same manoeuvre at 9 o'clock (Fig. 7.87). Finally remove the implantation forceps, stabilise the anterior chamber with BSS and close the main incision.

Remark: A retropupillary implantation requires no iridectomy.

8. Closure of main incision, removal of trocars

Close the limbus-parallel incision with Ethilon 10-0. Cefuroxime (e.g. Zinacef) is recommended for intracameral endophthalmitis prophylaxis.

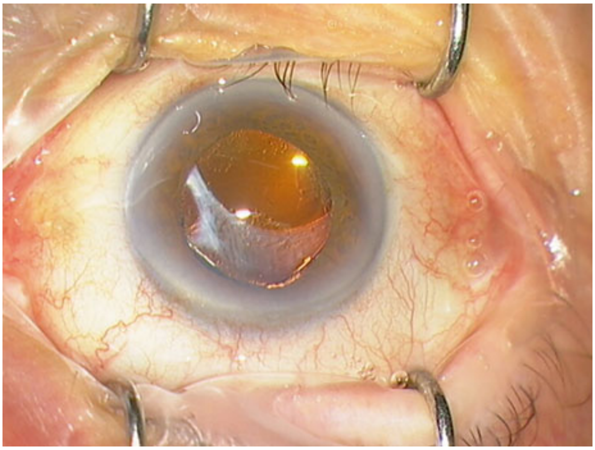


Fig. 7.75 An anterior dislocated bag-IOL complex secondary to zonular lysis

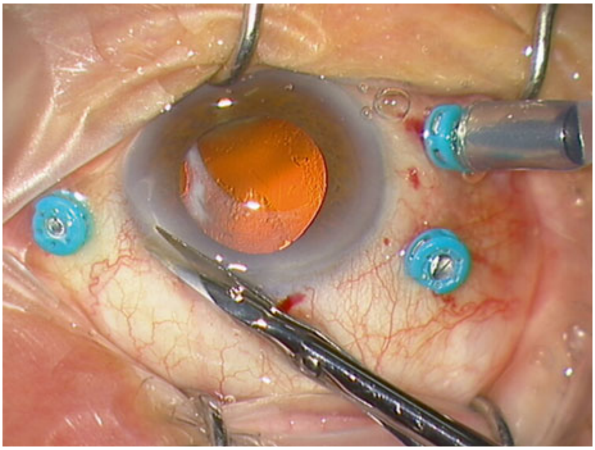


Fig. 7.76 Open the conjunctiva along the limbus from 10 o'clock to 2 o'clock with the Vannas scissors (limbal peritomy)

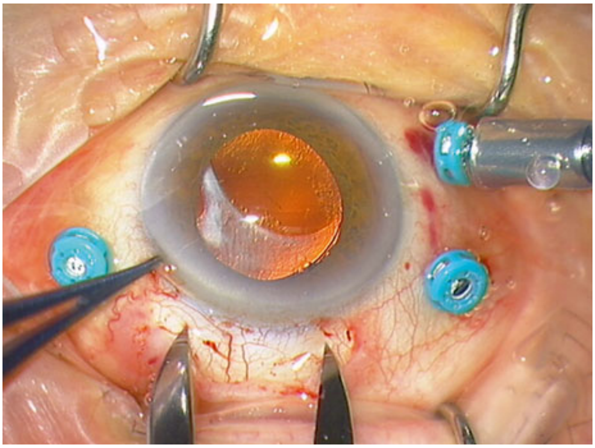


Fig. 7.77 Mark a 6 mm broad scleral incision with the caliper. The incision is approximately 1.5 mm behind the limbus

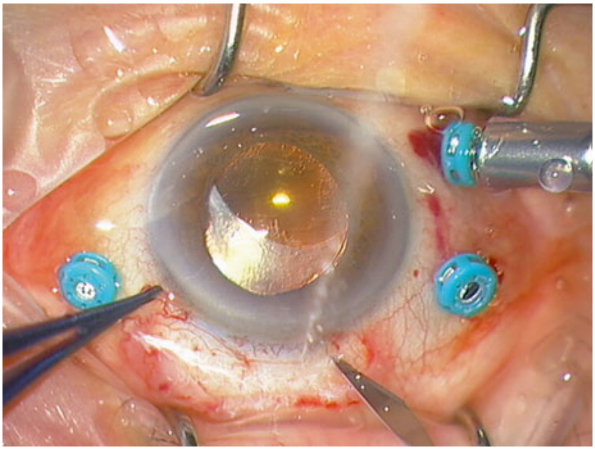


Fig. 7.78 An approximately 0.3-mm-deep incision with the 15° knife is performed (50 % scleral thickness)

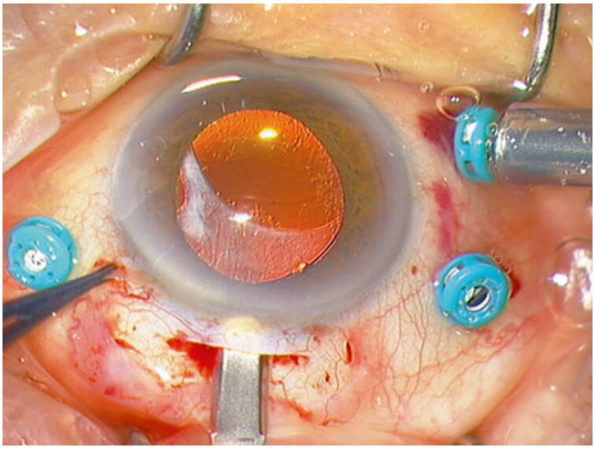


Fig. 7.79 Dissect a scleral flap with the bevel up crescent knife. If the knife is visible through the sclera, then you are at the correct depth

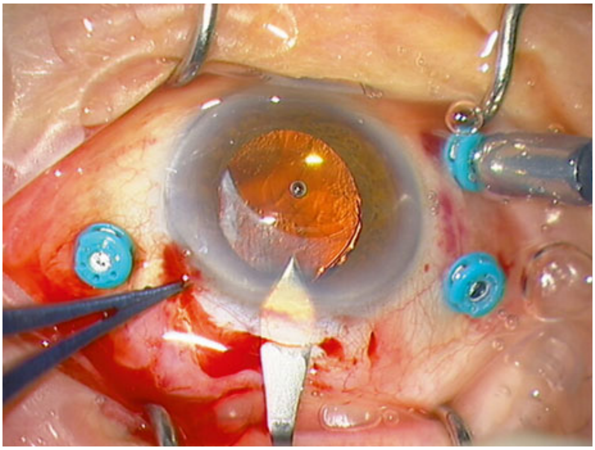


Fig. 7.80 Then open the anterior chamber with a 2.4-mm blade

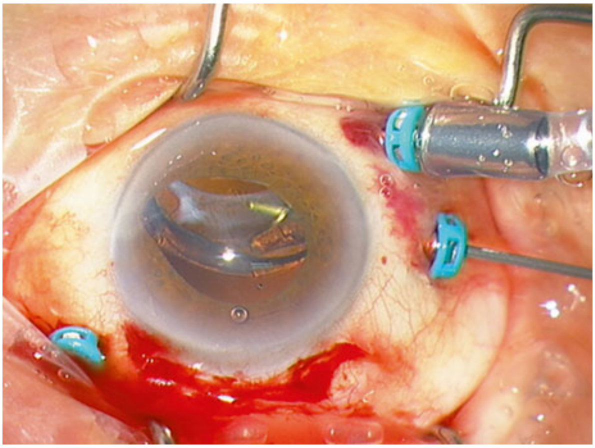


Fig. 7.81 Luxate the IOL at 12 o'clock up to the pupillary plane in order to access it with the forceps

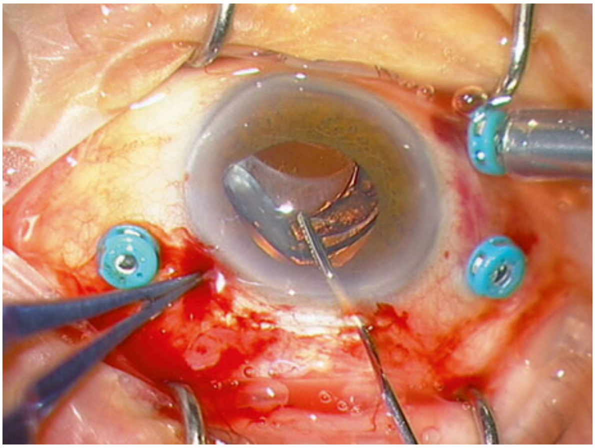


Fig. 7.82 Then remove the IOL with the serrated jaws forceps

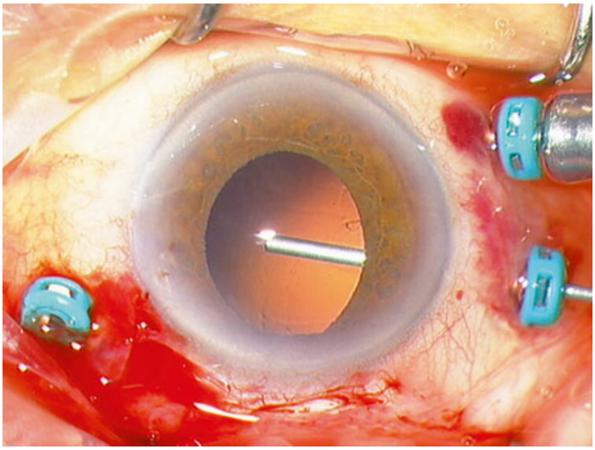


Fig. 7.83 Perform an anterior vitrectomy

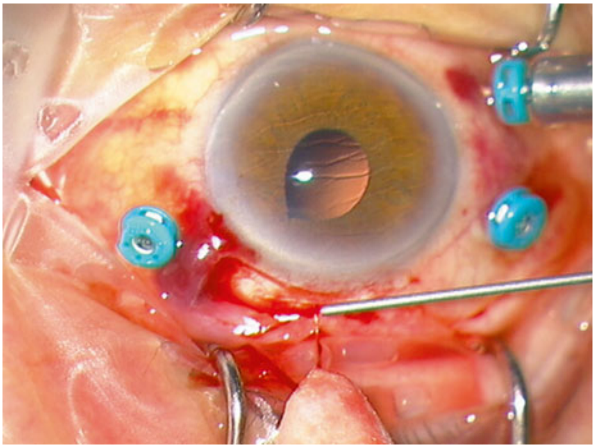


Fig. 7.84 A vitreous strand through the main incision causing an oval pupil. Cut the vitreous strand with a Vannas scissors or with the vitreous cutter

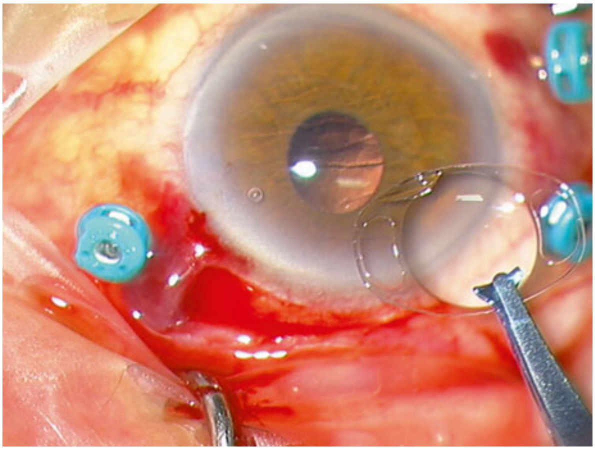


Fig. 7.85 Turn the iris-claw IOL upside down for implantation

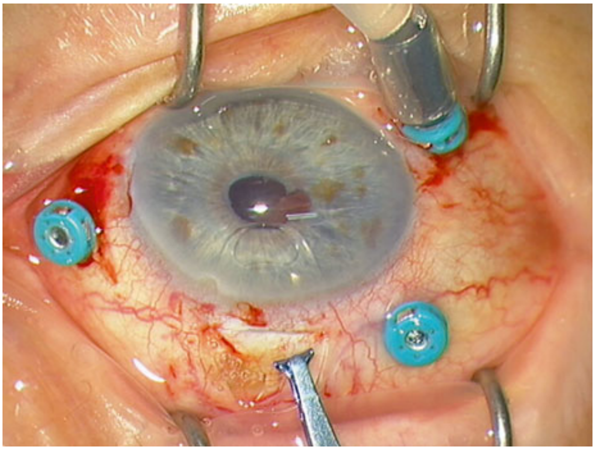


Fig. 7.86 Implant the IOL with the IOL forceps (AMO)

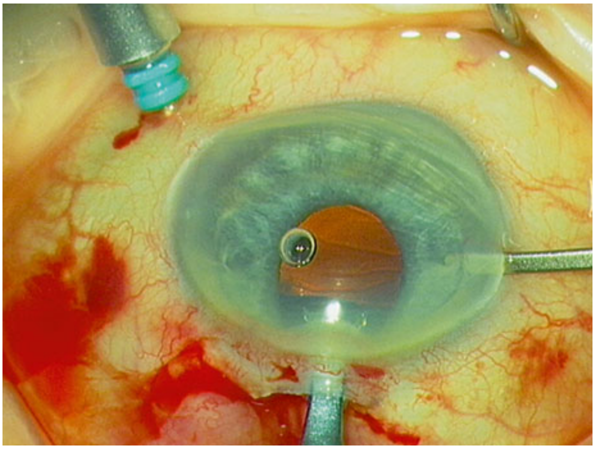


Fig. 7.87 Tilt the IOL behind the iris and then press the iris tissue with an enclavation spatula (no push-pull instrument) behind the claws

Pits and Pearls No. 27

Possible Complications: *Choroidal detachment* (Fig. 7.88). A choroidal detachment can result if high pressure fluctuations occur during manipulations at the main incision, e.g. when extracting the IOL or during implantation of the IOL in the anterior chamber. The infusion should be closed, the anterior chamber filled with viscoelastics, and the IOP should be normotensive when performing these procedures. A choroidal detachment can be observed by a darkening pupil (no red reflex). Close immediately the main incision with a suture. An expulsive choroidal detachment disappears within 1–3 months.

7.4.2 Scleral Fixation of Dislocated Bag-IOL Complex (Hoffmann Technique)

Video 7.32: Hoffmann technique

This suture fixation technique is using reverse scleral pockets without conjunctival opening to reduce surgical trauma. The technique could be used for transscleral suture fixation of a PCIOL, subluxated fibrosed capsular bag-IOL complex or modified capsular tension ring. Surgery lasts about 30 min and is performed in local or general anaesthesia.

Instruments

1. Anterior chamber maintainer or OVD
2. Double-armed polypropylene suture (9-0 or 10-0) with long needle (Alcon. Polypropylene. 8065304901)
3. 15-degree knife
4. Mini crescent knife (e.g. Mini glaucoma knife, DORC, The Netherlands, or Ultra sharp scleral pocket knife 1.0 mm, Alcon Grieshaber, USA)
5. Sharp 27-G needle and/or endoforceps (e.g. Scharioth IOL fixation forceps set 1286.SFD, DORC Int., The Netherlands)
6. Push-pull instrument (Kuglen hook, Fig. 2.15)

Individual Steps

1. Insertion of permanent infusion or injection of OVD.
2. Partial thickness paralimbal incision.
3. Scleral pocket dissection.
4. Transscleral suture placement through scleral pockets with double-armed suture.
5. Externalisation of suture from scleral pockets towards the cornea.
6. Tying and knotting the suture.
7. Burring the suture ends in scleral pocket.
8. Remove infusion and/or OVD.

The Operation Step by Step

1. Insertion of permanent infusion or injection of OVD.
2. Partial thickness paralimbal incision.

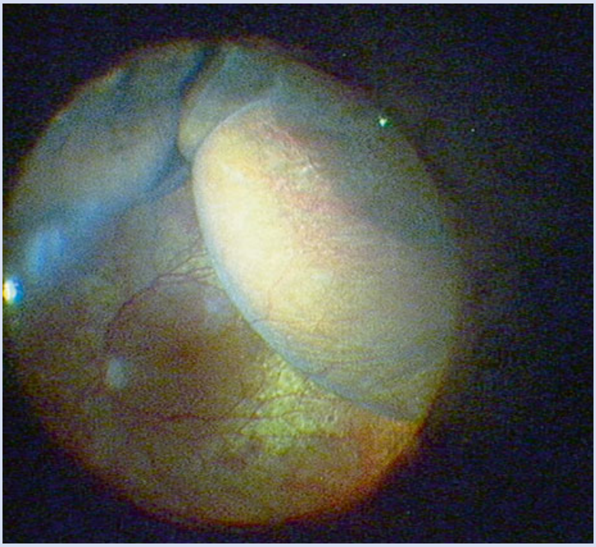


Fig. 7.88 A dreaded complication: Choroidal detachment. The reason is the big main incision and pressure fluctuations during manipulations at the main incision. It is therefore important to close the infusion and fill the anterior chamber with viscoelastics when working in the anterior chamber

3. Scleral pocket dissection.

After creating a paracentesis the eye is stabilised either by anterior chamber maintainer or OVD filling of the anterior chamber. Two partial-thickness paralimbal incisions approximately 2.0–3.0 mm wide are made inside the clear cornea using a 15° straight knife or a guarded blade with 0.3-mm incision depth at the desired fixation site (Fig. 7.89). This is usually repeated for a second fixation site. This is exactly 180° in case of transscleral fixation of a PCIOL or a capsular bag, but not in case of a modified capsular tension ring (Cionni 2 L CTR, Morcher, Germany). Starting from these incisions scleral pockets are dissected posteriorly at this depth using mini crescent knife (Fig. 7.90). This scleral pocket has to be at least 2.5–3.0 mm long to facilitate later externalisation of the sutures.

4. Transscleral suture placement through scleral pockets with double-armed suture.
5. Externalisation of suture from scleral pockets towards cornea.

Side port incisions are made almost opposite to these scleral pockets, and the needle of the double-armed 9-0 or 10-0 polypropylene suture is introduced through the side port incision. The first needle is then stitched through the ciliary sulcus, sclera and conjunctiva ab interno in the area of the scleral pocket (Fig. 7.91). If the iris is moving, the needle should be placed a bit more posterior to prevent damage to the iris root and postoperative UGH syndrome.

The second needle of the double-armed suture is then placed through the side port incision with special care that no corneal tissue is catched. Then the needle is placed through the peripheral fibrosed capsular bag catching the IOL haptic or even better a capsular tension ring in case of subluxated capsular bag-IOL complex. Here an endoforceps (e.g. Scharioth IOL fixation forceps set 1286.SFD, DORC Int., The Netherlands) could be used to stabilise the implant. In case of a modified capsular tension ring, the needle is placed through the hole in the fixation eyelet. Now the needle is stitched through the ciliary sulcus, sclera and conjunctiva ab interno in the area of the scleral pocket (Fig. 7.92). Alternatively a 27-G needle could be placed ab externo through the conjunctiva and sclera in the area of scleral pocket, and the tip of the suture needle is placed into the lumen of this 27-G needle to guide it. Then needles are cut off the sutures (Fig. 7.93), and with the help of a push-pull hook or an endoforceps, the suture is catched in the scleral pockets and withdrawn towards the cornea.

This same procedure is repeated with the second double-armed suture for the second scleral fixation site (Fig. 7.94).

6. Tying and knotting the suture.
7. Burring the suture ends in scleral pocket.
8. Remove infusion and/or OVD.

Using the two ends of a suture, a three-throw knot is made and gently tightened (Fig. 7.95). The tension is carefully adjusted on both sites to ensure that the IOL is well centred. Once the IOL is centred, another knot is added to fixate the suture. The suture ends are cut and then repositioned into the scleral pockets (Fig. 7.96). Anterior chamber maintainer and/or OVD is removed from the anterior chamber. Incisions are hydrated and checked for leakage. They can be sutured if needed.

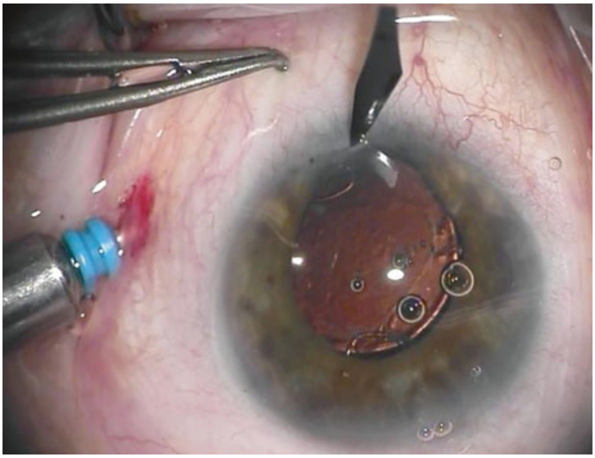


Fig. 7.89 Creating a 2.0–3.0-wide limbus-parallel incision with 15° knife or 0.3-mm guarded blade

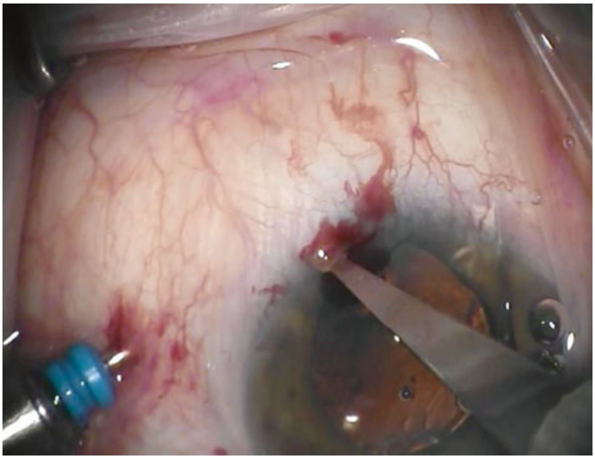


Fig. 7.90 Posteriorly directed dissection of scleral pocket with mini crescent knife

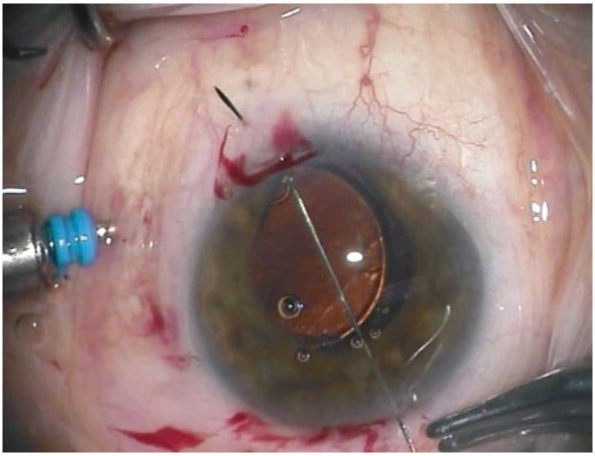


Fig. 7.91 The first needle of a double-armed polypropylene suture is placed transscleral in the area of the scleral pocket

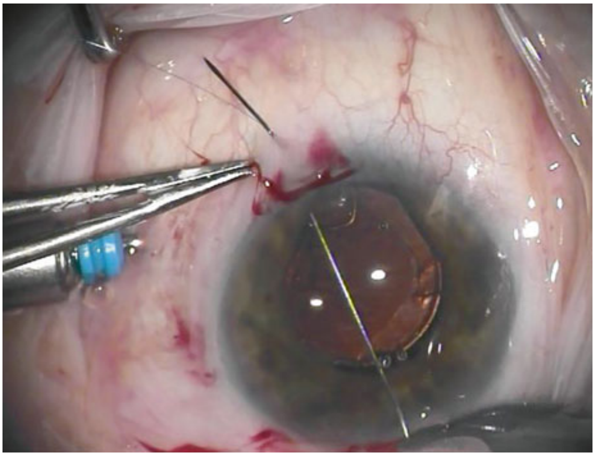


Fig. 7.92 The second needle of double-armed polypropylene suture is placed transscleral in the area of the scleral pocket a bit away from the first one; note the first suture part is already externalised

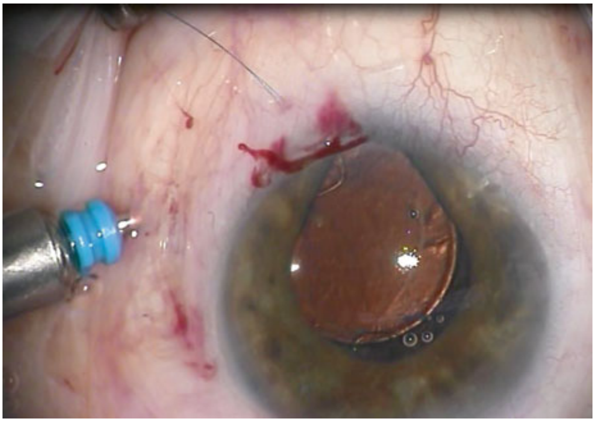


Fig. 7.93 After removing the needles at the first scleral pocket

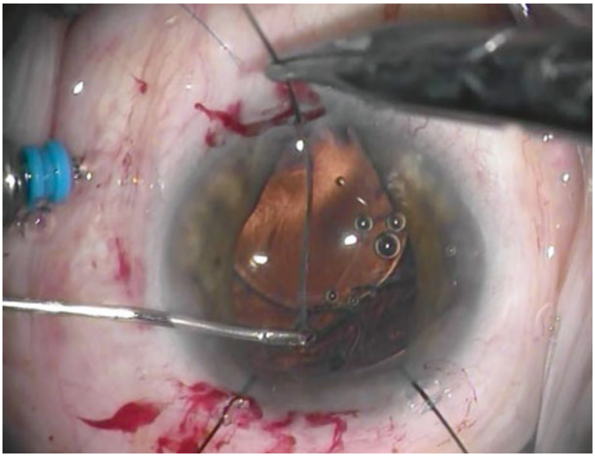


Fig. 7.94 The same procedure is repeated with the second scleral pocket

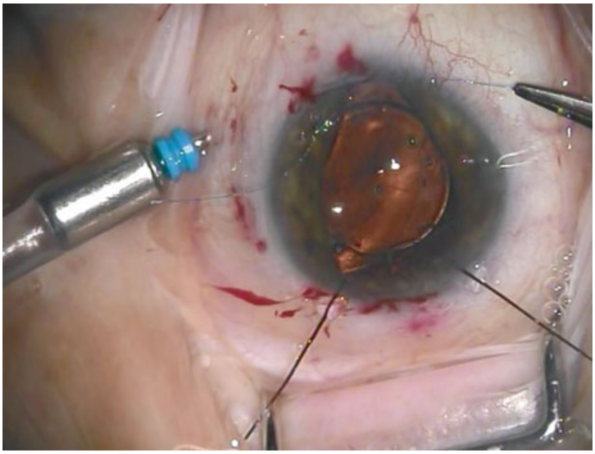


Fig. 7.95 Polypropylene suture is tightened, while suture loop is pulling inside the implant and centring the IOL

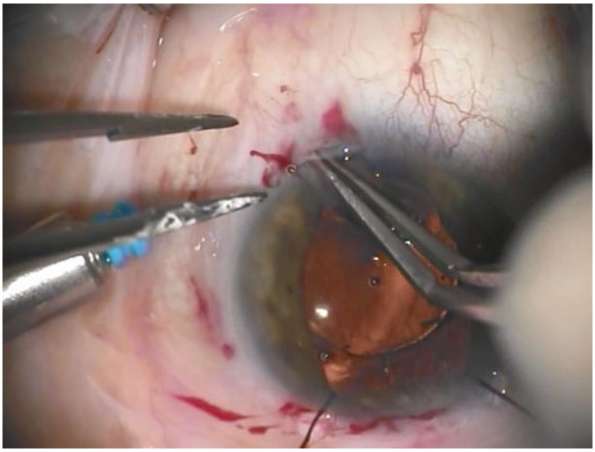


Fig. 7.96 Ends of the polypropylene suture are placed into the scleral pocket

7.5 Summary

Dislocated Bag-IOL Complex

First Step: Extraction of bag-IOL complex. Learn to perform a frown incision in order to extract the bag-IOL complex.

Second Step: Implantation of an IOL

1. Fixation of haptics (3-piece IOL) into scleral tunnels (Scharioth technique)
2. Scleral suturing of haptics (3-piece or 1-piece IOL)
3. Iris fixation (iris-claw IOL)

Dislocated IOL with Intact Anterior Capsule

Reposition the IOL in the sulcus and buttonhole the IOL in the rhexis if possible (lens capture).

All these surgeries can be performed with a phacoemulsification machine and the insertion of one or two trocars at pars plana.

Part II

Complication Management Using a Vitrectomy Machine

General Surgical Techniques for Posterior Segment Surgery

8

Contents

Electronic supplementary material Supplementary material is available in the online version of this chapter at http://dx.doi.org/10.1007/978-3-642-54449-1_8. Videos can also be accessed at http://www.springerimages.com/videos/978-3-642-54448-4.

U. Spandau, G. Scharioth, *Complications During and After Cataract Surgery*,
DOI 10.1007/978-3-642-54449-1_8,

8.1 Standard Instruments for Pars Plana Vitrectomy

Retinal surgery is a very "instrumental" operating area. This means that you as a surgeon during surgery require many different instruments (Fig. 8.1), significantly more than during phacoemulsification. Therefore one should know as a surgeon all different instruments, because only by their application you will obtain a high surgical quality. The individual surgical instruments are introduced.

Vitrectomy Set

Here you find all details of our phacoemulsification instrument set, which we use at the University Hospital of Uppsala (Fig. 8.2). The content varies of course from hospital to hospital.

1. 1x lid speculum Liebermann. Geuder G-15960
2. 1x irrigating cannula. Geuder G-15180 (for irrigation of the eye)
3. 1x dressing forceps, serrated. Geuder G-18781
4. 1x tissue forceps, 1 × 2 teeth. Geuder G-18791
5. 1x Castroviejo suturing forceps, straight. Geuder G-19023
6. 1x Barraquer Cilia forceps. Geuder G-18750 (for suturing)
7. 1x trocar forceps. DORC 1276.2 (for removal of the trocars)
8. 1x eye scissors, straight pointed-pointed 9 cm. Geuder G-19350
9. 1x Vannas scissors. Geuder G-19760
10. 1x Halsted mosquito forceps, curved serrated. Geuder G-18181
11. 1x Hartmann mosquito forceps, straight serrated. Geuder G-18170 (for washing the eye)
12. 1x Barraquer needle holder, curved, without lock. Geuder G-17500
13. 1x Sclera depressor, double ended. Geuder G-32715
14. 1x Braunstein fixed caliper. Bausch & Lomb E2402 (Scleral marker 3.5 & 4.0 mm)

Trocars

More and more ophthalmic companies have 23-G trocars in their product portfolio (Alcon, DORC, Bausch & Lomb, Geuder) (Figs. 8.8, 8.4, and 8.5). Trocars consist of a metal cannula and mostly of a valve. The valve prevents the outflow of intraocular water. The trocars are inserted with an inserter. The inserter includes a marker at the top and a knife at the tip. The trocar is inserted in a so-called one-step technique (marking, incision and implantation).

We recommend trocars with valves. They are especially pleasant for beginners, because the eye is always normotensive. The valves maintain a closed system, i.e. when removing the instruments or even stopping the infusion the eye remains normotensive (Fig. 8.1).

Important: The closed valve trocar system has the disadvantage that no open "drain" is present as in conventional 20-G vitrectomy. If a fluid or gas is injected into the eye, the intraocular pressure increases. This problem can be avoided by the use of a special infusion cannula, which simultaneously injects and removes fluid.

Trocar Forceps

Indication: Manipulation of trocars (Figs. 8.6, 8.7, and 8.8). A very useful forceps for any kind of manipulation of the trocars. DORC 1276.2

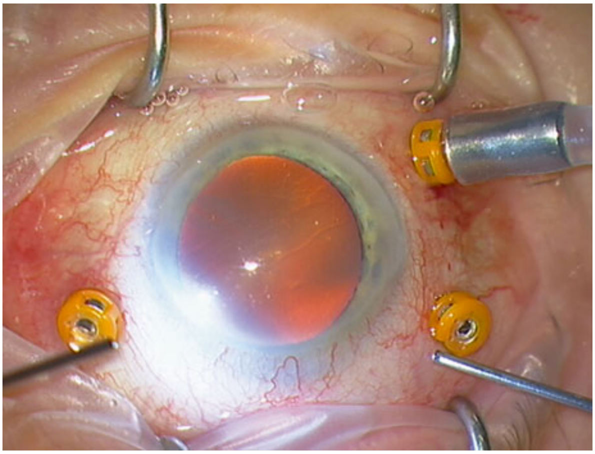


Fig. 8.1 This is the typical surgical setup for a small-gauge vitrectomy. Three trocars are inserted, also called three-port vitrectomy. The inferotemporal trocar holds the infusion line. Both superior (2 and 10 o'clock) trocars are for the instruments. One hand holds the light pipe and the other hand an instrument (e.g. vitreous cutter, forceps)

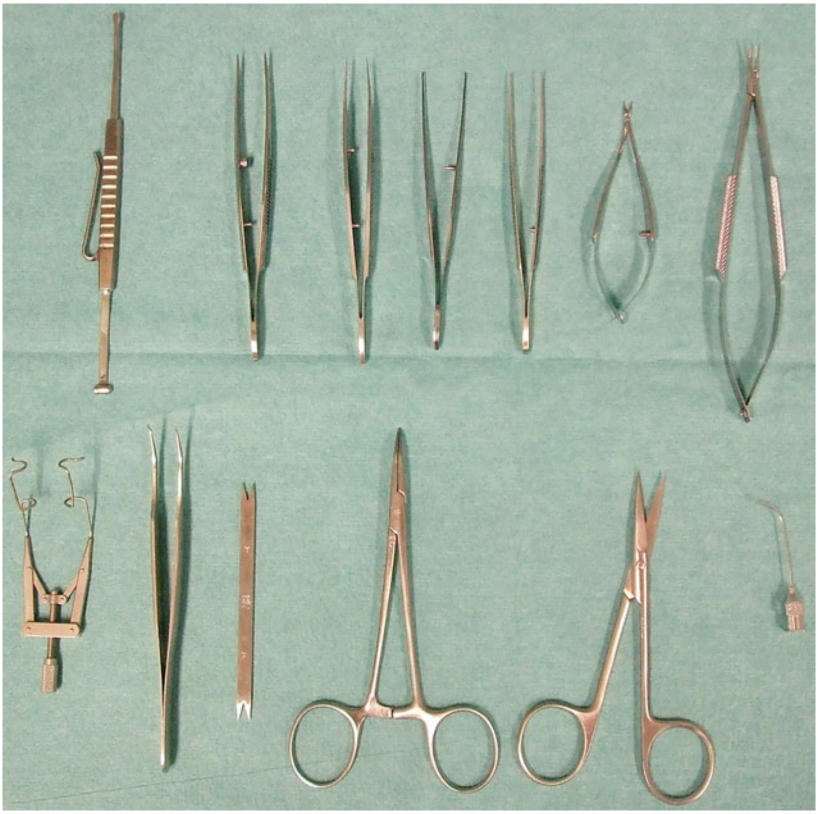


Fig. 8.2 The instrument set for a vitrectomy as we use it at our hospital. With courtesy of the Kaden Verlag

Fig. 8.3 A 25-gauge one-step trocar from Alcon. The trocar is at the left side, the handpiece has a blade at the left side and a marker on the right side

Fig. 8.4 A 23-gauge trocar from Geuder. A Geuder cannula is made from plastic

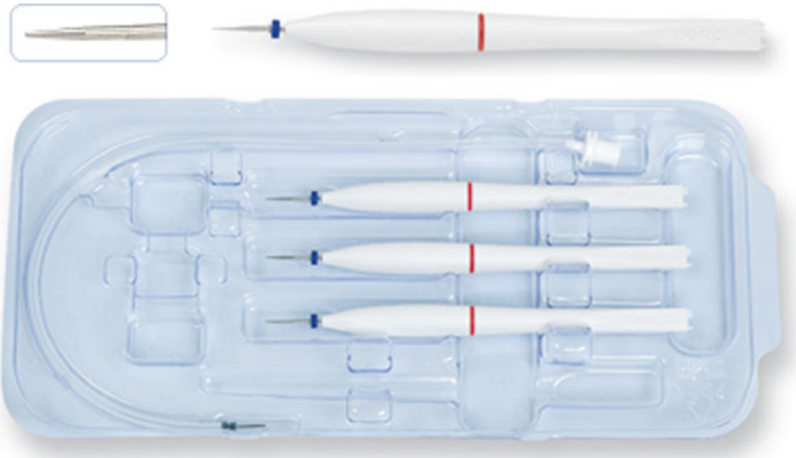


Fig. 8.5 A typical set for trocars (DORC). The package includes 3 trocars and one infusion line

Fig. 8.6 Trocar forceps. Indication: Manipulation of trocars. DORC 1276

Fig. 8.7 The trocar forceps holds a trocar

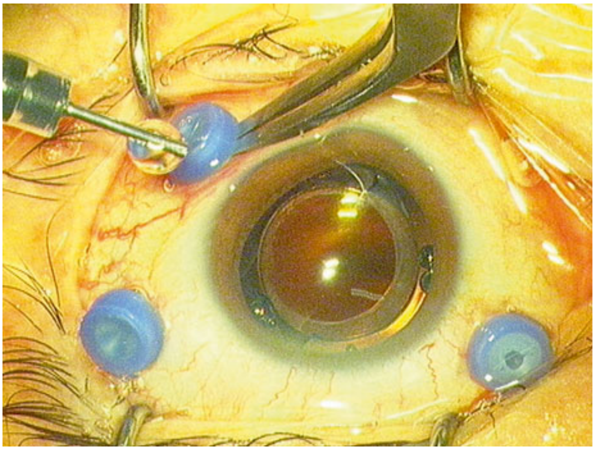


Fig. 8.8 For the insertion of the infusion line, an instrument is required. Use a trocar forceps or alternatively an anatomic forceps

Scleral Marker

Indication: Mark the position of the sclerotomy on the sclera: 3.5–4 mm behind the limbus (Fig. 8.9). Many manufacturers incorporate a marker in the handle of the trocar inserter.

Light Fiber (Efndoilllluminators)

There are two types of endoillumination: Hand-held light pipes (Fig. 8.1) and scleral fixated endoillumination (chandelier light, Figs. 8.10 and 8.11).

Light pipes are available with different-sized cones of light. For routine cases, one holds the light pipe with the nondominant hand and the vitreous cutter with the dominant hand. A chandelier light is fixated in the sclera and illuminates the entire fundus. This enables bimanual surgery and allows the surgeon to use a second active instrument in addition to the vitreous cutter. For optimal illumination of a chandelier light, an external light source (Photon, Xenon) or a modern vitrectomy machine (Stellaris PC, Constellation, Eva) is required.

Vitreous Cutter

Vitreous cutters that are connected to a phaco machine are mostly 20G and have a cut rate of 500–1,000 cuts/min. The opening of the vitreous cutter is called a port. During anterior vitrectomy the dominant hand holds the vitreous cutter in the main incision and the nondominant hand holds an irrigation handpiece in the paracentesis.

High-speed vitreous cutters (Fig. 8.12), which are connected to a vitrectomy machine have a cut rate of 5,000–7,500 cuts/min. High-speed cutters are available in 20G, 23G, 25G and 27G. A 23-G high-speed vitreous cutter removes the vitreous as fast as a normal 20-G vitreous cutter. High-speed cutters exercise less strain on the retina and are therefore less traumatic.

What can a vitreous cutter remove? Vitreous of course, but a vitreous cutter can also easily cut iris tissue, a lens capsule and a soft nucleus. It cannot remove Elschnig pearls or a very fibrotic lens capsule.

The foot pedal has different vitrectomy settings depending if you use a phaco machine or a vitrectomy machine. It is really important to get acquainted with the settings of the foot pedal in your OR, because a cataract surgeon uses the vitrectomy settings only seldom.

Fig. 8.9 Scleral marker. Braunstein fixed caliper. We always use this instrument for marking of sclerotomies. Alternatively the marker on the trocar can be used. Bausch &Lomb, Storz instruments: E2402

Fig. 8.10 In some cases a scleral-fixated illumination (chandelier light) is required. The advantage of this method is that both hands are free for the use of instruments

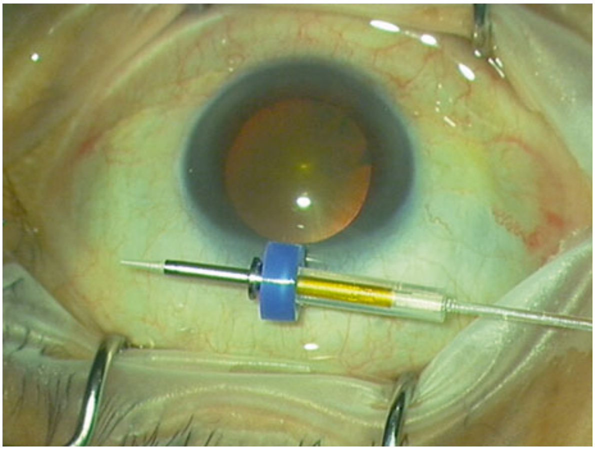


Fig. 8.11 This chandelier light (DORC) is inserted into a trocar and therefore simple to use

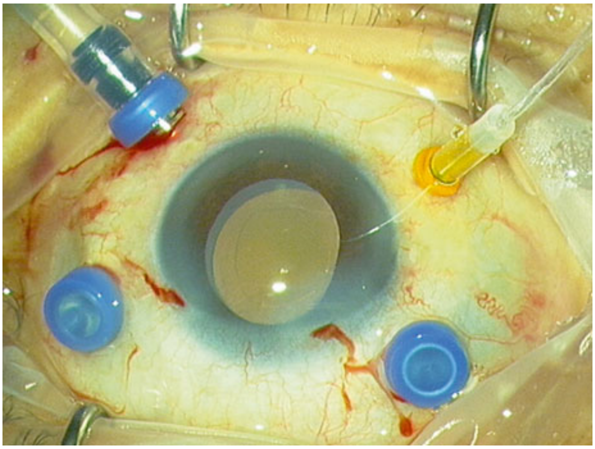


Fig. 8.12 A 23-G high-speed vitreous cutter (DORC) with 5,000 cuts/min. A regular vitreous cutter for phaco machines is 20G and cuts 500 cuts/min

Fragmatome

Indication: Emulsification of a dropped nucleus in the vitreous cavity (Fig. 8.13). It is available in 20 and 23 gauge but is used without a trocar cannula. Perform a non-lamellar 20-G sclerotomy for the fragmatome with a sclerotomy knife (Fig. 8.14). A fragmatome is difficult to use. On the one hand, it is less powerful than a normal phaco handpiece. On the other hand, it can exert high levels of suction in the posterior segment. Lens fragments tend to jump away from the needle tip. In such cases, one must aspirate the fragments in the needle tip before emulsification (see Appendix, Materials). Aspiration of the vitreous or the retina into the handpiece must be avoided (retinal damage or choroidal detachment).

Backflush Instrument (=Charles Flute Instrument)

Indication: Aspiration of fluid and pressure control. The backflush instrument has a 23-G cannula. It aspirates in fluid by capillary force and pressure difference (Figs. 8.15 and 8.16). The backflush cannula can also be used for injection of fluids (e.g. PFCL, dye) into the eye.

Double-Barreled Cannula

Indication: This cannula is used for the injection of fluids. In this book we use this cannula to inject PFCL. The cannula prevents an intraocular hypertension during injection (Fig. 8.17)

Scleral Depressor

A scleral depressor indents the retina (Fig. 8.18). It is a standard instrument for pars plana vitrectomy. It is used for trimming of the vitreous base, in particular in retinal detachment surgery. For the described surgeries in this book, the scleral depressor is required for a dropped nucleus case. Often nuclear fragments are located in the vicinity of the retina and you only reach them by indenting the retina. In addition, the instrument is needed for the search of retinal ruptures at the end of a vitrectomy.

Serrated (Jaws) Forceps

These forceps have the shape of a crocodile jaw and exert more traction and grip than the Eckardt forceps. They are therefore more suitable for the removal of PVR membranes, grasping a dislocated IOL or intraocular foreign body (Fig. 8.19).

Triamcinolone

Kenalog® (Squibb). Indication: Staining of the vitreous (Fig. 5.21)

Fig. 8.13 The fragmatome (=endophaco handpiece) is used for emulsification of a dislocated nucleus in the vitreous cavity. It is inserted directly into a 20-G sclerotomy without use of a trocar. The fragmatome is difficult to handle because it is not as powerful as a normal phaco handpiece and lens fragments tend to jump away from the needle tip. On the other hand, it can exert high levels of suction in the posterior segment resulting in aspiration of vitreous or retina into the tip

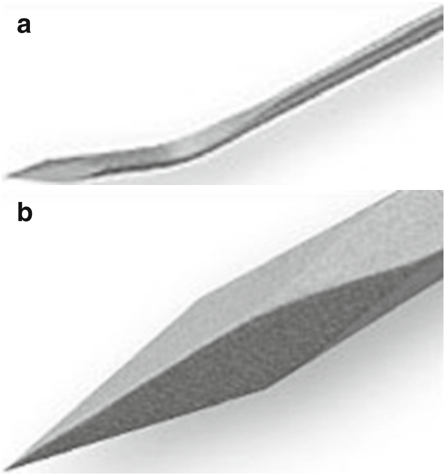


Fig. 8.14 (**a**, **b**) Sclerotomy knife, 1.3 mm. Indication: Paracentesis and 20-G sclerotomy. The fragmatome requires a 20-G sclerotomy. I recommend this knife for the sclerotomy. 20-G V-lance. Alcon. 8065912001

Fig. 8.15 A flute or backflush needle. This cannula can also be used for injection of dyes, antibiotics or PFCL into the vitreous cavity

Fig. 8.16 A backflush instrument (flute instrument after Charles). It works with capillary force. Indication: Aspiration of fluid in the vitreous cavity

PFCL

Indication: Luxation of nucleus to pupillary plane and flatten the retina. Perfluorocarbon (PFCL, heavy water) does not mix with vitreous. It is heavier than water and is therefore always located at the posterior pole (Table 8.1). One disadvantage is that it always needs to be completely removed, as it is retinotoxic if left within the eye for weeks to months. In detachment surgery, it is used to flatten the detached retina and push subretinal fluid through the breaks into the vitreous.

We use PFCL in this book for luxating a dislocated nucleus from the vitreous cavity to the anterior chamber. Finally, it may be used as a protectant of the posterior pole in cases of dislocated IOL or lens matter. There are many providers, e.g. DORC and B & L.

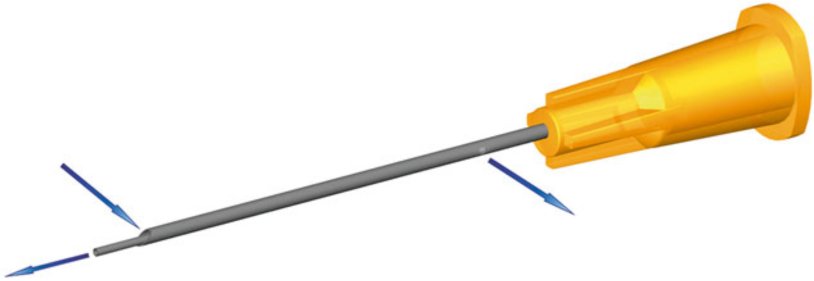


Fig. 8.17 Double-barreled infusion cannula. Indications: Injection of fluids (PFCL). The cannula prevents an intraocular hypertension during injection. DORC: Double bore cannula. EFD.06

Fig. 8.18 A scleral depressor. Indication: Effective examination of the fundus. Geuder 32715

Fig. 8.19 A 23-G intravitreal serrated jaws forceps. Indication: General purpose grasping, for example, an IOL in the anterior chamber or vitreous cavity. DORC: 1286.C06

Table 8.1 Relative location of gases, oils and PFCL in the vitreous cavity

<table>
<tr><th colspan="2">Lens</th></tr>
<tr><td>Air/gas</td><td rowspan="4">Vitreous Space</td></tr>
<tr><td>Conventional silicone oils</td></tr>
<tr><td>Water</td></tr>
<tr><td>Perfluorocarbon</td></tr>
<tr><th colspan="2">Retina</th></tr>
</table>

8.2 Binocular Indirect Ophthalmo Microscope (BIOM)

The usage of the BIOM (Oculus) requires some practice and should therefore be trained beforehand. The EIBOS and RESIGHT require a shorter training time while the BIOM requires a bit longer training time (Figs. 8.20, 8.21, and 8.22).

The surgeon or the scrub nurse flicks in the BIOM. Next, the light pipe is introduced in the temporal trocar towards the macula, until the pupil is bright. Then, the inverter is activated, the microscope light turned off and the image is focussed.

For beginners, it may be frustrating to adjust the focus at the beginning of vitrectomy. However, if you keep a few rules in mind, you will find focussing easy. There are three adjustable parameters: (1) Focus wheel at the BIOM; (2) focus on foot pedal of the microscope and (3) zoom on foot pedal of the microscope (Fig. 8.20). When focussing the image, you should only change the two parameters focus wheel BIOM and focus foot pedal and NOT the zoom. You should only change the zoom when you have a sharp image.

Remember the Following Steps:
1. Minimal zoom.
2. Move the microscope with the focus foot pedal so far down towards the cornea, until you get a fairly big image (red pupil).
3. Turn the focus wheel (BIOM) until you get a sharp retinal image.

If the image is sharp, move the microscope further down towards the cornea with the focus of the foot pedal (Caution: Corneal touch!). Lastly, you can increase the zoom with the zoom pedal but be aware that the resolution decreases the more zoom you have.

If the image is totally blurred and you eventually cannot continue, or you changed the front lens, always return to the initial parameters (lowest zoom).

If you are using the EIBOS system, try to reach the manual focus with your right index or middle finger. Once you have mastered this, it makes focussing a lot easier than advising the scrub nurse in focussing up or down.

An alternative to the BIOM systems is a contact lens (Fig. 8.23). This method requires an assistant positioning the contact lens.

8.3 Anaesthesia

We recommend a peribulbar anaesthesia. The most pain during vitrectomies is inflicted through insertion of trocars and impression of the sclera. Then there is the time aspect. The duration of these described posterior segment surgeries is approximately 60–90 min, which is much longer than a cataract operation. We use a blunt retrobulbar cannula (25G, Atkinson, BD) which minimises the risk to perforate the globe.

Fig. 8.20 A BIOM system from Oculus

Fig. 8.21 A BIOM system (EIBOS) from Leica

Fig. 8.22 A BIOM system (RESIGHT) from Zeiss

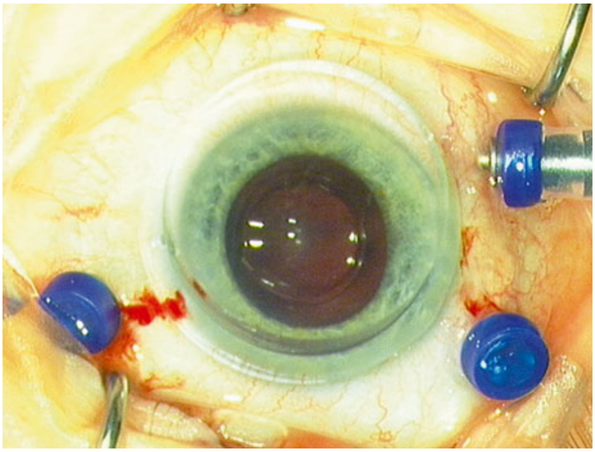


Fig. 8.23 An alternative to a BIOM system is a contact lens. The contact lens method requires an assistant who manoeuvres the lens

8.4 Pars Plana Vitrectomy

Video 8.33: Insertion of trocar cannulas

Video 8.34: Combined phaco + PPV

Location Terms for Vitrectomy

Lens = Front or anterior, retina = back or posterior. You place a sclerotomy not below the limbus, but behind or posterior to the limbus (Fig. 8.24).

Instruments

1. Vitrectomy set
2. BIOM with widefield lens
3. Light fibre
4. Vitreous cutter
5. Maybe: Backflush instrument

Dye

Triamcinolone

Tamponade

Intraoperatively: Maybe PFCL

Postoperative: Maybe air

Individual Steps

1. Insertion of trocars
2. Insertion of a chandelier light
3. Activate the BIOM
4. Central vitrectomy
5. Induction of a posterior vitreous detachment
6. Peripheral vitrectomy
7. Anterior vitrectomy
8. Injecting PFCL
9. Check for peripheral tears
10. Postoperative tamponade
11. Trocar removal
12. Scleral suture

The Operation Step by Stey

1. Insertion of trocars

   The sclerotomies are performed in the pars plana (there is no retina). The distance of the sclerotomy behind the limbus is 3.5–4.0 mm. Use a scleral marker by which you can measure and mark the sclerotomy. It is advisable to always (even the beginner phase out) use this scleral marker in order to avoid unnecessary complications by misplaced sclerotomies. The most trocars include a scleral marker at their top.

   The insertion of the trocars is technically easy (Figs. 8.25, 8.26, 8.27, 8.28, 8.29, 8.30, 8.31, and 8.32). Fixate the globe with a cotton swab, and mark the

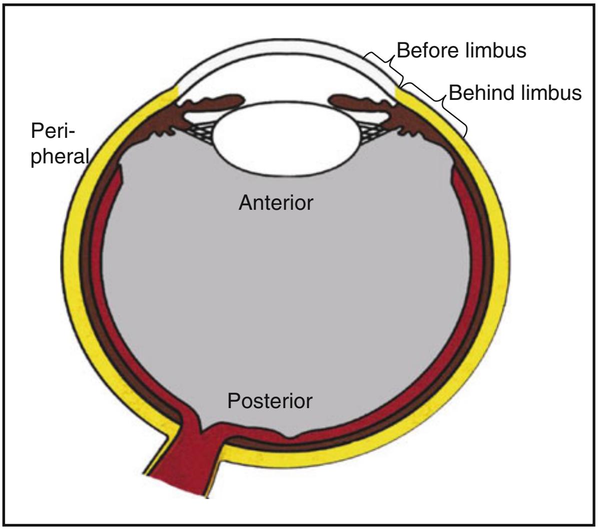


Fig. 8.24 Location designations in vitrectomy

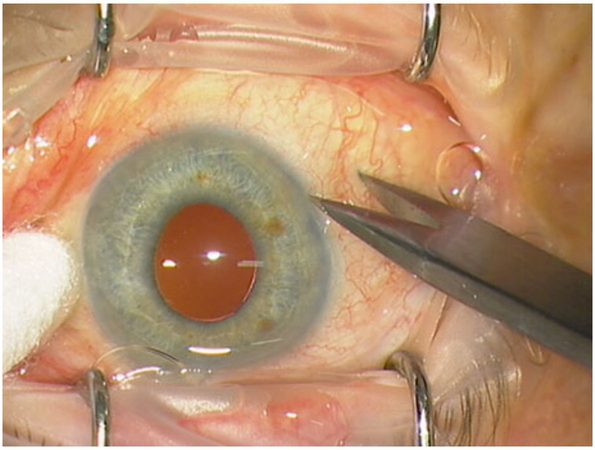


Fig. 8.25 Mark the sclerotomy with a scleral marker

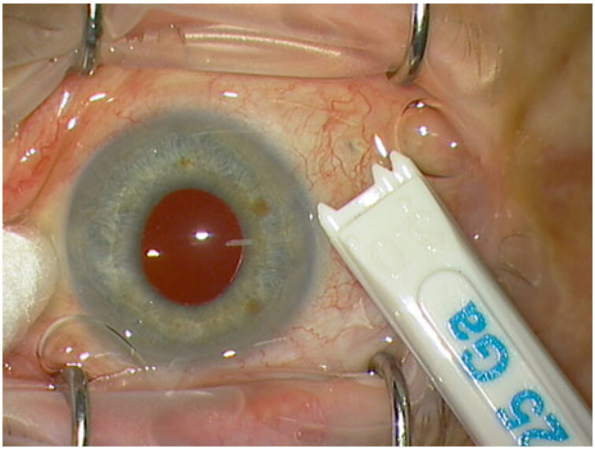


Fig. 8.26 Alternatively, mark the sclerotomy with the scleral marker on the trocar

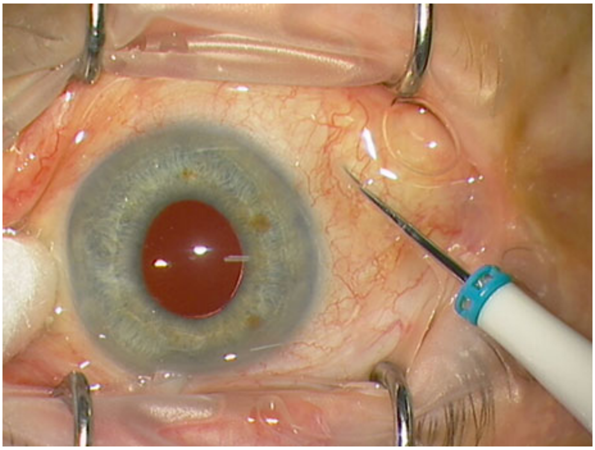


Fig. 8.27 Insert the blade transconjunctivally in a 15° angle to the sclera

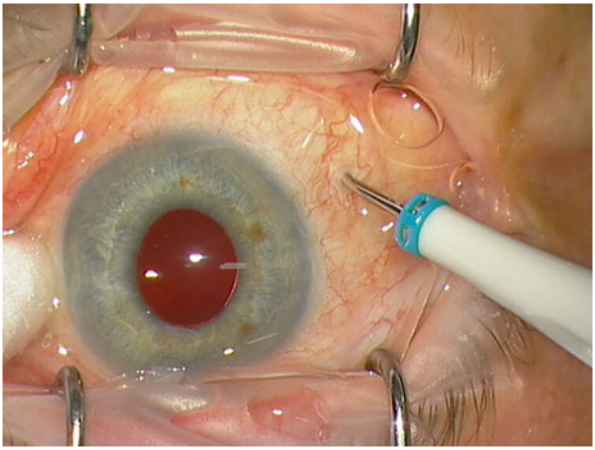


Fig. 8.28 Insert the blade half through

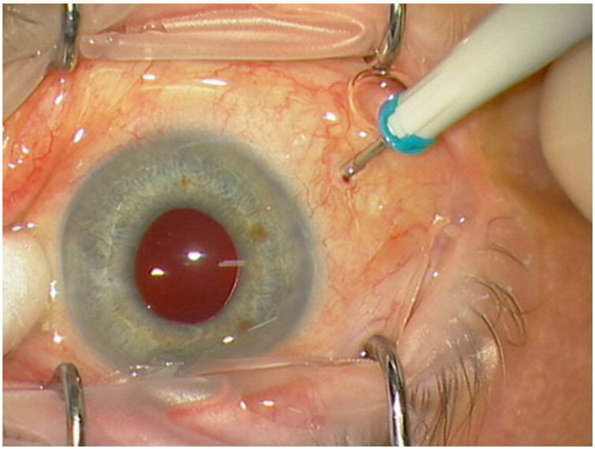


Fig. 8.29 Then raise the trocar (Alcon) and insert it the second half perpendicularly (centre of the eye)

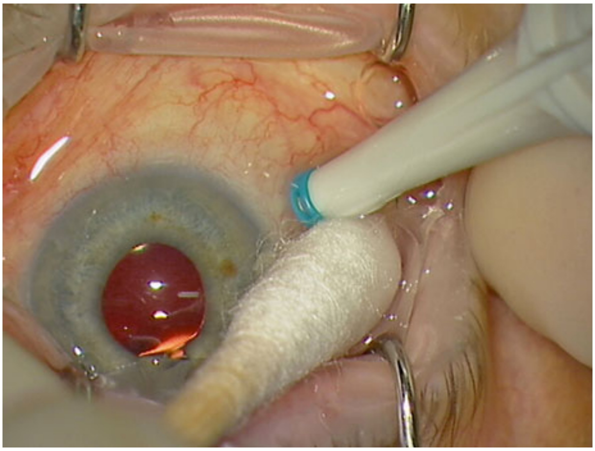


Fig. 8.30 Fixate the trocar with an instrument (cotton swab, anatomic forceps, trocar forceps) and remove the handpiece

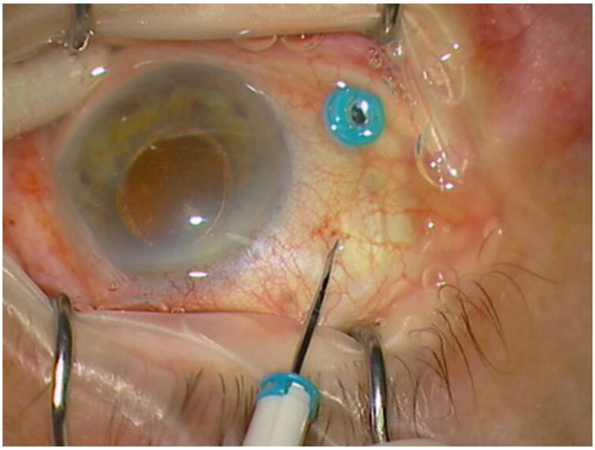


Fig. 8.31 Insert the second trocar at 10 o'clock

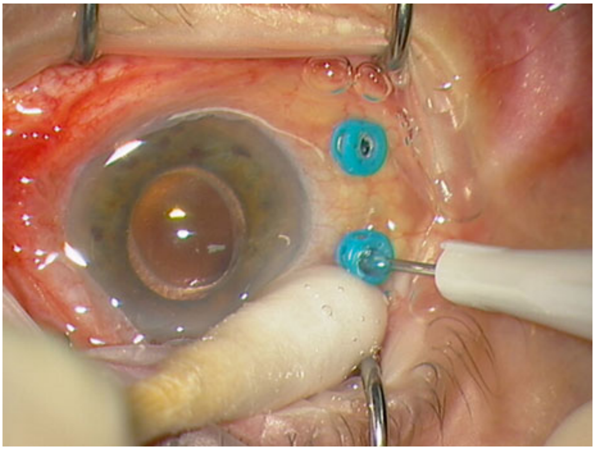


Fig. 8.32 Remove the handpiece. Then insert the third trocar at 2 o'clock

sclerotomy with the scleral marker. Stab the trocar inserter at an angle of approximately 15° through the conjunctiva and the sclera. If you are halfway through, raise the inserter up and insert it the second half in the direction of the centre of the eye (perpendicularly). Fixate then the valve with the cotton swab or an anatomic forceps and remove the inserter.

Start inferotemporal at 4–5 o'clock (left eye) or 7–8 o'clock (right eye) with the infusion trocar. Continue with the instrument trocars at 2:30 and 9:30 o'clock. Fixate then the infusion trocar with the trocar forceps (DORC) or an anatomic forceps (e.g. Geuder) and insert the infusion line (Fig. 8.33). Check then whether the infusion trocar is located in the vitreous space by indenting the trocar towards the cornea. The infusion is only opened at the beginning of the vitrectomy.

The inspection whether the infusion trocar is located in the vitreous space is so important because a subchoroidal located infusion trocar causes a choroidal detachment and a subepithelial located trocar causes a detachment of the pars plana epithelium (Table 8.2).

Pits and Pearls No. 28

Subepithelial Located Infusion: If you detect a choroidal detachment during vitrectomy, then stop at once with vitrectomy and inspect the infusion trocar. The infusion trocar is most likely subepithelial located. Stop the infusion, remove the infusion line, and reinsert it into an instrument trocar. Open the infusion again and check whether the choroidal detachment decreases. Now check the position of the infusion trocar. Is it 3.5 mm posterior (behind) of the limbus? If not, then remove the trocar and place it correctly. Is the trocar subepithelial? If so, then insert the infusion trocar elsewhere, e.g. inferonasally.

Pits and Pearls No. 29

Blood in the Anterior Chamber: If a bleeding occurs in the anterior chamber, you can either remove it with I/A or inject viscoelastic into the anterior chamber to press the blood to the edge of the anterior chamber. If the bleeding ceased, the blood clots can be extracted with an intravitreal forceps through a paracentesis.

2. Insertion of a chandelier light

   In a normal vitrectomy one hand is engaged by holding the light fibre. But in some vitrectomy cases, it is very useful to have two hands to your disposal. For these cases, a scleral-or trocar-based light fibre (so-called chandelier light) has been invented. I highly recommend the use of a chandelier light because it is technically so much easier to work with two free hands in the vitreous space. The extraction of a luxated IOL or the removal of a dropped nucleus is much easier if you can work with two hands. I recommend the use of trocar-based chandelier lights because they are easier to insert than scleral-fixated lights. Possible suppliers are DORC, ALCON and Synergetics (Figs. 8.34, 8.35, and 8.36).

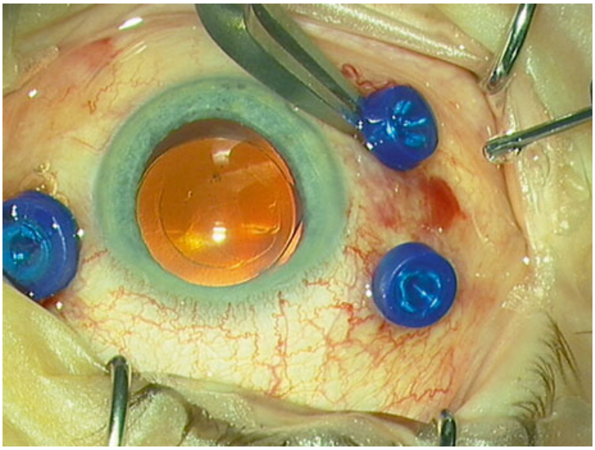


Fig. 8.33 All three trocars (DORC) are inserted. Fixate the infusion trocar with the trocar forceps and insert the infusion line. Then check if the infusion trocar is located in the vitreous cavity. The infusion line is switched off until you start with the vitrectomy

Table 8.2 Anatomy of the pars plana (from outside to inside)

Sclera
Subchoroidal space
Choroid
Pars plana epithelium
Vitreous

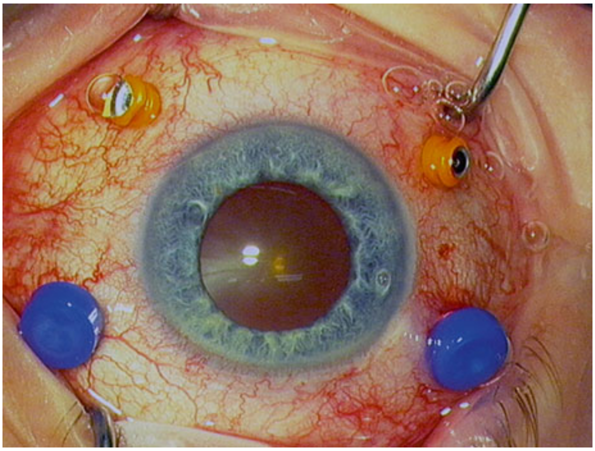


Fig. 8.34 If you use a scleral-fixated illumination (chandelier light), then insert a trocar at 5 o’clock

New vitrectomy machines Stellaris PC (Bausch & Lomb) and Constellation (Alcon) or Eva (DORC) have powerful light sources, to which you can connect a chandelier light.

3. Activate the BIOM
The surgeon flicks in the BIOM. Introduce then the light fibre and move it inwards until the pupil is bright. Then, the inverter is turned on, the microscope light switched off and the image focussed. For usage of the BIOM, see above Sect. 8.2.

Pits and Pearls No. 30
Cornea and Humidification: A good view to the retina is essential for a successful retinal surgery. In longer surgeries with a duration of about 1 h, the cornea may deteriorate. We use for corneal humidification methylcellulose (Celoftal®, Alcon or Ocucoat®, Bausch & Lomb), which guarantees a clear cornea even during long operations. A corneal abrasion is rarely necessary but should be performed if the view is bad.

Pits and Pearls No. 31
Small Pupil: If the pupil constricts during surgery, then inject 0.01 % intracameral adrenaline. The pupil will extend within seconds. Alternatively, the pupil can be expanded with two push-pull instruments or iris retractors.

4. Central vitrectomy
Now we can finally start with the vitrectomy (Fig. 8.37). First the infusion has to be turned on by the scrub nurse. Then we start with the central vitrectomy or core vitrectomy. For machine settings see Table 8.3. In contrast to cataract surgery, it is amazing how much space you have in the vitreous cavity.

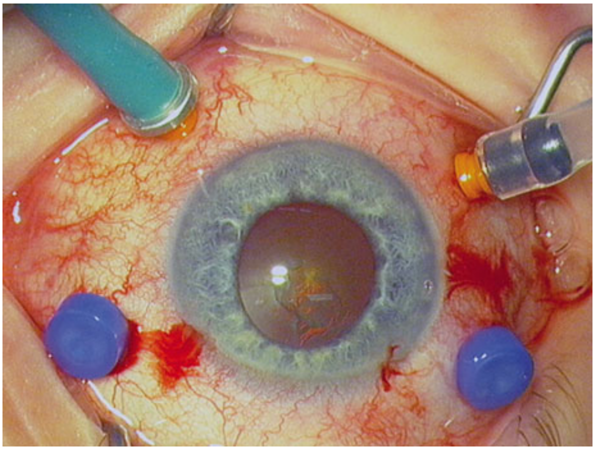


Fig. 8.35 Insert the chandelier light inside the trocar

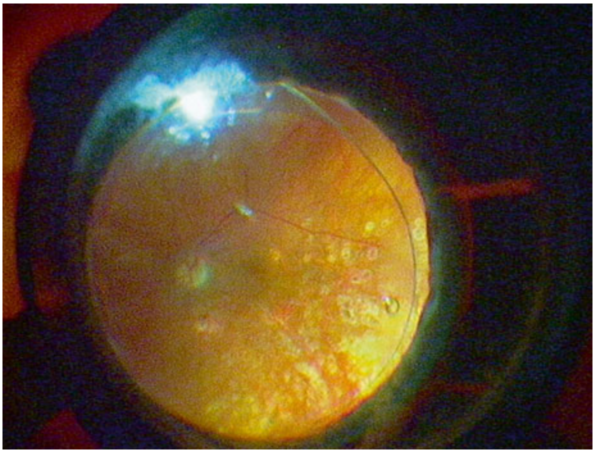


Fig. 8.36 The vitreous cavity is illuminated by the chandelier light (panoramic light)

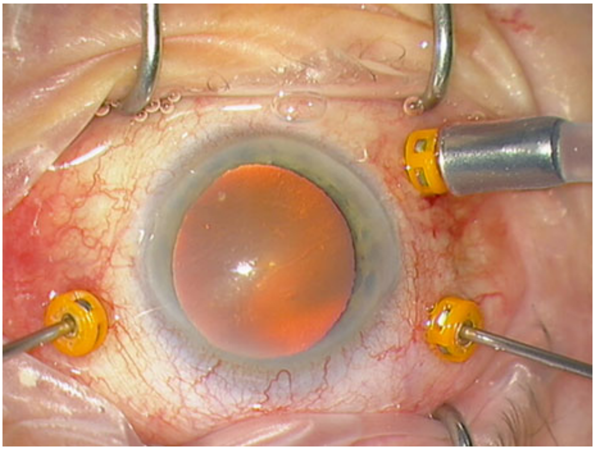


Fig. 8.37 Start with the vitrectomy. Insert the light pipe and the vitreous cutter into the instrument trocars

There are some differences in the movements of the instruments between phacoemulsification and vitrectomy. Make calm and slow movements during vitrectomy as opposed to quick movements during irrigation/aspiration in phaco. And in contrast to phacoemulsification where the instruments are held almost horizontally, you have to hold the instruments almost vertically in PPV. Hold the instruments towards the orbital apex. Another important difference is that the irrigation handpiece during I/A moves a little, but the light fibre during PPV is in constant motion (Figs. 8.38 and 8.39). Light fibre and vitreous cutter move simultaneously, i.e. the light fibre acts like a torch for the vitreous cutter in the vitreous cavity. The light beam is directed to the tip of the vitreous cutter. Both instruments are moved circularly in the vitreous cavity, as if peeling an onion from the inside to the outside. The vitreous is often difficult to recognise. It is therefore essential to move vitreous cutter and the light fiber together and to vitrectomise in the light cone. Vitrectomise the nasal half of the vitreous cavity and then change the instruments and vitrectomise the temporal side or vice versa. One should always remember that the eye is a sphere. You have plenty of room in the middle of the eye. You can estimate how close you are to the posterior pole by observing the shadow of the vitreous cutter on the retina. Caution: The retina forgives no mistakes, and retinal holes are made quickly. The same applies to the posterior capsule.

Pits and Pearls No. 32

Triamcinolone and PVD: We recommend beginners to inject approximately 0.1 ml of triamcinolone into the vitreous cavity in order to visualise the vitreous better. The vitreous is much easier to visualise and the vitrectomy and particularly a posterior vitreous detachment are significantly easier to perform.

5. Induction of a posterior vitreous detachment

   A posterior vitreous detachment is seldom necessary for these in this book mentioned surgeries. It might be necessary for the removal of a dropped nucleus because small nuclear fragments can get trapped in the vitreous at the posterior pole; in this case a posterior vitreous detachment is necessary.

   Increase the zoom in order to magnify the optic disc. As a setting for the vitrectomy machine, I recommend to increase the vacuum to 600 mmHg. Position the vitreous cutter just before the optic disc or on the nasal side of the optic disc. Do not position the vitreous cutter on the temporal side of the optic disc! You may cause an irreversible visual defect. Then increase the maximum suction (kick through the foot pedal) and pull the vitreous cutter slowly towards the lens. If the manoeuvre succeeds, you will recognise a kind of fine silk screen, which moves with the vitreous cutter forward (Fig. 8.40). If you want to perform the manoeuvre again, cut first the vitreous in the vitreous cutter port. Otherwise you move the vitreous cutter with incarcerated vitreous within the vitreous cavity and may induce retinal tears. This entire manoeuvre must sometimes be repeated several times until it succeeds.

Table 8.3 Approximate settings for 23-gauge vitrectomy

	Cuts/min	Vacuum mmHg
Core vitrectomy	3,000–5,000	400
Peripheral vitrectomy	5,000	100–200
Posterior vitreous detachment	Switched off	400–600
Opening of posterior capsule	200	400
Removal of capsular fibrosis	100	200

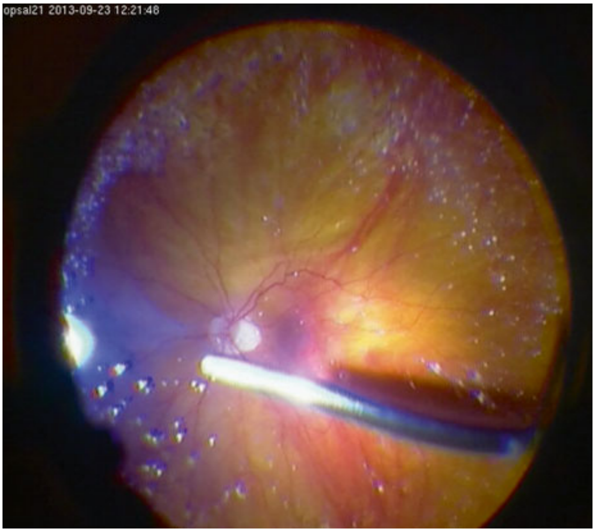


Fig. 8.38 At the left side you see the light pipe and at the right the vitreous cutter. A vitreous with asteroid hyalos is easier to detect and easier for the beginner to remove

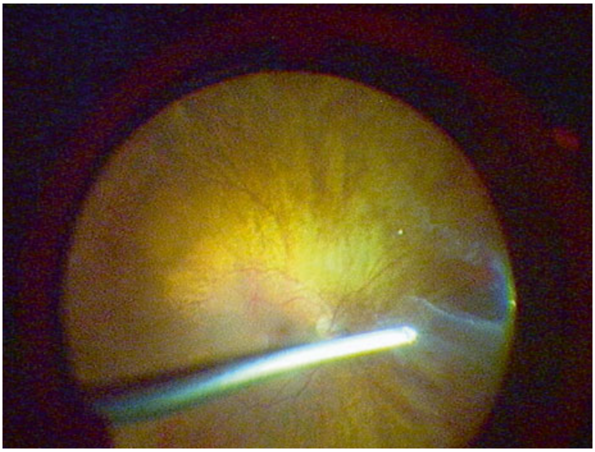


Fig. 8.39 Change the instruments in order to vitrectomise the other side. The normal vitreous is rather difficult to detect

6. Peripheral vitrectomy
   A thorough peripheral vitrectomy is in the most here-described cases not necessary (Figs. 8.39). An exception is again a dropped nucleus or nuclear fragments which tend to stick to the retina; in these cases you have to vitrectomise close to the retina. For these cases I absolutely recommend a chandelier light so that you indent the retina through use of a scleral depressor. Alternatively, the scrub nurse has to indent the sclera.

   If you work close to the retina, I recommend to decrease the vacuum to 100–200 mmHg (less aspiration means less risk to suck in the retina) and increase the cutting frequency (e.g. 5,000 cuts/min).
7. Anterior vitrectomy
   As a beginner, you will be amazed how much vitreous is present in the eye. Even after a thorough peripheral vitrectomy, there is still much vitreous behind the lens.

   Remove the anterior vitreous without BIOM (Fig. 8.41). Hold the vitreous cutter behind the posterior capsule and move the cutter in circular fashion while the port of the cutter is directed downwards in order not to injure the capsule.
8. Injecting PFCL
   PFCL must be injected *slowly*. Quickly injected PFCL can induce retinal damage (Figs. 8.42 and 8.43). The tip of the infusion cannula should never be directed to the macula. Start with a bubble at the posterior pole and then move the cannula slowly forward. The tip stays the whole time in the growing bubble in order to prevent the so-called fish eggs.

   Injection of PFCL: There are two methods. (1) Bimanually, using a backflush instrument (Fig. 8.16) and a 5-cc syringe filled with PFCL. During injection, pressure is released from the second trocar with the backflush instrument. Otherwise you will create a dangerous excess pressure in the eye. (2) Monomanually, injection with a double-barreled cannula (Fig. 8.17). A double-barreled cannula enables injection of fluid while maintaining the intraocular pressure. When fluid is injected, the intraocular pressure rises; this pushes fluid out of the eye through the second opening within the cannula. An intraocular hypertension is NOT possible. Therefore, only one hand is needed for injection with a double-barreled cannula (DORC. EFTIAR, dual bore cannula, 23-gauge/0.6 mm.
   Removing PFCL
   Position the tip of the backflush instrument above the optic disc and aspirate the PFCL completely (Fig. 8.44). If a last drop "refuses" to be aspirated then check if the drop is not located behind the posterior hyaloid. If this is the case, you will have to induce a posterior vitreous detachment in order to reach the last drop.
9. Check for peripheral tears
   At the end of vitrectomy peripheral tears must be excluded. Indent the retina with the sceral depressor. If you find a tear, then laser treat it now, or if you lack an endolaser, then laser treat it postoperatively with an exolaser.
10. Postoperative tamponade
    Gas tamponades are not described in this book. If you have a case with a focal detachment, I would carry out an air tamponade by performing a fluid-air exchange. Hold the backflush needle just above the optic disc, the scrub nurse

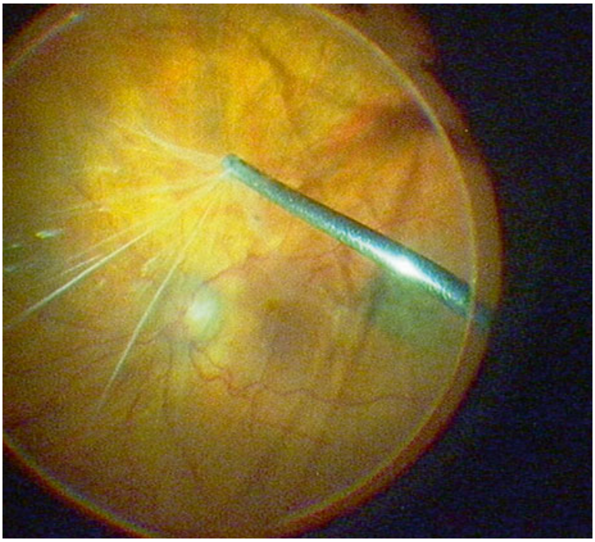


Fig. 8.40 Posterior vitreous detachment. The posterior hyaloid has a silken texture. Move the vitreous cutter slowly from the posterior pole towards the lens

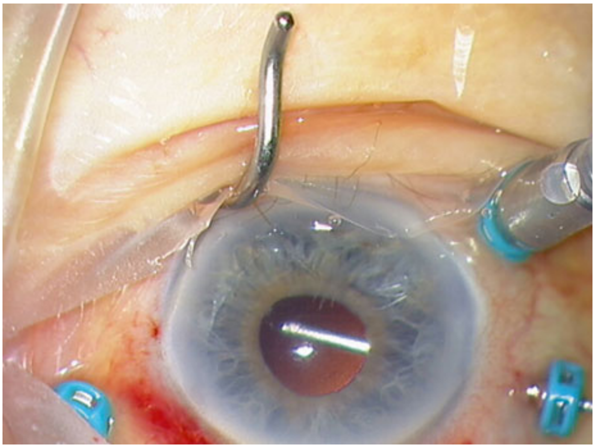


Fig. 8.41 An anterior vitrectomy is performed without the BIOM. Move the vitreous cutter along the edge of the pupil and direct the port of the vitreous cutter downward in order not to damage the anterior capsule. If you damage the anterior capsule, then extend the focal damage to a round posterior rhexis

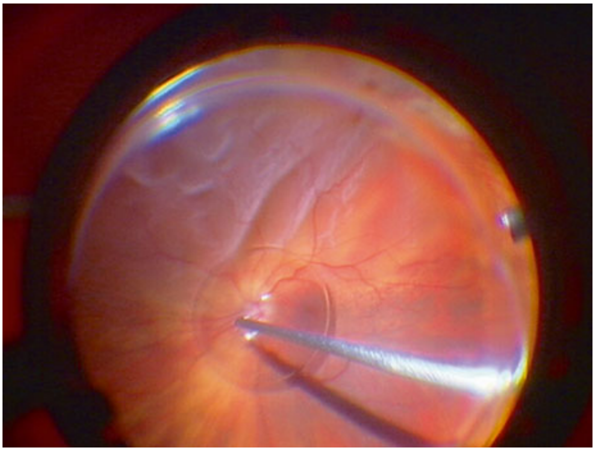


Fig. 8.42 Injection of PFCL with a double-barreled cannula (retinal detachment). Place the cannula tip outside the temporal arcades and inject a bubble. Increase the bubble and draw the cannula slowly up. Avoid several bubbles and avoid an extensive injection; it may cause a mechanical damage to the retina. And never inject in the direction of the macula

changes to air infusion and wait until the intraocular fluid is aspirated. Do not insist to aspirate the intraocular fluid completely in order to avoid a retina touch.

NOTE: When a fluid or gas is injected into the eye, one may create a dangerous overpressure, which can lead to closure of the central artery. Decompress the eye in such a case by holding a backflush instrument into the second trocar. You can also remove a valve, but this leads to a rather uncontrolled pressure equalisation.

11. Trocar removal

    Remove the trocars in this order: First the instrument trocars and last the infusion trocar. The infusion trocar remains until the end to avoid hypotension during removal of the trocars. The infusion remains open until the removal of the infusion trocar.

    Pull out an instrument trocar with the trocar forceps, then press on the sclerotomy with an anatomic forceps (e.g. Barraquer). Check now the sclerotomy for leakage (Fig. 8.45) or vitreous prolapse. In case of leakage suture the sclerotomy with a Vicryl 8-0 interrupted stitch (Fig. 8.46). If vitreous or uveal tissue prolapses into the sclerotomy, then remove it with the vitreous cutter, otherwise a possible vitreous wick syndrome and infection may result. Finally, remove first the infusion line and then the infusion trocar in order to avoid hypotension. If the globe is hypotensive at the end, inject BSS into the anterior chamber until normotension is achieved.

12. Scleral suture

    Suturing of a Sclerotomy

    A lamellar 23-G and 25-G sclerotomy requires usually no suture; a perpendicular 20-G sclerotomy (e.g. for the fragmatome), however, must be sutured. A leaking sclerotomy requires also a suture. A 23-G and 25-G sclerotomy is sutured with a Vicryl 8-0 interrupted stitch and a 20-G sclerotomy with a Vicryl 6-0 interrupted stitch or a Vicryl 8-0 cross stitch. To suture a sclerotomy is harder than one might assume. Grasp the sclerotomy with a surgical suturing forceps (e.g. Castroviejo) and move the needle through both wedges of the sclerotomy (Fig. 8.46). Check then the sclerotomy with the cotton swab. If it still leaks, remove the suture and make a new stitch. If you detect a vitreous strand, then remove it with the vitreous cutter.

Pits and Pearls No. 33

Suturing of Sclerotomy: I recommend that the beginner (for the first 20 vitrectomies) opens the conjunctiva focally at the area of the sclerotomy in order to clearly visualise the sclerotomy for the suture.

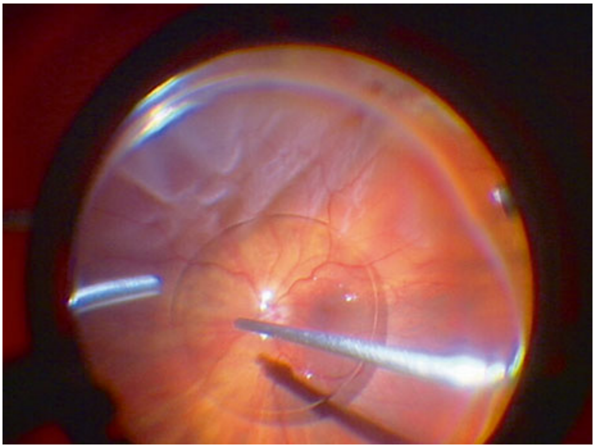


Fig. 8.43 Injection of PFCL with a backflush cannula. If you do not have the double-barreled cannula in stock, then use the backflush cannula. In this case you have to work bimanually. One hand injects the PFCL and the other hand holds a backflush instrument, which decompresses the eye

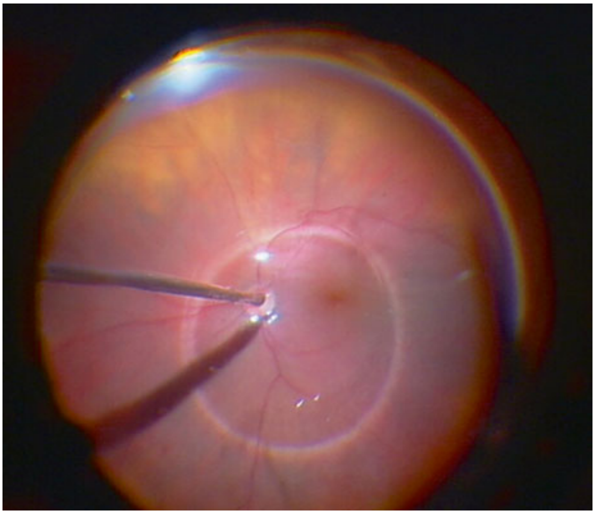


Fig. 8.44 Removal of PFCL. Hold the tip of the flute needle above the optic disc. Check 1 min after removal of the PFCL bubble if there is residual PFCL in the area of the optic disc

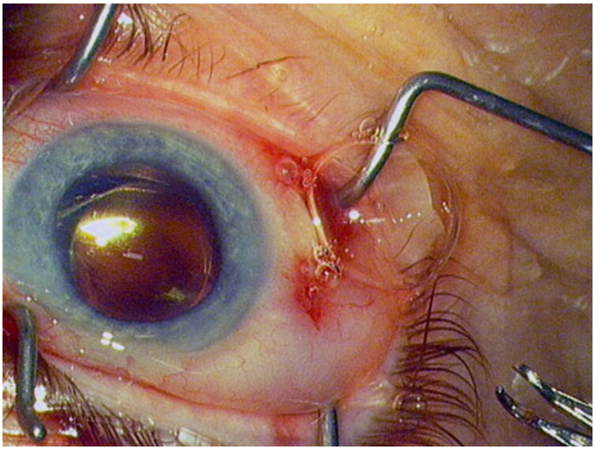


Fig. 8.45 Check the sclerotomies after removal of trocars. Is there a vitreous prolapse? Remove it with the vitreous cutter. Is there a leakage in form of an air bubble?

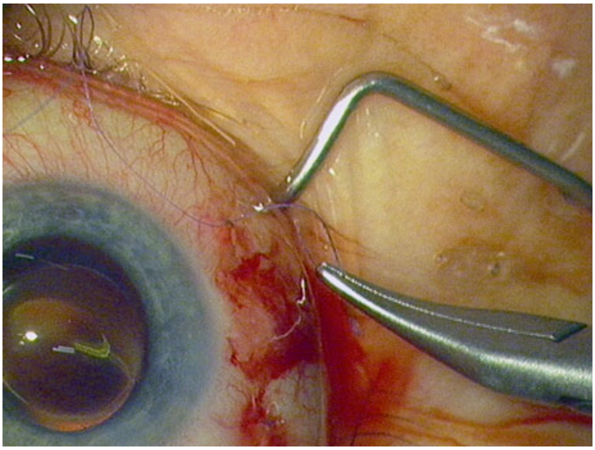


Fig. 8.46 In case of a leakage suture the sclerotomy with a Vicryl 8-0 interrupted stitch

Complication Management for Posterior Segment Cases

9

Contents

Electronic supplementary material Supplementary material is available in the online version of this chapter at http://dx.doi.org/10.1007/978-3-642-54449-1_9. Videos can also be accessed at http://www.springerimages.com/videos/978-3-642-54448-4.

U. Spandau, G. Scharioth, *Complications During and After Cataract Surgery*,
DOI 10.1007/978-3-642-54449-1_9,

9.1 Management of a Posteriorly Dislocated Nucleus (Dropped Nucleus)

Necessity of Surgery: If nuclear fragments drop, we always operate in order to prevent intraocular inflammation and hypertension. In case of dropped soft cortical fragments, we like to wait and do not operate if the eye remains quiet.

Timing of Surgery: A dropped nucleus is not an acute surgery. If the complete nucleus dropped, we would perform surgery within one week. If nuclear fragments drop, we would perform surgery within 1 month. The eye requires a dense follow-up until surgery.

Determine *preoperatively* with a maximally dilated pupil whether the anterior capsule is intact or not. If it is intact, implant a 3-piece IOL in the sulcus. If the anterior capsule is defective, implant an intrascleral-fixated or iris-fixated IOL.

The most difficult part of this surgery is the removal of the nucleus. There are two methods (Fig. 9.1). You can remove the nucleus with a fragmatome or lift the nucleus with PFCL to the pupillary plane and remove it there with a conventional phaco handpiece or the SICS technique. In soft to medium-hard nuclei, I recommend working with the fragmatome. If the nucleus is rock hard, I recommend the injection of PFCL and then phaco or extraction with the SICS method.

9.1.1 Extraction of a Posteriorly Dislocated Nucleus with Fragmatome

Video 9.35: Extraction of dropped nucleus with fragmatome

Video 9.36: Management of a dropped nucleus

Video 9.37: Subluxated nucleus and intrascleral IOL fixation

Do you know which tissue you can remove with a vitreous cutter and the fragmatome? This is an important knowledge for this case. With the vitreous cutter you can remove cortex, epinucleus, a soft nucleus and iris tissue (Figs. 9.2 and 9.3). You cannot remove a dense nucleus or a capsular fibrosis (Fig. 9.4). With the fragmatome (Fig. 9.5) you can remove a dense nucleus (Fig. 9.4). A rock hard nucleus is hard to remove by a fragmatome. The fragmatome is less powerful than a normal phaco handpiece. To remove such a nucleus, you need to perform phaco at the pupillary plane or a SICS.

Instruments

1. 4-port trocar system with chandelier light fibre
2. 120D lens
3. Fragmatome (Fig. 9.5)
4. 1.30-mm V-lance for 20-G sclerotomy (Fig. 9.6)

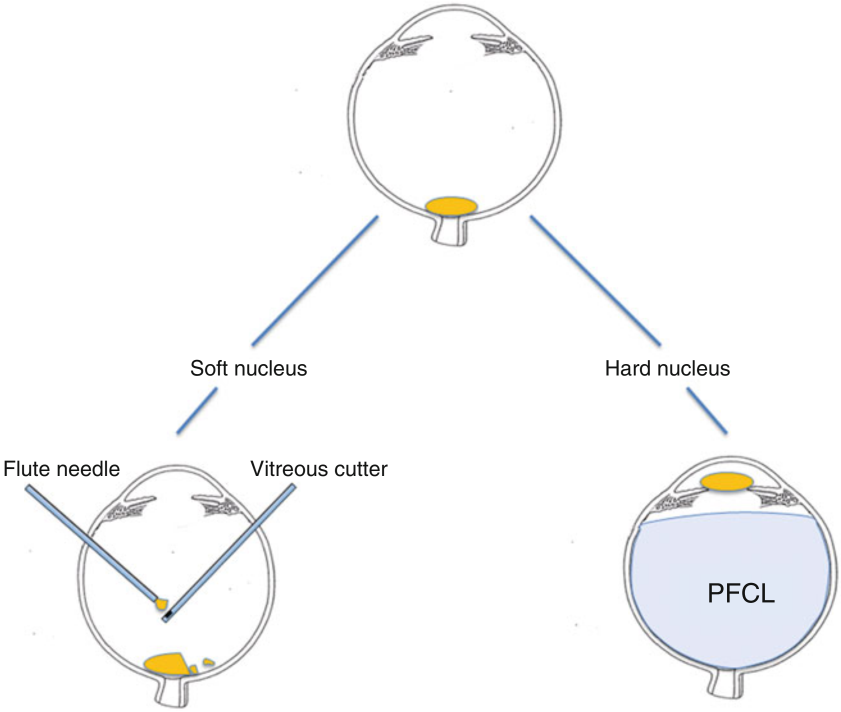


Fig. 9.1 Posterior dislocation of a nucleus. For removal two methods are possible: If the nucleus is not hard, then it can be removed with a vitreous cutter and fragmatome. The use of PFCL is not necessary. If the nucleus is hard or you have no fragmatome, then inject PFCL to lift up the nucleus. Lift the nucleus up to pupillary plane and perform a phaco or lift it up to the anterior chamber and perform an ICCE

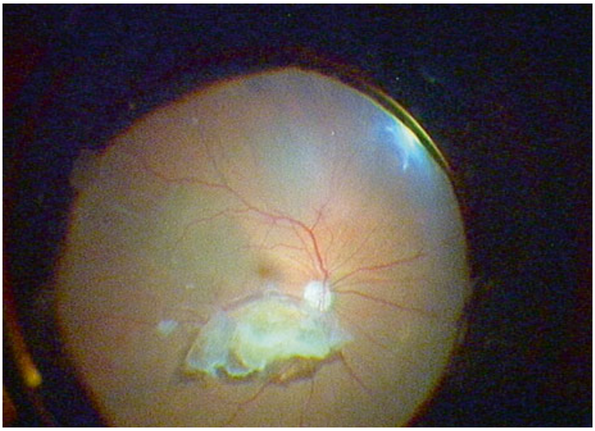


Fig. 9.2 This nuclear fragment is not hard. It can be removed by the vitreous cutter or the fragmatome

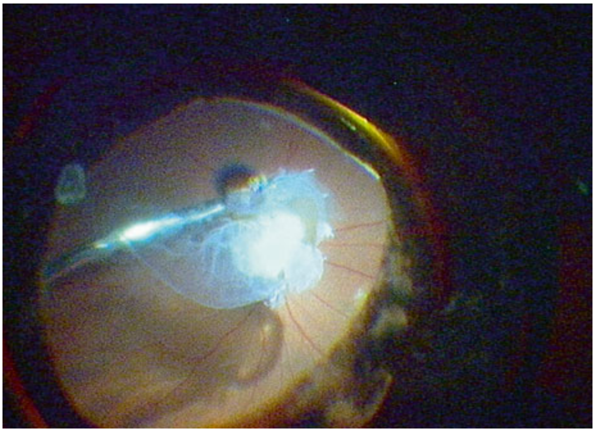


Fig. 9.3 The nuclear fragment is removed with the vitreous cutter

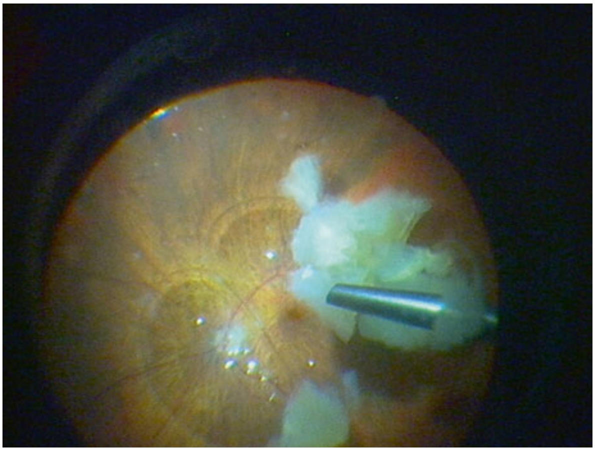


Fig. 9.4 This nuclear fragment is too hard for the vitreous cutter. It has to be removed with the fragmatome. PFCL was injected to protect the macula

Fig. 9.5 A fragmatome. The fragmatome is used without trocar but with a 20-G sclerotomy

Fig. 9.6 A 20-G sclerotomy blade. Indication: Sclerotomy for the fragmatome

Individual Steps

1. 4-port system with chandelier light fibre
2. 20-G sclerotomy at 9 o'clock
3. Anterior vitrectomy via pars plana
4. Removal of residual cortex from the lens capsule via paracentesis
5. Core vitrectomy
6. Phacoemulsification of the nucleus with fragmatome and flute needle
7. Implantation of an intraocular lens
8. Removal of trocar cannulas

The Operation Step by Step

1. 4-port system with chandelier light fibre
2. 20-G sclerotomy at 9 o'clock

   After insertion of three trocars, we insert a chandelier light fibre, because we work bimanually in step 6. Then open the conjunctiva at 9 o'clock in the area of the sclerotomy and perform a non-lamellar (perpendicular) 20-G sclerotomy with the V-lance. This sclerotomy is used for the fragmatome and closed as soon as the nucleus is removed, in order to avoid leakage from the sclerotomy.
3. Anterior vitrectomy via pars plana
4. Removal of residual cortex from the lens capsule via paracentesis
5. Core vitrectomy

The anterior vitreous is cut with the vitreous cutter via pars plana. Make circular movements with the vitreous cutter. The vitreous cutter port points down in order to avoid a damage of the lens capsule (Figs. 9.7, 9.8, 9.9, 9.10, 9.11, 9.12 and 9.13). Aspirate then the residual cortex with the vitreous cutter via a paracentesis. It is important that you switch the vitreous cutter to aspiration and not to cutting. Otherwise you risk destroying the anterior capsule. If the lens capsule is free from the cortex, continue with a core vitrectomy from pars plana.

6. Phacoemulsification of the nucleus with fragmatome and flute needle

   Soft lens material can be removed first with the vitreous cutter (approximately 400 cuts/min). For hard lens fragments, you can use the flute needle in your left hand and the fragmatome in the right hand. Aspirate the lens fragments with the flute needle and emulsify them in the central vitreous cavity with the fragmatome. This procedure is performed repeatedly until all the lens fragments are removed (Figs. 9.14, 9.15 and 9.16).

   If you perform this procedure without flute needle (only with the fragmatome), there is a risk that during the frequent aspiration of the lens fragments with the fragmatome, you may injure the retina (retinal break) or the choroid (choroidal haemorrhage). In addition, the frequent aspiration of the lens fragments clogs the vitreous cutter. If the suction is not working properly, the risk is increased to induce damage to the retina or choroid.
7. Implantation of the IOL

   If more than two third of the anterior capsule are intact, the lens is implanted into the sulcus ("haptic out, optic in") (Fig. 9.17). If not, fixate a lens to the sclera or to the iris (e.g., iris-fixated IOL).
8. Removing of infusion trocars

   The 20-G sclerotomy must be sutured with a Vicryl 6-0 interrupted stitch or a Vicryl 8-0 cross stitch.

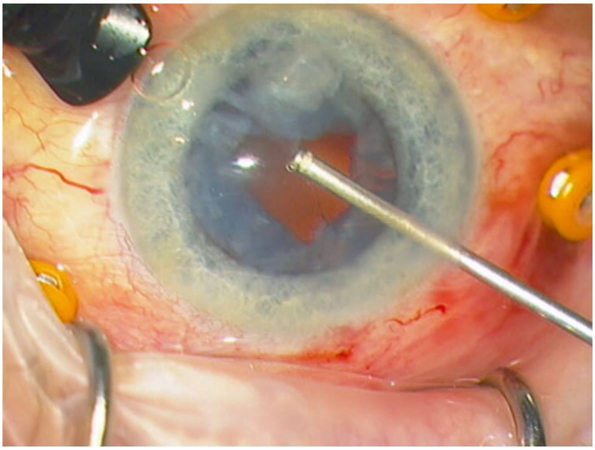


Fig. 9.7 Situation after complicated cataract surgery with dropped nucleus. Start with removal of the cortex

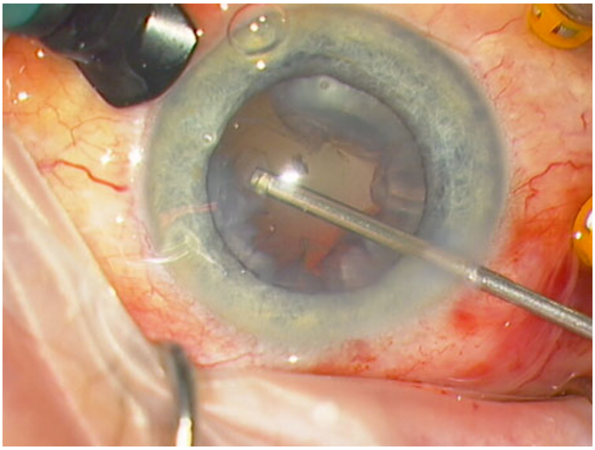


Fig. 9.8 Use the aspiration mode of the vitreous cutter for removal of the cortex

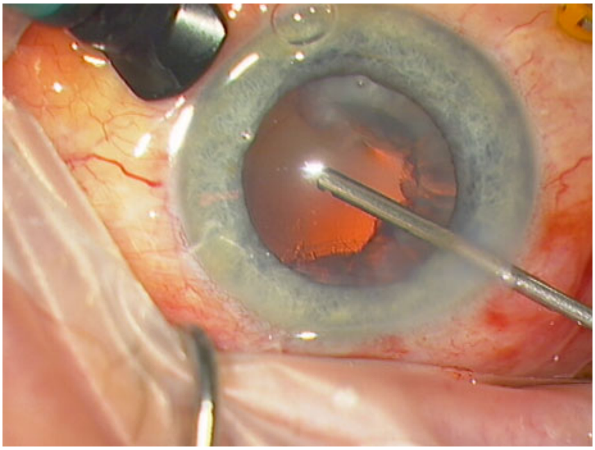


Fig. 9.9 And the cutting mode of the vitreous cutter for removal of the vitreous prolapse. Switch back and forth between aspiration of the cortex and cutting of the vitreous

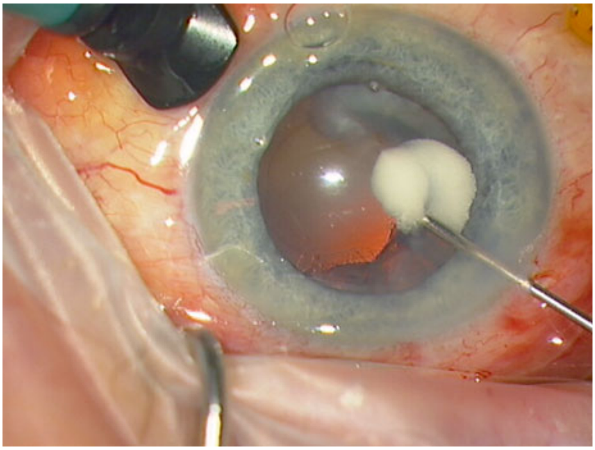


Fig. 9.10 Inject triamcinolone to stain the vitreous

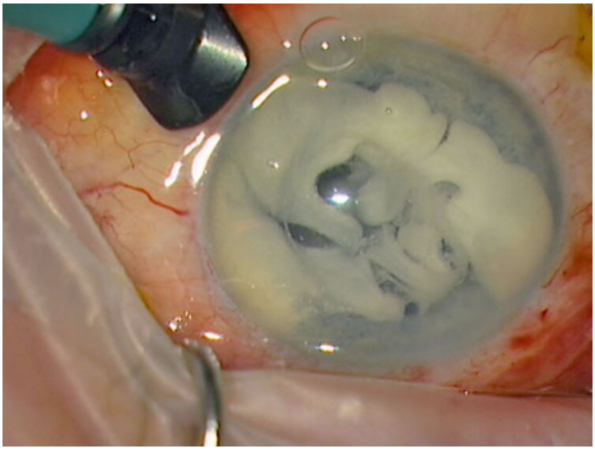


Fig. 9.11 Do not inject too much triamcinolone otherwise the view is obscured. In this case remove some triamcinolone by injecting BSS into the anterior chamber

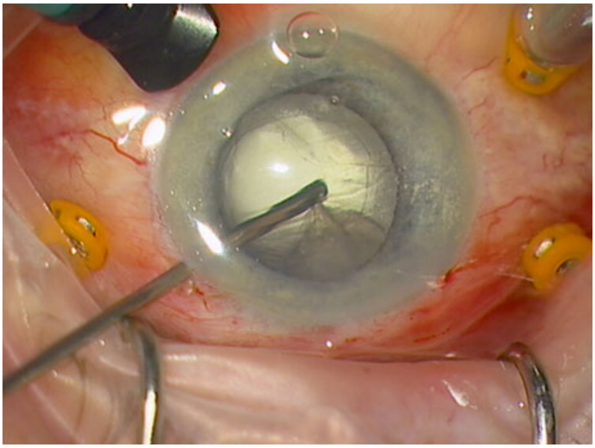


Fig. 9.12 This manoeuvre can also be performed from pars plana, the working angle from the limbus is however a bit better

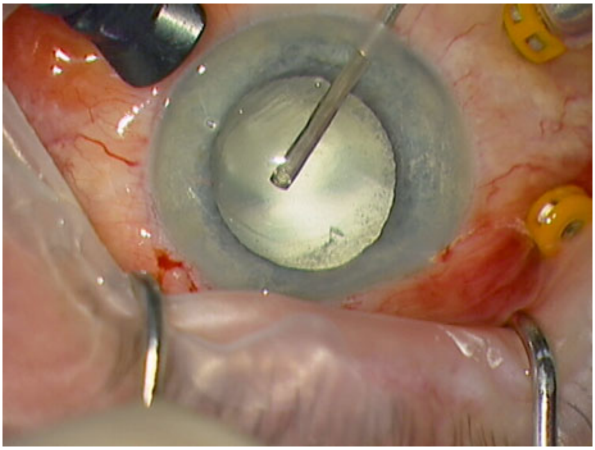


Fig. 9.13 The cortex is completely removed. You can now proceed with removal of the dropped nucleus

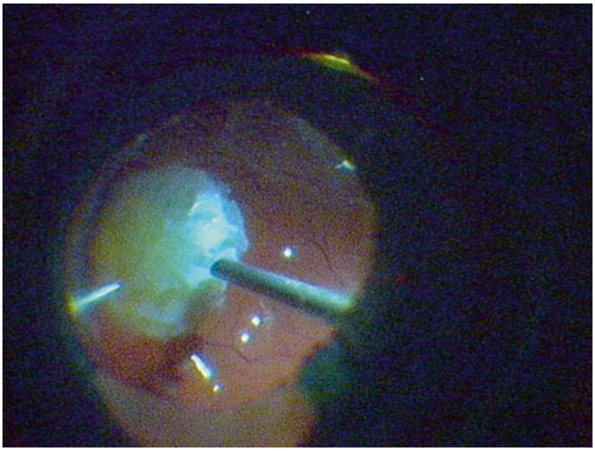


Fig. 9.14 Work bimanually. Lift the nucleus from the retina with the backflush instrument and emulsify it with the fragmatome (With courtesy of the Kaden Verlag)

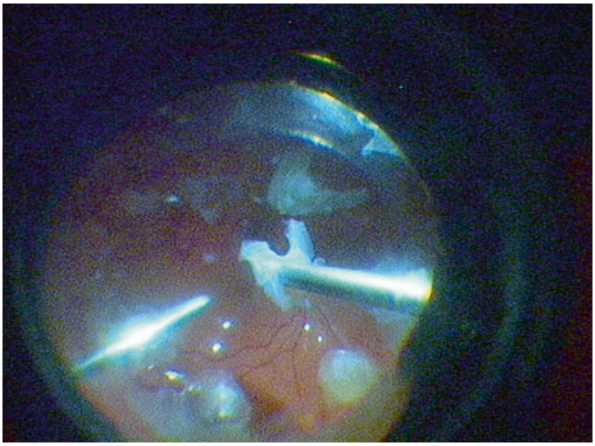


Fig. 9.15 The nucleus crumbles into many pieces. Every fragment must be picked up with the backflush instrument and removed with the fragmatome. The picking up of small fragments from the retina is a dangerous manoeuvre because the retina can be easily damaged (With courtesy of the Kaden Verlag)

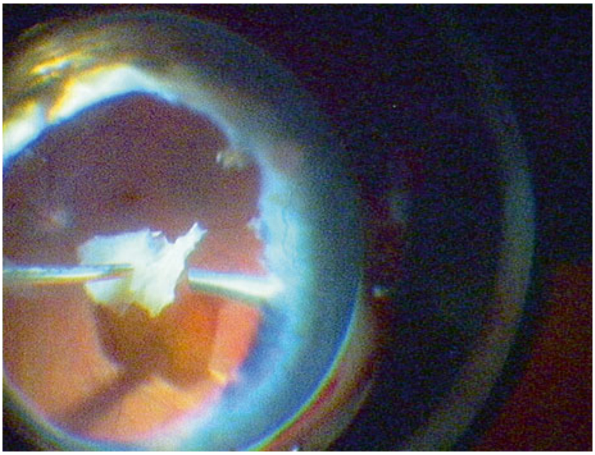


Fig. 9.16 Use therefore the backflush instrument and not the fragmatome to pick up the fragments from the retina (With courtesy of the Kaden Verlag)

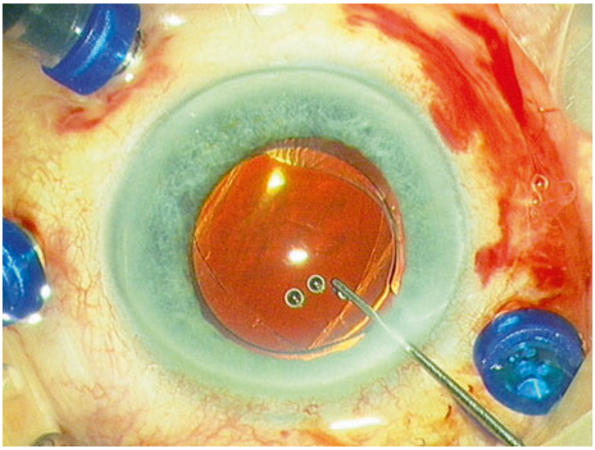


Fig. 9.17 Insert then the IOL in the sulcus and buttonhole the optic behind the rhexis (lens capture) (With courtesy of the Kaden Verlag)

9.1.2 Extraction of a Posteriorly Dislocated Nucleus with PFCL

Video 9.30: ICCE and iris-claw IOL

Video 9.38: Phaco nightmare and intrascleral fixation

Video 9.39: Extraction of dropped nucleus with ICCE

Instruments

1. 4-port trocar system
2. 120D lens
3. 15° blade
4. Crescent-angled bevel up knife
5. Tunnel knife, 2.4 mm
6. Double-barreled infusion cannula

Tamponade

Intraoperative: PFCL

Postoperative: None

Individual Steps

1. 3-port system
2. Vitrectomy
3. Injection of PFCL and dislocation of the nucleus to the pupillary plane
4. Phacoemulsification of the nucleus

   or
5. Extraction of the nucleus with the SICS method
6. Implantation of an intraocular lens
7. Removal of trocars

Operation Step by Step

1. 3-port trocar
2. Vitrectomy
3. Injection of PFCL and dislocation of the nucleus to the pupillary plane

   A 3-port system should be sufficient. The anterior vitreous is removed with the vitreous cutter via pars plana. Then the residual cortex is aspirated from the lens capsule with the vitreous cutter via a paracentesis. It is important that you switch the vitreous cutter to aspiration and not to cutting. Otherwise there is a risk of destroying the anterior capsule (Figs. 9.7, 9.8, 9.9, 9.10, 9.11, 9.12 and 9.13). If the lens capsule is free from the cortex, continue with vitrectomy from pars plana.

   Instill a PFCL bubble, if necessary luxate the nucleus with the flute instrument onto the PFCL bubble (Figs. 9.18 and 9.19). Then inject PFCL up to the sclerotomies; the nucleus is then pushed up to the level of the pupil (Fig. 9.20).

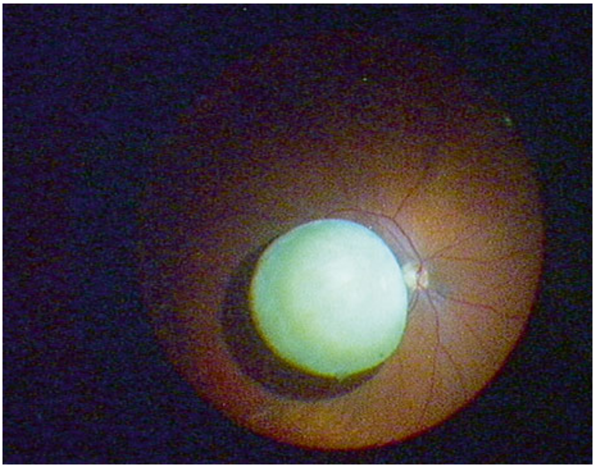


Fig. 9.18 A posteriorly dislocated nucleus since a trauma 20 years ago. The patient had no symptoms

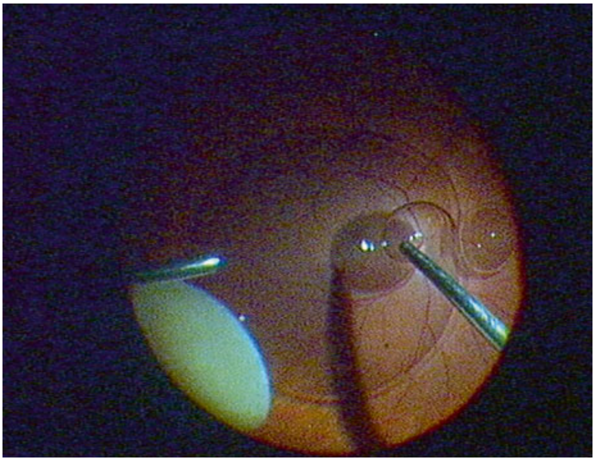


Fig. 9.19 Inject PFCL to lift up the nucleus

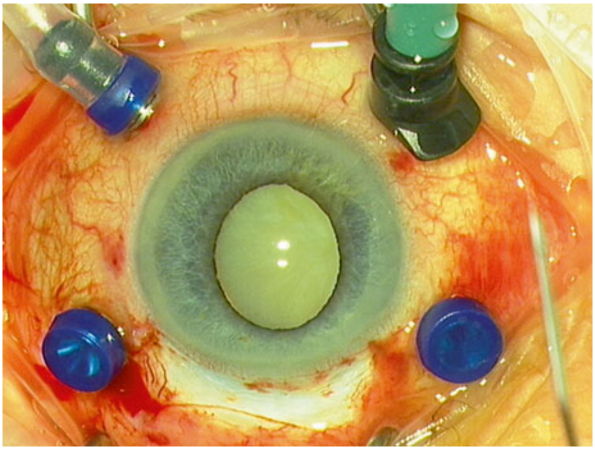


Fig. 9.20 The nucleus is located behind the pupil. You can either emulsify the nucleus now with a phaco-emulsification handpiece or proceed with a SICS (ICCE) (With courtesy of the Kaden Verlag)

4. Phacoemulsification of the nucleus

   Emulsify next the nucleus with a normal phaco handpiece. The disadvantage of this method is that the phacoemulsification disintegrates the nucleus into small pieces which may slide away on the PFCL bubble in the retinal periphery and must be retrieved from there. The viscoelastic in the pupil can help to hold the lens fragments in the pupil. The second disadvantage is an injury of the endothelium with the phaco energy, which may result in a decompensated cornea if you have a hard lens and a less advanced phaco handpiece.

   or

5. Extraction of the nucleus with the SICS method

   If the nucleus is too hard for the phaco, you can extract the nucleus faster and with a lower risk of complications in toto (Figs. 9.21 and 9.22). I recommend the so-called SICS technique (small-incision cataract surgery), which is a modified form of ECCE. In short, limbal peritomy from 11 to 1 o'clock with Vannas scissors, mark then with the caliper an 8-mm-wide frown incision, dissect the frown incision with a crescent bevel up knife, open the anterior chamber with a 2.4-mm tunnel knife. The next steps are the luxation of the nucleus into the anterior chamber, injection of viscoelastics below and above the nucleus and finally extraction of the nucleus with loop, fish hook or viscoelastics. The incision may be sutured with a Vicryl 8-0 cross stitch (for details see Sect. 4.6).
6. Implantation of the intraocular lens
7. Removal of trocars

   If more than two thirds of the anterior capsule are intact, the lens is implanted into the sulcus ("haptic out, optic in"). If not, fixate a lens to the sclera or to the iris (e.g. iris-fixated IOL) (Fig. 9.23).

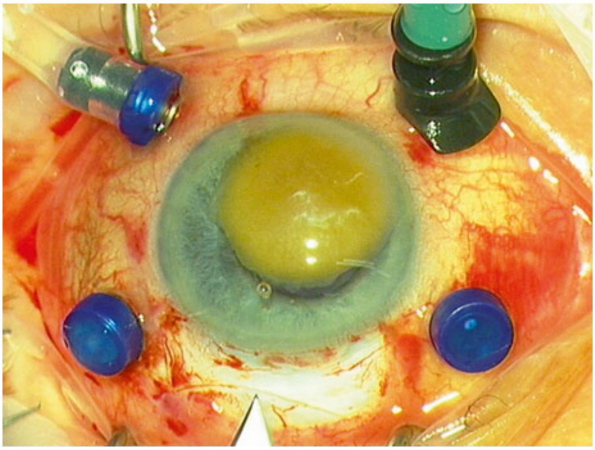


Fig. 9.21 Luxate the nucleus into the anterior chamber. Do not emulsify the nucleus in the anterior chamber in order to avoid endothelial damage (With courtesy of the Kaden Verlag)

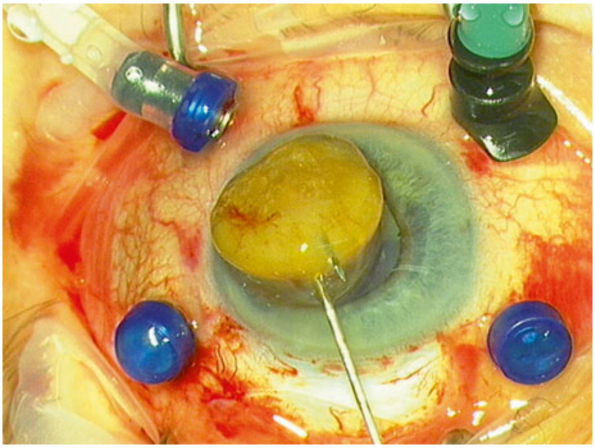


Fig. 9.22 Remove the nucleus with a fish hook through the frown incision at 12 o'clock (With courtesy of the Kaden Verlag)

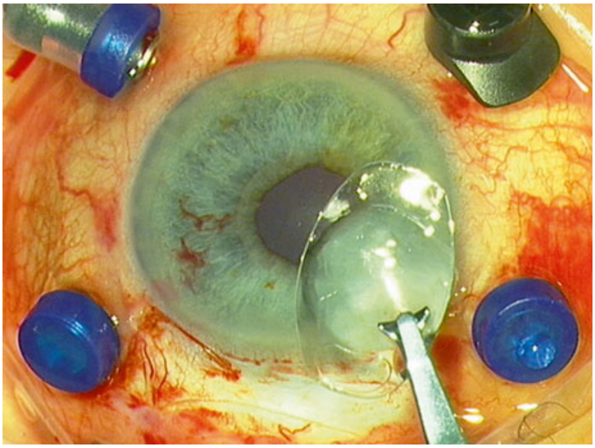


Fig. 9.23 Implant an iris or scleral-fixated IOL (With courtesy of the Kaden Verlag)

9.2 Management of a Posteriorly Dislocated Bag-IOL Complex

A (sub)luxation of the lens with capsular bag (Fig. 9.24) occurs with increasing frequency. There are several options to perform this surgery.

1. Removal of bag-IOL complex and secondary IOL implantation (iris-fixated or intrascleral-fixated IOL (Scharioth technique))
2. Removal of lens capsule within the vitreous cavity and scleral or intrascleral fixation of IOL
3. Scleral fixation of bag-IOL complex (Hoffmann technique)

In the first technique, one removes the IOL with capsular bag and implants an iris-fixated IOL. This technique requires a short operation time (30–45 min); the disadvantage is the large, astigmatism inducing main incision. It is thus advisable to perform a sclerocorneal main incision (see also Sect. 4.6). If you implant a foldable 3-piece IOL with Scharioth technique, you require a smaller main incision (45–60 min).

In the second technique, only the capsular bag is removed and the IOL is fixated in the sulcus. The second technique is time consuming (90 min) because the capsular bag must be removed inside the vitreous cavity. But it requires no main incision and the patient maintains the same intraocular lens. One drawback is that sometimes a lens tilt occurs. This disadvantage can be avoided, if one applies the Scharioth method in which the haptics are fixated in a scleral tunnel (see also Sect. 5.2).

The third technique is technically difficult because there is no support of the IOL behind the pupillary plane due to lack of vitreous.

These surgeries may well be performed under local anaesthesia. We prefer 25-gauge vitrectomy because aphakic eyes tend to have a postoperative hypotony.

9.2.1 IOL Extraction and Implantation of an Iris-Fixated IOL

Videos 9.14, 9.15, 9.16, and 9.31: IOL extraction and implantation of an iris-claw IOL

(Remark: We do not have a video fitting exactly to the described surgical method. But all three videos describe a part of the surgery.)

The main complication of this surgery is a choroidal detachment due to the large main incision. We recommend 25-G trocars due to the advantage of an improved wound closure and subsequently less postoperative hypotension. The latter occurs more frequently in aphakic patients, because the iris-lens diaphragm is missing. The second part of this operation is identical to Sect. 4.8.

Instruments

1. 3-port trocar system
2. 120D lens
3. Vitrector
4. Serrated jaws forceps (Fig. 8.18)
5. Iris-claw IOL and implantation instruments (Fig. 5.1)
6. Marking caliper (Fig. 2.21)
7. 15° knife (Fig. 2.5)
8. Crescent-angled bevel up knife (Fig. 2.7)
9. 2.4-mm main incision knife (Fig. 2.6)

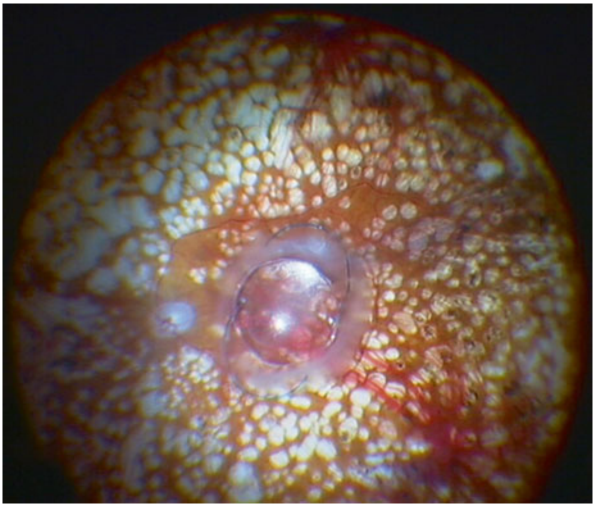


Fig. 9.24 A posteriorly luxated bag-IOL complex in a vitrectomised eye

Individual Steps

1. Insertion of trocars
2. Paracentesis at 3 and 9 o'clock
3. Limbal peritomy and sclerocorneal incision at 12 o'clock
4. Vitrectomy
5. Extraction of the IOL with capsular bag
6. Injection of Miochol
7. Implantation of an iris-fixated IOL
8. Close the conjunctiva, removal of the trocars

Operation Step by Step

1. Insertion of trocars
2. Paracentesis at 3 and 9 o'clock
3. Limbal peritomy and sclerocorneal incision at 12 o'clock

   Perform a paracentesis and inject viscoelastic into the anterior chamber. Perform a limbal peritomy from 11 to 1 o'clock with Vannas scissors and if necessary cauterise the bleeding vessels. Mark a 6-mm broad incision with the caliper. Perform a 6-mm-wide limbus-parallel sclerocorneal incision with a 15° knife (Figs. 9.25, 9.26 and 9.27). The limbal incision should start 1–1.5 mm behind the limbus. Dissect a scleral flap with the crescent bevel up knife.
4. Vitrectomy
5. Extraction of the IOL with capsular bag

   If necessary perform first a vitrectomy in order to reach the IOL.

   It is not easy to grasp the IOL monomanually because you need to lift the IOL first a little bit up in order to grasp it. In addition the IOL is normally located at the posterior pole so that a retinal damage may have severe consequences. The manoeuvre is quite easy when performed bimanually. Insert a chandelier light. Then take a backflush instrument in your left hand and an intravitreal forceps in your right hand. Aspirate the IOL optic with the backflush instrument and lift it a little bit up. Then grasp the IOL with the forceps and luxate it through the pupil. An alternative is of course the use of PFCL. If you work with PFCL, you can work monomanually. Inject a PFCL bubble so that the bubble lifts the IOL up. Then grasp the IOL with the intravitreal forceps.

   Lift the IOL up to the pupillary plane and then with the help of a second instrument, e.g. vitreous cutter, luxate the IOL into the anterior chamber (Fig. 9.28). This manoeuvre is a bit tricky and a few attempts may be necessary. The IOL can be easily removed from the anterior chamber with the serrated jaws forceps (Fig. 9.29). The infusion is closed during removal of the IOL from the anterior chamber. Inspect then the periphery for retinal holes; a full vitrectomy is not necessary.
6. Injection of Miochol
7. Implantation of an iris-fixated IOL

   Before implantation of an iris-claw IOL, the pupil must be constricted. Inject Miochol. The iris-claw IOL can be implanted in the anterior chamber or retropupillar (Fig. 9.30). For details see Sect. 5.1.
8. Close the conjunctiva, removal of the trocars

   Close the limbus-parallel incision with Ethilon 10-0. Cefuroxime (e.g. Zinacef) is recommended for intracameral endophthalmitis prophylaxis.

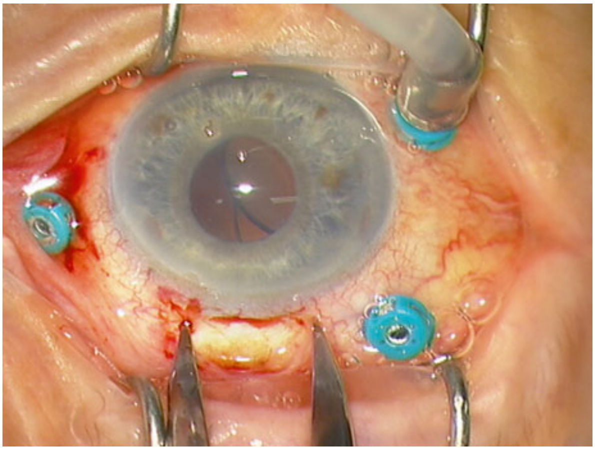


Fig. 9.25 Perform a limbal peritomy from 11 to 1 o'clock and mark a 6-mm broad main incision with the caliper

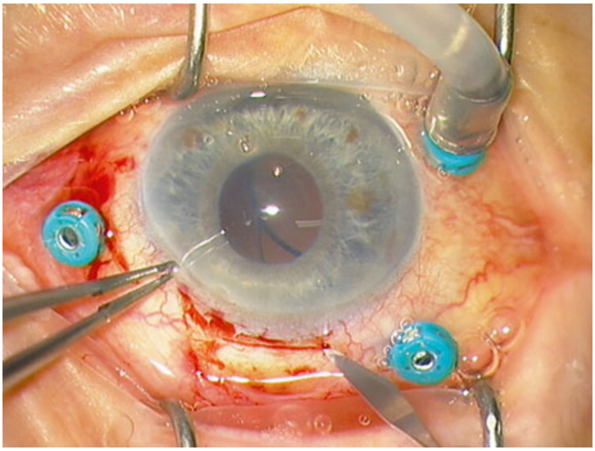


Fig. 9.26 Perform a 50 % scleral thickness horizontal incision with the 15° knife

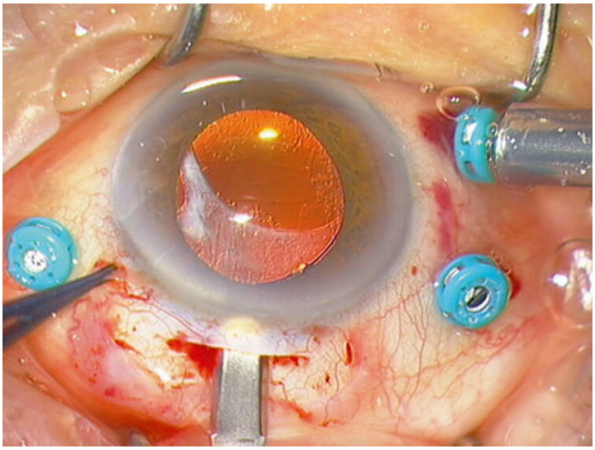


Fig. 9.27 Dissect a scleral flap with a crescent knife and then open the anterior chamber with a 2.4-mm blade

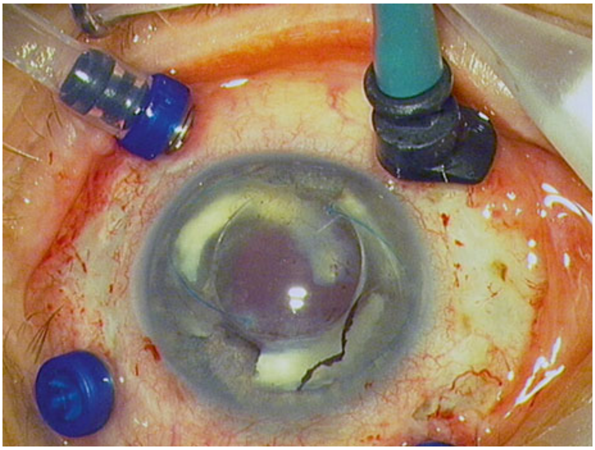


Fig. 9.28 Perform a vitrectomy if necessary. Grasp the luxated IOL with an intravitreal forceps (i.e. serrated) and luxate in into the anterior chamber

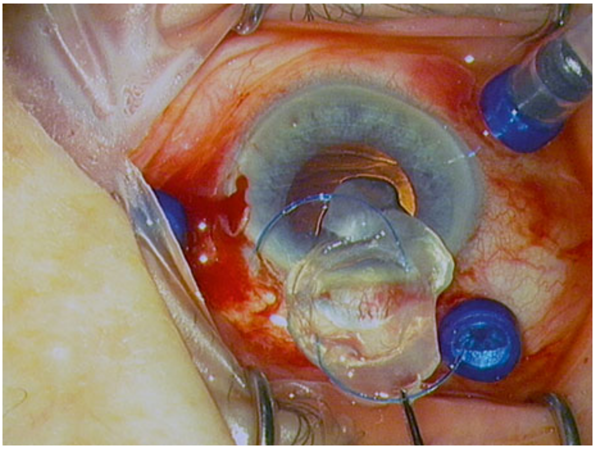


Fig. 9.29 Extract the IOL with the serrated jaws forceps

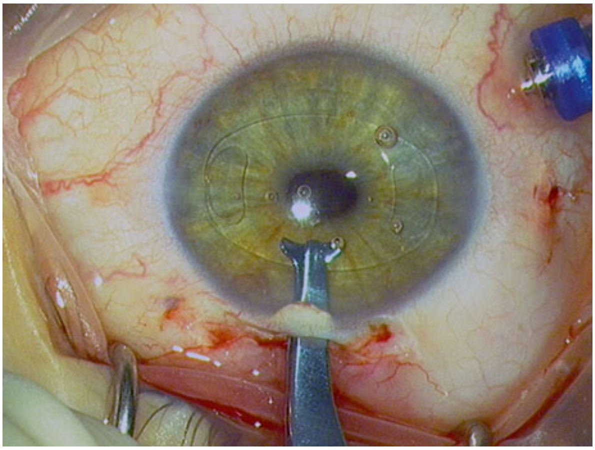


Fig. 9.30 Implant an iris or scleral-fixated IOL

9.2.2 Scleral and Intrascleral Fixation of the Dislocated IOL

Video 9.20: Scleral fixation of a luxated IOL

Video 9.21: Scleral fixation of IOL

Video 9.40: Hyphaema after complicated cataract surgery

Video 9.41: Luxated IOL and intrascleral fixation of IOL

Most eyes with a posterior dislocated IOL are vitrectomised (Fig. 9.31). The most tedious part of this surgery is the removal of the capsular bag from the IOL (Figs. 9.32 and 9.33). This procedure is performed inside the vitreous cavity. After removal of the capsular bag, the IOL has to be fixated. In case of a 3-piece IOL, you can perform an intrascleral or scleral fixation (see Sect. 5.3). In case of a 1-piece IOL, you can only perform a scleral fixation. The main postoperative complications are vitreous bleeding from the ciliary body and IOL tilt.

Sutures for Scleral-Fixated IOL

1. Two curved needles. Alcon. Polypropylene, blue monofilament, double armed. 8065307601

   Indication: Scleral fixation of a dislocated IOL

   or
2. One straight needle, one curved needle. Alcon. Polypropylene, blue monofilament, double armed. 8065304901

   Indication: Secondary implantation and scleral fixation of an IOL secondary to aphakia

Instruments

1. 23-G or 25-G 3-port trocar with chandelier light
2. 120D lens
3. 2x intravitreal forceps, e.g. serrated jaws forceps (Fig. 8.18)
4. Polypropylene 10-0 suture with curved needle (i.e. Alcon. Polypropylene, blue monofilament, double armed. 8065307601)

Individual Steps

1. 3-port trocar with chandelier light
2. Focal peritomy at 3 and 9 o'clock
3. Core vitrectomy
4. Removal of capsular bag
5. Two sclerotomies (1.5 mm posterior to the limbus) at 3 and 9 o'clock
6. Extraction of a haptic at 3 o'clock, place a suture onto the haptic and push it back into the eye; the same procedure at 9 o'clock.
7. Suture the haptic suture in a snake shape to the sclera
8. Close the conjunctiva, removal of the trocars

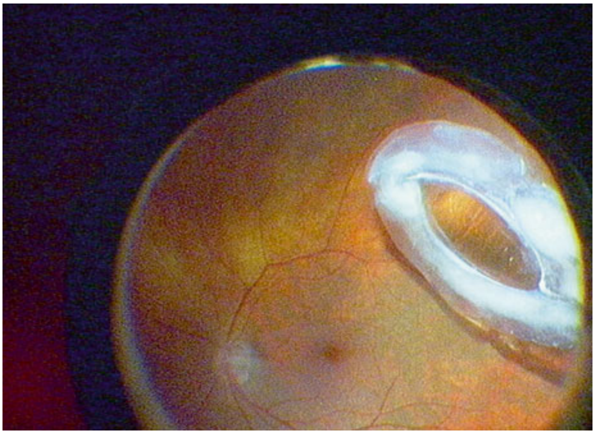


Fig. 9.31 A posteriorly dislocated bag-IOL complex (With courtesy of the Kaden Verlag)

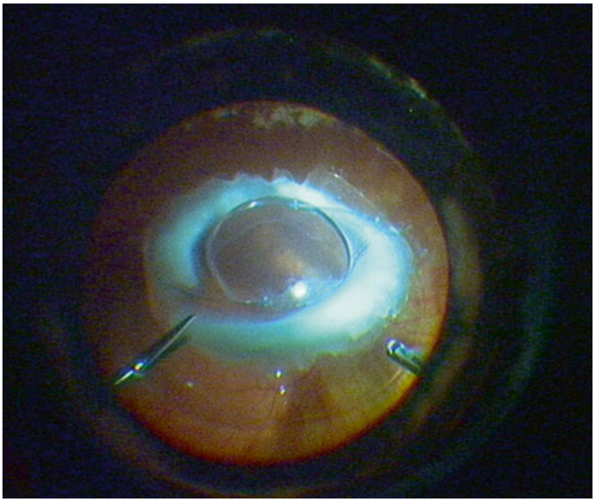


Fig. 9.32 Fixate the IOL with a serrated jaws forceps and cut the fibrotic capsule with the vitreous cutter (With courtesy of the Kaden Verlag)

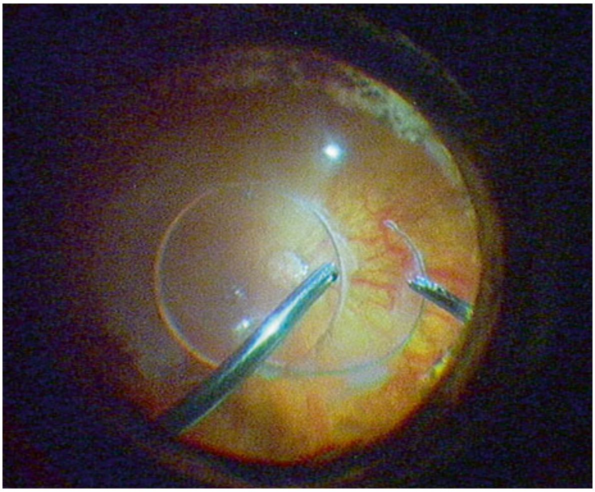


Fig. 9.33 Be cautious with the haptics, the vitreous cutter can damage them (With courtesy of the Kaden Verlag)

Operation Step by Step

1. 3-port trocar with chandelier light
2. Focal peritomy at 3 and 9 o'clock

   Open the conjunctiva at 3 and 9 o'clock to make space for one sclerotomy and a scleral suture, i.e. approximately from 2 to 4 o'clock and from 8 to 10 o'clock. Then cauterise the bleeding vessels. Insert the trocars and the chandelier light as usual for the 4-port trocar system.
3. Core vitrectomy
4. Removal of capsular bag

   First vitrectomise the central vitreous. You may inject PFCL in order to protect the macula from the haptics (Fig. 9.32). Hold the IOL with an intravitreal forceps and remove the capsular bag with the vitreous cutter (Fig. 9.33). Do not come too close to the haptic; the vitreous cutter can damage it!
5. Two sclerotomies (1.5 mm posterior to the limbus) at 3 and 9 o'clock
6. Extraction of a haptic at 3 o'clock, place a suture onto the haptic and push it back into the eye; the same procedure at 9 o'clock.

   In case of a 3-piece IOL, fasten the suture in the middle of the haptic, and in case of a 1-piece IOL, at the end of the haptic (Fig. 9.34).

   After you externalised both haptics (Fig. 9.35), you can either suture the haptics to the sclera (Fig. 9.36, see Sect. 5.3) or perform an intrascleral implantation (Scharioth technique, see Sect. 5.2).

9.3 Summary

Use trocars with valves. They are much easier to use. The infusion is always switched on, if you work in the posterior chamber. The infusion is always switched off, if you work in the anterior chamber.

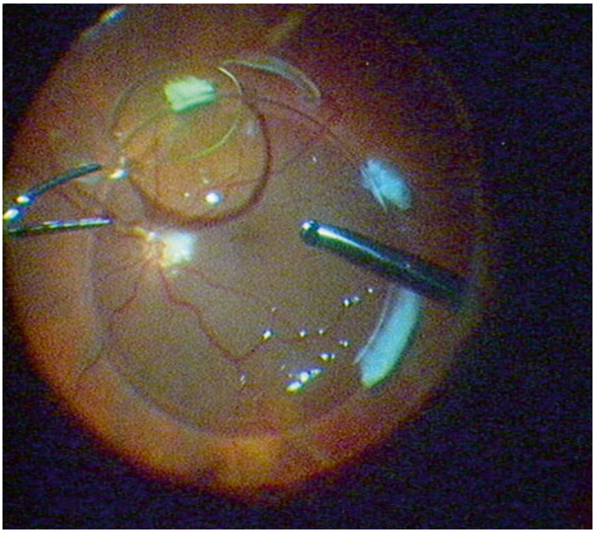


Fig. 9.34 Even a 1-piece IOL can be scleral fixated, the intrascleral fixation (Scharioth technique) is however not possible with a 1-piece IOL (With courtesy of the Kaden Verlag)

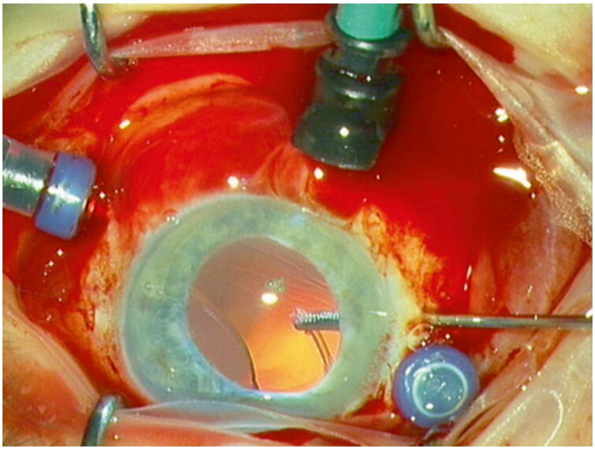


Fig. 9.35 Perform a focal peritomy at 3 and 9 o'clock. Perform then a sclerotomy 1.5 mm behind the limbus with the V-lance (With courtesy of the Kaden Verlag)

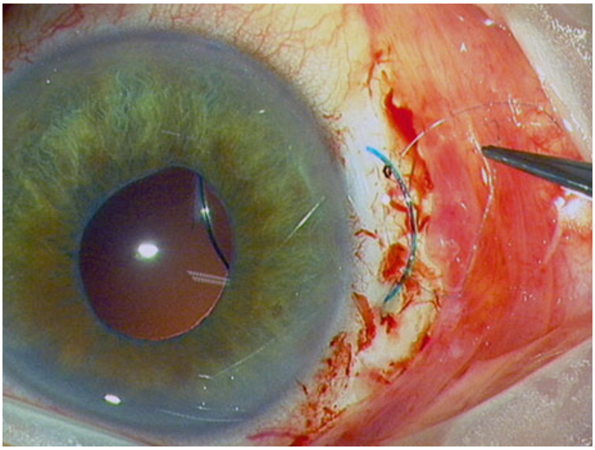


Fig. 9.36 Insert the intravitreal forceps through the sclerotomy, grasp the tip of the haptic and pull it through the sclerotomy (With courtesy of the Kaden Verlag)

Surgical Pearls

10

Contents

Electronic supplementary material Supplementary material is available in the online version of this chapter at http://dx.doi.org/10.1007/978-3-642-54449-1_10. Videos can also be accessed at http://www.springerimages.com/videos/978-3-642-54448-4.

U. Spandau, G. Scharioth, *Complications During and After Cataract Surgery*,
DOI 10.1007/978-3-642-54449-1_10,

10.1 Intraocular Lens Exchange

Video 10.42: IOL exchange

Instruments

1. 15° paracentesis knife
2. 2.4-mm tunnel incision knife
3. Maybe: Iris spatula (Fig. 4.115)
4. Push-pull instrument or Kuglen hook (Figs. 10.1 and 10.2)
5. Capsulotomy scissors (Fig. 10.3)

Individual Steps

1. Paracentesis
2. Injection of viscoelastic in capsular bag
3. Mobilisation of IOL
4. Rotation of IOL on iris
5. Cutting of IOL
6. Extraction of IOL
7. Implantation of IOL

The Operation Step by Step

1. Paracentesis
2. Injection of viscoelastic in capsular bag
3. Mobilisation of IOL
   Begin with a paracentesis at 10 and 2 o'clock and a main incision at 9 o'clock. Inject viscoelastic into the anterior chamber. Then inject viscoelastic between the anterior capsule and the IOL. This has to be done 360° (Figs. 10.4 and 10.5). Try cautiously to loosen the haptic with a push-pull manipulator or an iris spatula (Fig. 10.6). This manoeuvre is difficult at the haptics.
4. Rotation of IOL on iris
5. Cutting of IOL
   If the IOL is mobilised then rotate it outside the capsular bag (Fig. 10.7). Then luxate it with a rotational movement onto the iris (Fig. 10.8). The next step is the cutting of the IOL (Figs. 10.9, 10.10, and 10.11). Do not cut the IOL completely; leave 1–2 mm at the edge. Important regarding the cutting is that you begin to cut LEFT to the haptic (not right) (Fig. 10.10). From there you cut the optic into two halves but leave 1–2 mm at the end.
6. Extraction of IOL
7. Implantation of IOL
   Draw the haptic through the main incision and then extract the first half of the optic, the second half of the optic follows automatically (Figs. 10.12, 10.13, and 10.14). Implant finally the IOL and inject cefuroxime as endophthalmitis prophylaxis (Fig. 10.15).

Fig. 10.1 A push-pull instrument. Indication: Manipulator of nucleus, iris and IOL (Geuder 16175)

Fig. 10.2 The tip of the push-pull instrument. Very useful to rotate an IOL

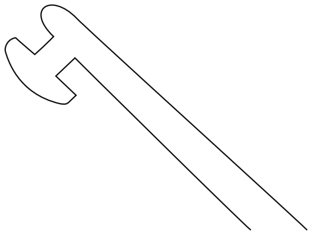
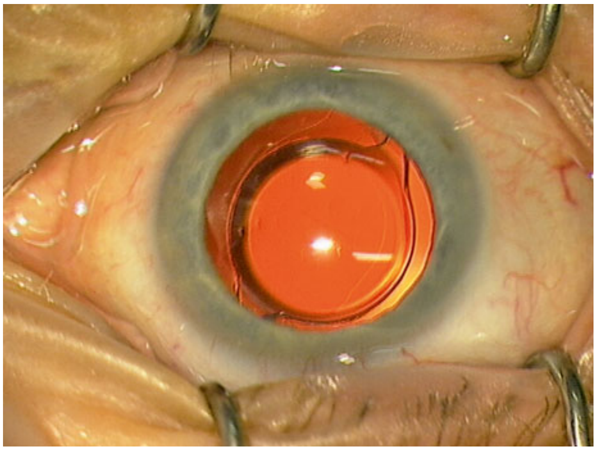


Fig. 10.3 Capsulotomy scissors. Indication: Cutting of an IOL (Geuder 19776)

Fig. 10.4 Preoperative status. A highly myopic patient, who was dissatisfied with his postoperative refraction of +1.0D



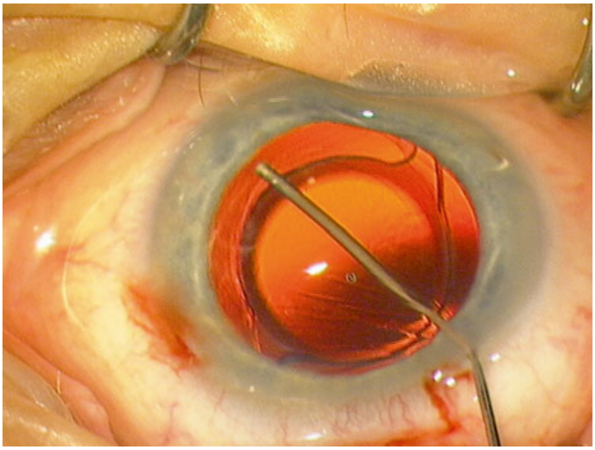


Fig. 10.5 Place the tip of the viscoelastic cannula between the anterior lens capsule and the IOL and inject viscoelastics in order to inflate the lens capsule

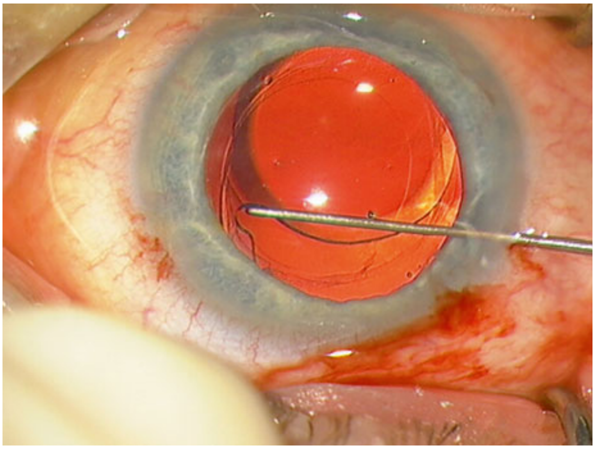


Fig. 10.6 Separate also the haptic from the lens capsule

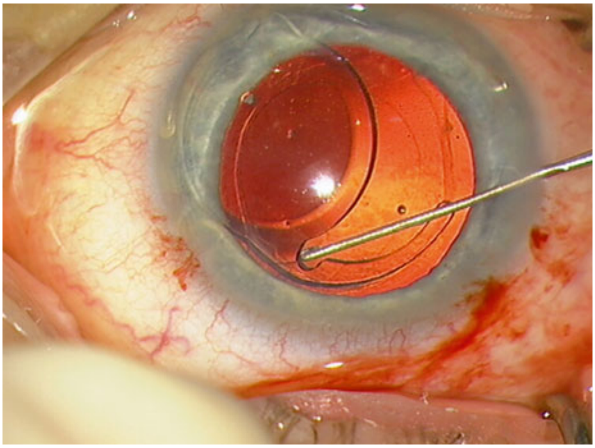


Fig. 10.7 Rotate the IOL out of the capsular bag with the help of the push pull. Inject viscoelastics behind the IOL to avoid a posterior capsular defect

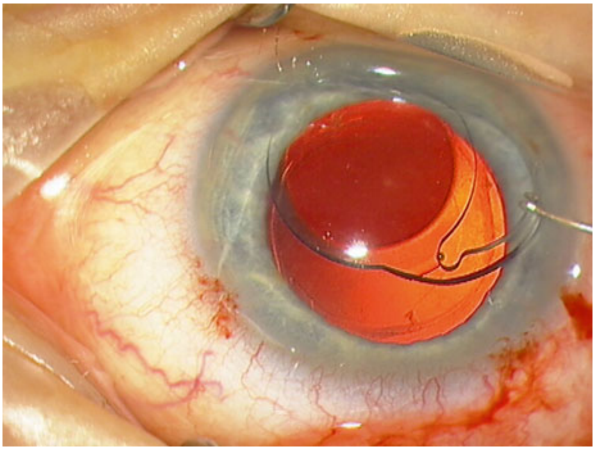


Fig. 10.8 Rotate a haptic towards the main incision

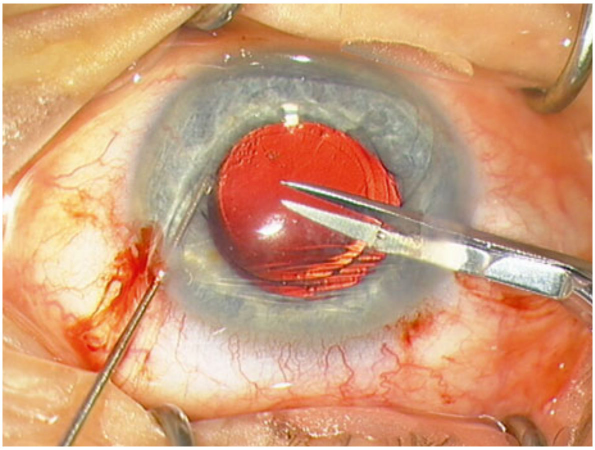


Fig. 10.9 Cut the IOL with the capsulotomy scissors

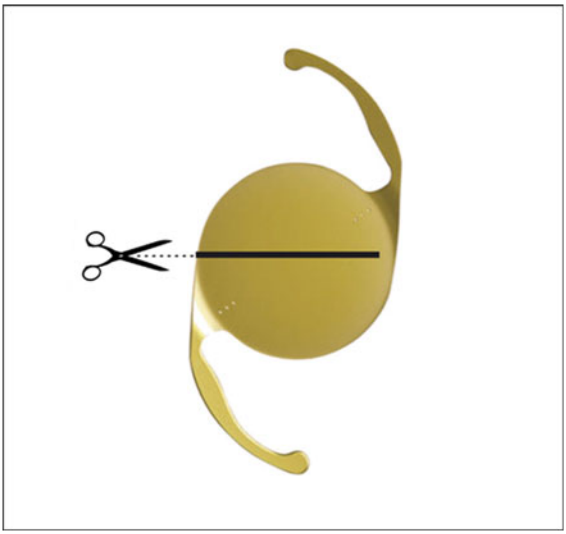


Fig. 10.10 Drawing how the IOL has to be cut. It is important to start the cutting on the left side (and not the right side) of the haptic

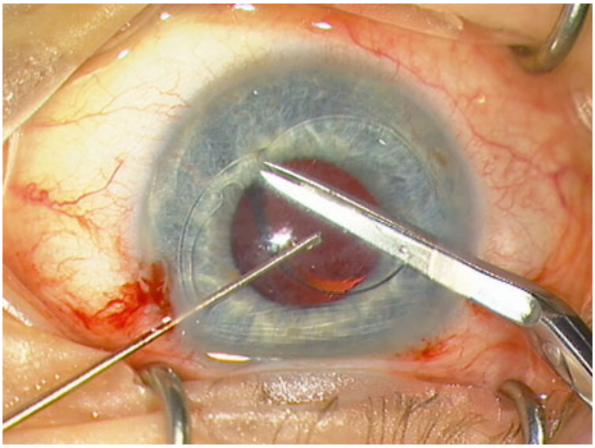


Fig. 10.11 If necessary stabilise the IOL to avoid a damage of the endothelium

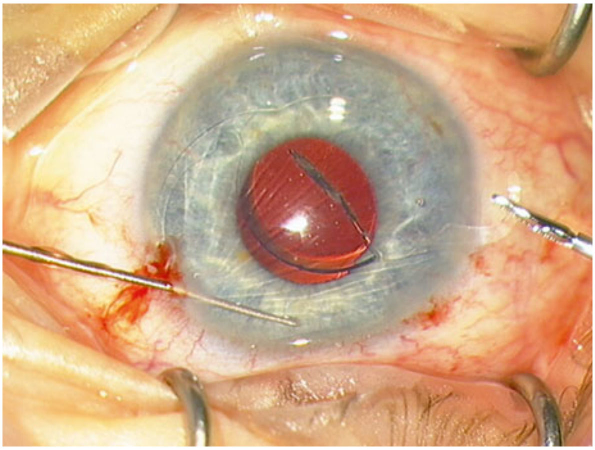


Fig. 10.12 Cut only 90 % of the IOL. Then grasp the haptic with a surgical forceps

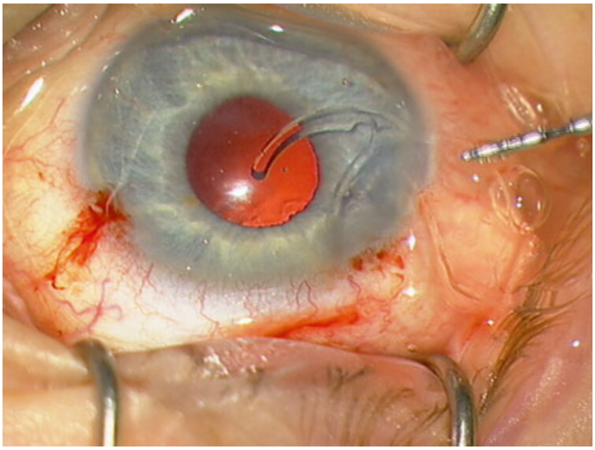


Fig. 10.13 Extract the first half of the IOL

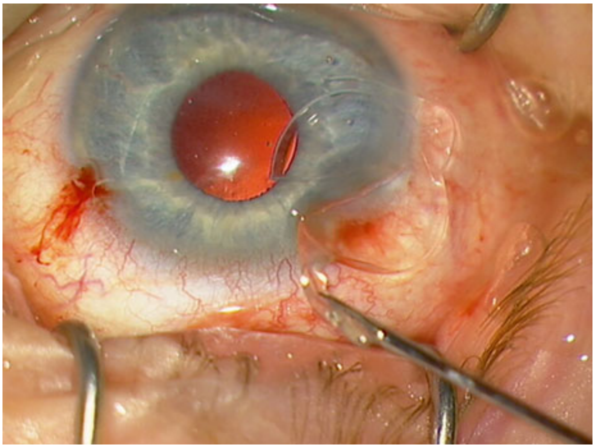


Fig. 10.14 Then extract the second half of the IOL

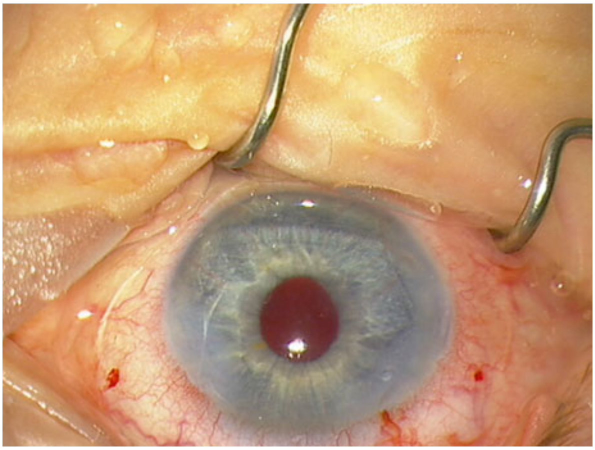


Fig. 10.15 Implant the new IOL into the bag

10.2 Extraction of an Acrylic IOL Through IOL Refolding

Video 10.43: IOL refolding

There are many reasons why an intraocular lens needs to be explanted, e.g. damaged IOL or haptic after implantation, wrong IOL power, late optic calcification or other opacities. PMMA IOL explantation requires large incision, but foldable IOL could be removed through small incision. For acrylic IOL intraocular refolding is a good technique. Surgery lasts about 10–15 min and is performed in topical, local or general anaesthesia.

Instruments
1. OVD
2. 15° knife
3. 3.0–3.2 mm phaco knife
4. Sinskey hook (Fig. 2.14)
5. Iris spatula (Fig. 2.16)
6. IOL implantation forceps (e.g. Geuder 31962)

Individual Steps
1. Creating main incision and injection of OVD.
2. Two side-port incisions 80–90° from main incision.
3. Small side-port incision exactly 180° to main incision.
4. Mobilisation of IOL.
5. Placing iris spatula under IOL and IOL implantation forceps over IOL optic.
6. Refolding of IOL.
7. Explantation of IOL.
8. Remove OVD and suture main incision if needed.

The Operation Step by Step
1. Creating main incision and injection of OVD.
2. Two side-port incisions 80–90° from main incision.
3. Small side-port incision exactly 180° to main incision.
   After creating the main incision anterior chamber is filled with OVD. Then two side-port incisions are created 80–90° away from main incision. An additional small side-port incision is created opposite to the main incision exactly at 180°.
4. Mobilisation of IOL.
5. Placing iris spatula under IOL and IOL implantation forceps over IOL optic.
6. Refolding of IOL.
7. Explantation of IOL.
   IOL is gently mobilised from capsular bag. Sometimes this requires additional injection of OVD between the anterior and posterior capsule. Then place some additional OVD behind the IOL optic. Iris spatula is introduced through the opposite side-port incision and placed behind the IOL. The implantation forceps is positioned on top of the IOL, and both instruments are pressed against each other (Fig. 10.16). The IOL starts to refold. After complete folding (Fig. 10.17),

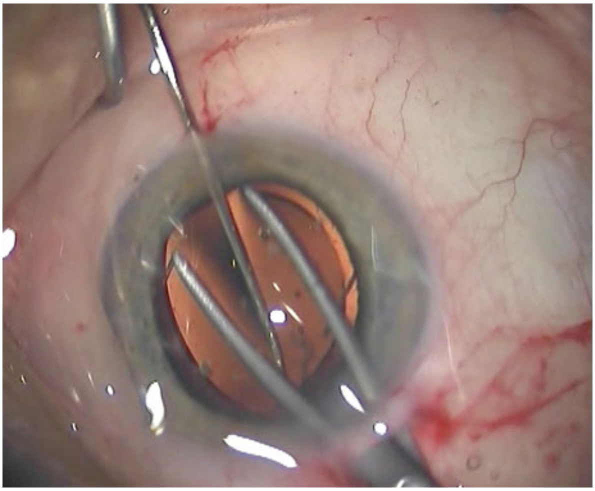


Fig. 10.16 Iris spatula is placed behind the IOL optic and IOL implantation forceps is placed on top of the IOL; note both instruments are inserted from opposite incisions

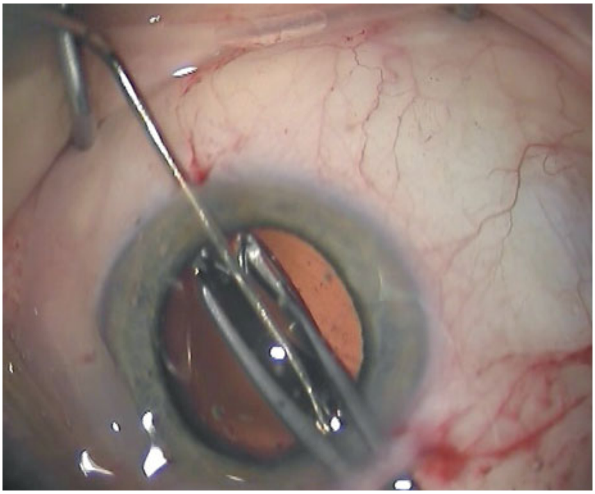


Fig. 10.17 IOL is intraocular refolded with pressure and counter pressure of both instruments

the forceps is released a bit to reduce friction and the spatula is removed (Fig. 10.18). Now implantation forceps is pressed again to fold the IOL completely. While turning the folded IOL 90°, it is explanted. It is important to ensure that anterior chamber stays deep and that is sufficiently filled with OVD to prevent contact to corneal endothelium while IOL is refolded and explanted. Explantation might need some pulling forces as the main incision is relatively tight for a refolded IOL with 6-mm optic diameter. If indicated now a new IOL is implanted.

8. Remove OVD and suture main incision if needed.
   Finally OVD is removed from the anterior chamber, and incisions are hydrated and checked for leakage. They can be sutured if needed with 10/0 nylon.

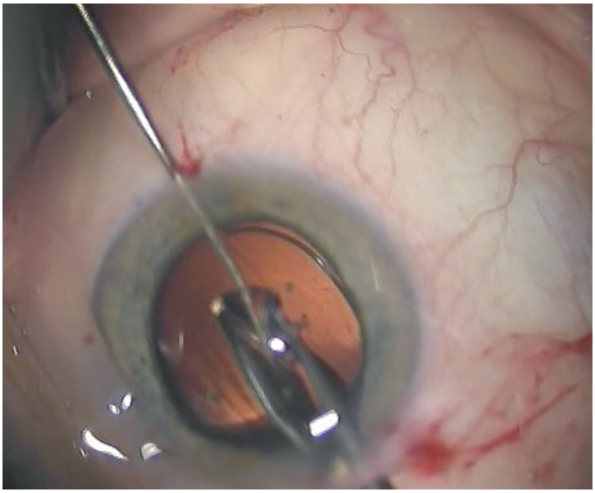


Fig. 10.18 Iris spatula is removed from behind the IOL; note IOL is turned 90° while explanted

10.3 Extraction of a Silicone IOL Through Bisecting of IOL

Video 10.44: Bisecting of silicone IOL

There are many reasons why an intraocular silicone lens needs to be explanted, e.g. damaged IOL or haptic after implantation, wrong IOL power, late optic calcification or persistent silicone oil adherence after vitreoretinal surgery. Most techniques for explantation of silicone IOL are very difficult to perform because the silicone material is very slippery. We therefore favour IOL bisecting technique. Surgery lasts about 10–15 min and is performed in topical, local or general anaesthesia.

Instruments

1. OVD
2. 15° knife
3. 3.0–3.2 main incision knife
4. Silicone lens bisector (e.g. G-32800 Geuder, Germany) (Fig. 10.19)
5. Sinskey hook (Fig. 2.14)
6. Suturing forceps (e.g. Castroviejo forceps (Fig. 2.11))

Individual Steps

1. Creating main incision and side-port incision, injection of OVD.
2. IOL mobilisation.
3. Haptics removal.
4. Placing the wire loop of the bisector around the IOL optic.
5. Bisecting the IOL.
6. Explantation of the two IOL halves.
7. Remove OVD.

The Operation Step for Step

1. Creating main incision and side-port incision, injection of OVD
2. IOL mobilisation
3. Haptics removal

   After creating the main incision, the anterior chamber is filled with OVD (Figs. 10.20 and 10.21). Then two side-port incisions are created 80–90° away from main incision. IOL is gently mobilised from capsular bag. Sometimes this requires additional injection of OVD between the anterior and posterior capsule. Then place some additional OVD behind the IOL optic. We prefer to cut the IOL haptic in case of a three-piece silicone IOL (Fig. 10.22). This could be done with a 20-G endoscissors. Haptics are removed.

Fig. 10.19 Silicone lens bisector. Indication: For dividing implanted silicone lenses. Geuder, 32800

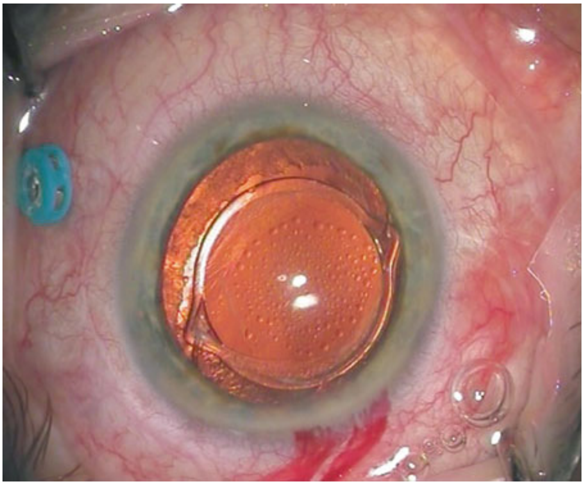


Fig. 10.20 Silicone IOL (SI60, AMO, USA) with massive silicone oil adherence after multiple vitreoretinal surgeries, several attempts to clean the IOL (e.g. with solvent solution F6H6, Fluoron, Germany) were unsuccessful

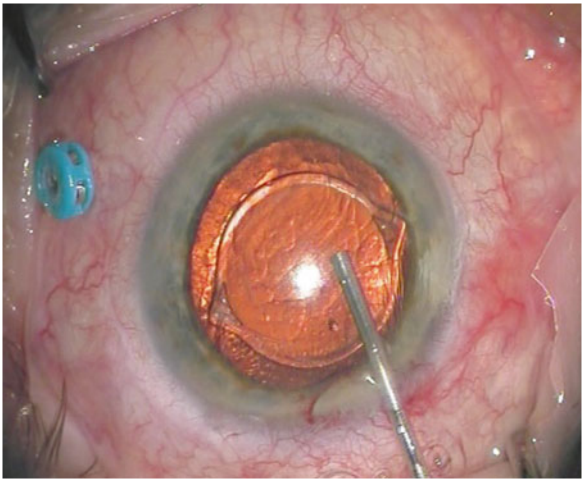


Fig. 10.21 Injection of OVD through main incision

4. Placing the wire loop of the bisector around the IOL optic
5. Bisecting the IOL
   The bisector is inserted through the main incision, and the wire loop is externalised from the device (Fig. 10.23). IOL is gently decentred and the wire loop is placed around the optic (Fig. 10.24). Sudden movement of the IOL pieces during bisection could cause corneal endothelium damage. We place therefore a second instrument on top of the IOL optic (Figs. 10.24 and 10.25). While the wire loop is pulled back into the bisector, the optic is cut into two halves (Figs. 10.26 and 10.27). Bisector and Sinskey hook are removed.
6. Explantation of the two IOL halves
7. Remove OVD
   IOL pieces are grasped with a toothed forceps (e.g. fine colibri forceps) and explanted (Figs. 10.28 and 10.29). If indicated now a new IOL is implanted. Finally OVD is removed from the anterior chamber and incisions are hydrated and checked for leakage. They can be sutured if needed with 10-0 nylon.

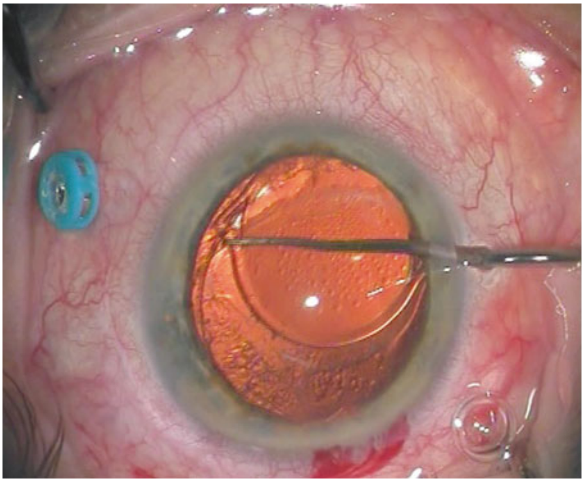


Fig. 10.22 IOL mobilisation from capsular bag, haptic is placed on the anterior iris surface

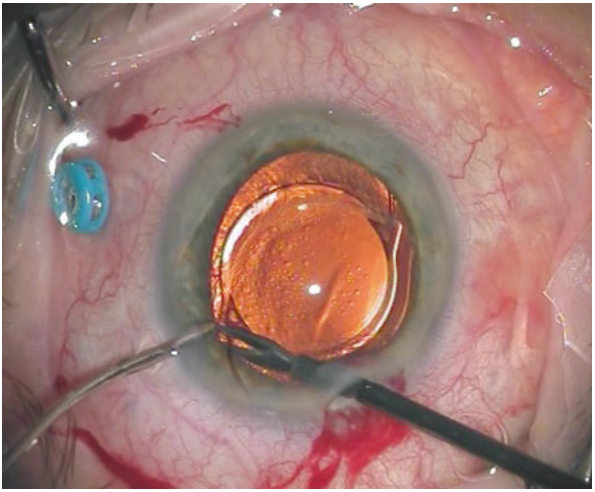


Fig. 10.23 IOL haptic is cut with a 20-G endoscissors; second instrument is a curved Scharioth forceps (DORC, the Netherlands)

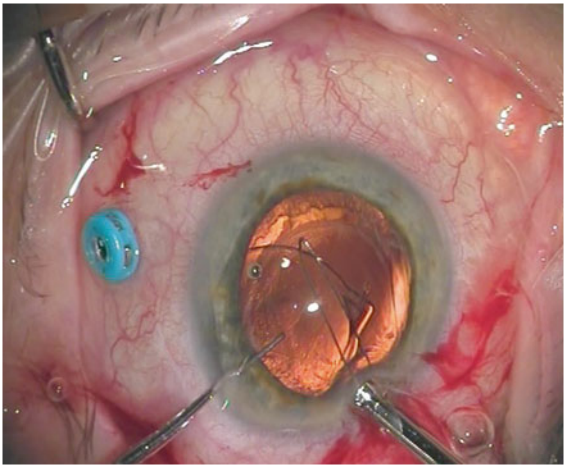


Fig. 10.24 IOL is slightly decentred and wire loop of the bisector is placed over the IOL optic; second instrument is used to manipulate the IOL

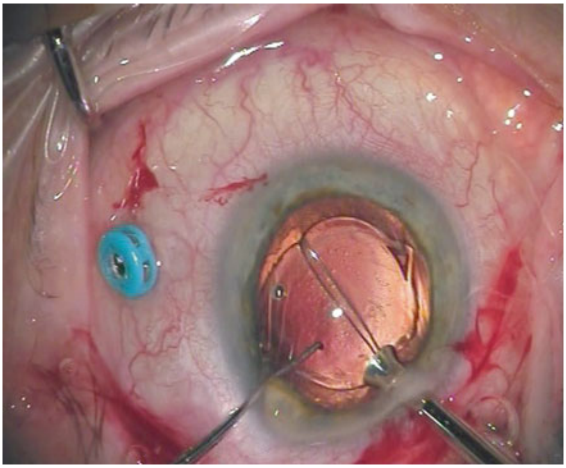


Fig. 10.25 IOL is recentred; wire loop is placed exactly over the middle of the optic

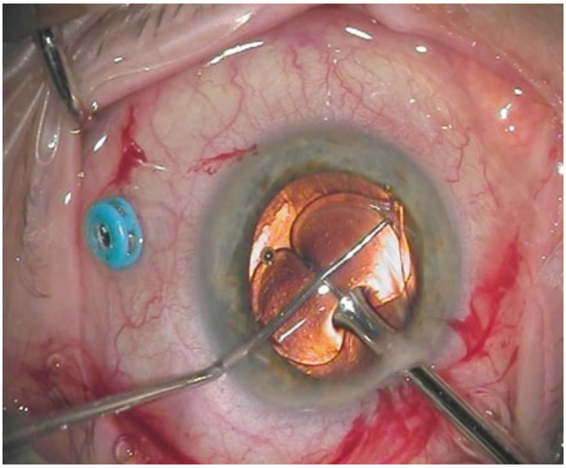


Fig. 10.26 Wire loop of the bisector is pulled backwards, before the optic is cut, the IOL starts to fold; note the second instrument is placed over the IOL to prevent uncontrolled movements of the IOL pieces

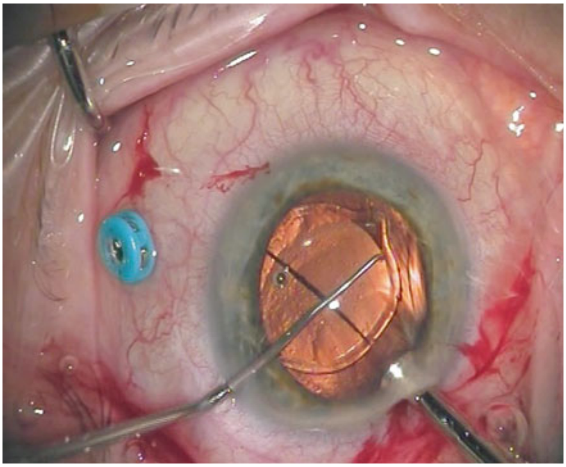


Fig. 10.27 IOL bisection is completed; wire loop is completely retracted; note the clear cut through the IOL optic

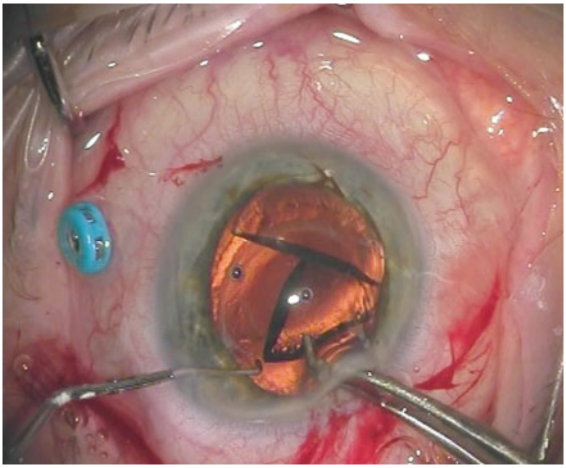


Fig. 10.28 First IOL piece is grasped with a toothed forceps and explanted

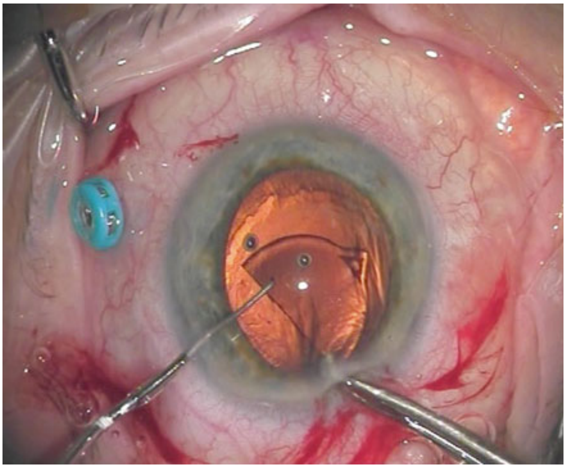


Fig. 10.29 Second IOL piece is grasped and removed

10.4 Iris Capture by the IOL Optic

An iris capture by the IOL (Fig. 10.30) optic causes a reduced mobility of the iris and pupil, dislocation of the IOL and may cause intraocular inflammation. We recommend removing an iris capture.

Instruments

1. Intravitreal scissors (Fig. 10.31), alternatively capsulotomy scissors (Fig. 10.32)
2. Maybe: Iris spatula (Fig. 2.16)

Individual Steps

1. Removal of posterior synechiae
2. Repositioning of IOL

The Operation Step by Step

1. Removal of posterior synechiae
2. Repositioning of IOL
   Inject viscoelastics into the anterior chamber (Fig. 10.33). Try to loosen the posterior synechiae with the viscoelastic cannula or easier with the iris spatula. If you do not succeed, then cut the posterior synechiae as close as possible to the lens capsule with an intravitreal scissors (Figs. 10.34 and 10.35). Constrict the pupil with Miochol to check if all synechiae have been removed (Fig. 10.36).

Pits and Pearls No. 34

If you discover an *IOL capture* within 1 week after surgery, then perform as follows: Attach a 27-G cannula (grey cannula) onto a 2-ml syringe. Place patient behind the slit lamp. Drop topical anaesthesia + povidone iod. Perform a paracentesis and press the optic with the cannula behind the iris.

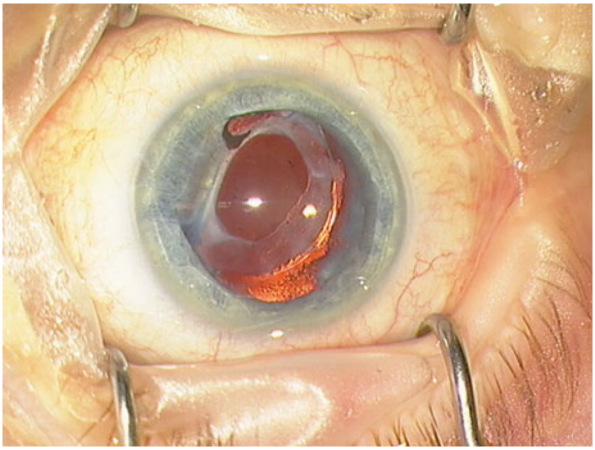


Fig. 10.30 A long-standing iris capture. The left side of the IOL is located before the iris

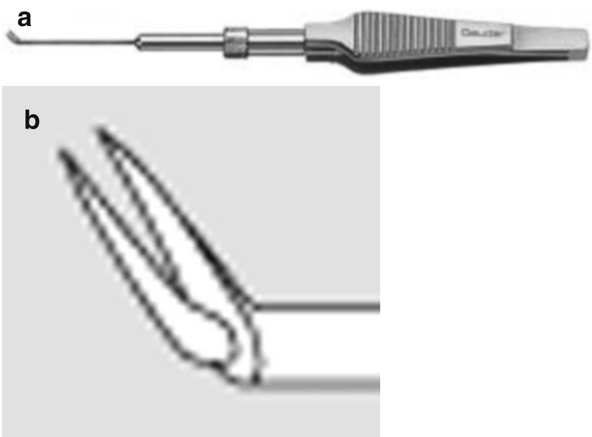


Fig. 10.31 Capsule scissors after *Kampik* (**a**, **b**)*. The instrument fits through a paracentesis.* 22 gauge. Indication: Cutting of capsule or iris. Geuder 38215

Fig. 10.32 Intravitreal scissors (**a**, **b**). 23 gauge. Indication: General cutting of tissue. DORC 1286.J06

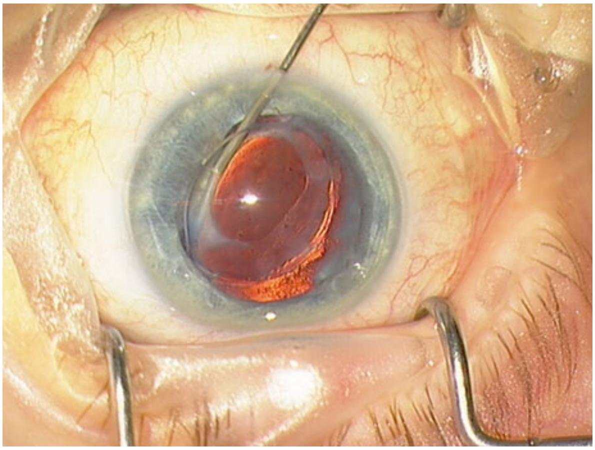


Fig. 10.33 Inject viscoelastics between IOL and iris

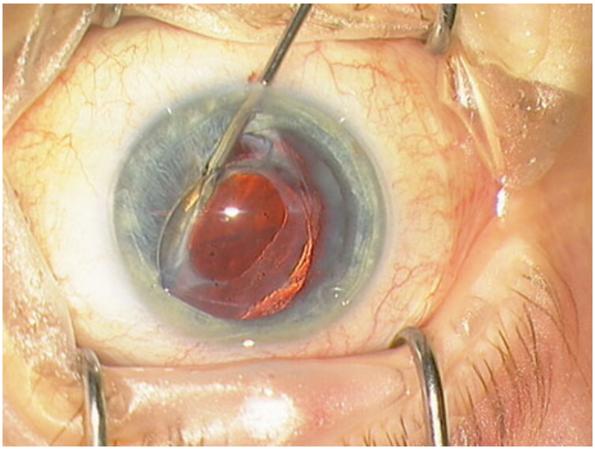


Fig. 10.34 Cut the iridal adhesion with intravitreal scissors, e.g. 23-G straight intravitreal scissors. The advantage of intravitreal scissors or the capsule scissors of Kampik is that they fit through a paracentesis. Alternatively, regular capsulotomy scissors can be used but they require a main incision

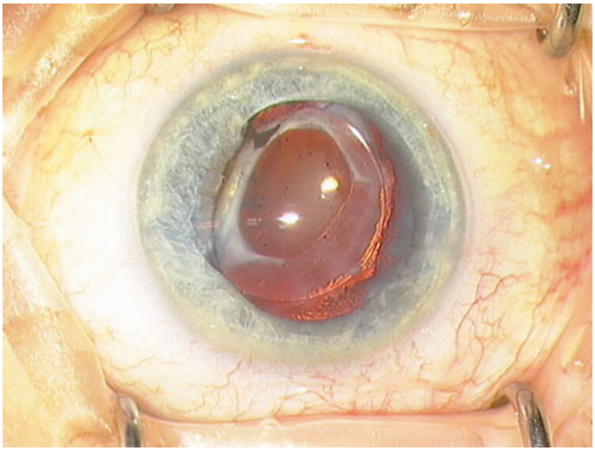


Fig. 10.35 Check with an iris spatula if all posterior adhesions are removed

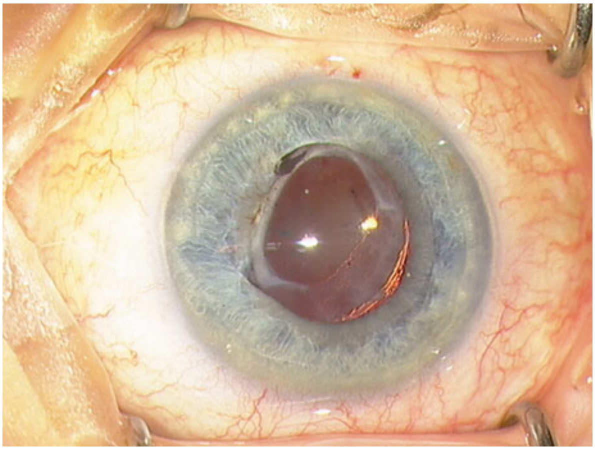


Fig. 10.36 Inject Miochol to constrict the pupil

10.5 Iridoplasty

This patient suffered from a dislocated nucleus secondary to Marfan syndrome and was operated with phacoemulsification. An IOL could not be implanted because of the large zonular lysis. Under the surgery an iris defect at 12 o'clock was created. In the next surgery an anterior vitrectomy was performed and a retropupillar iris-claw IOL implanted (Fig. 10.37). The iris defect was not operated because an iris defect at 12 o'clock causes usually no symptoms. The patient, however, complained of photophobia in comparison to her other eye. We decided therefore to perform an iridoplasty.

Instruments

1. Polypropylene 10-0 suture with one straight needle and one curved needle (i.e. Alcon. Polypropylene, blue monofilament, double armed. 304901)
2. 27-G grey cannula on a syringe
3. Push-pull instrument (Fig. 2.15)

Individual Steps

1. Insertion of the 10-0 suture needle at 11 o'clock.
2. Insertion of the grey cannula at 1 o'clock.
3. Needle the right and left edge of the pupil.
4. Main incision at 12 o'clock.
5. Retract the suture ends and make a knot.

The Operation Step by Step

1. Insertion of the 10-0 suture needle at 11 o'clock.
2. Needle the right edge of the pupil.
3. Insertion of the grey cannula at 1 o'clock.
4. Main incision at 12 o'clock.
5. Retract the suture ends and make a knot.

Inject viscoelastics into the anterior chamber (Fig. 10.38). Stick the needle at 11 o'clock into the anterior chamber and place the needle through the right edge of the pupil. Stick the 27-G grey cannula at 1 o'clock into the anterior chamber. Now place the needle through the left edge of the pupil and then further into the lumen of the grey cannula. Retract the cannula with the needle at 1 o'clock. Cut the needle at the end of the suture. Perform a main incision at 12 o'clock with a 2.5-mm blade. Retract both ends of the sutures (right and left end) through the main incision at 12 o'clock (Fig. 10.39). Make a 3-2-3 knot pattern. Each knot can be pushed with the push-pull instrument to the pupil edge.

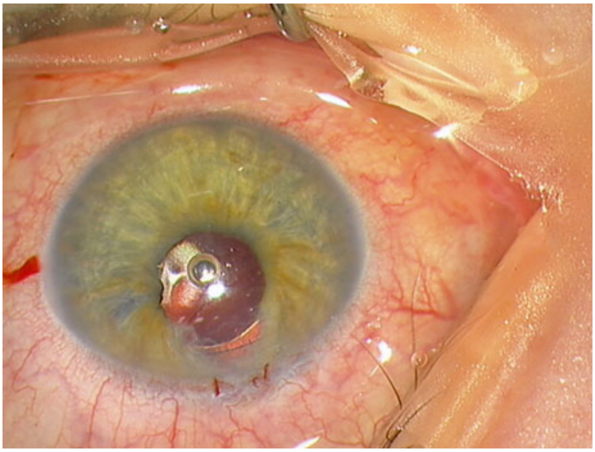


Fig. 10.37 A defect in the superior iris after a complicated cataract extraction

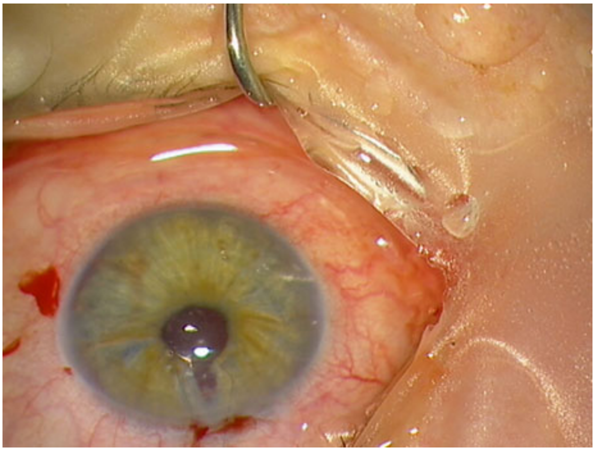


Fig. 10.38 A main incision is performed at 12 o'clock. Then the straight needle is placed through both pupillary edges at 12 o'clock. The needle is removed and the sutures retrieved through the main incision at 12 o'clock

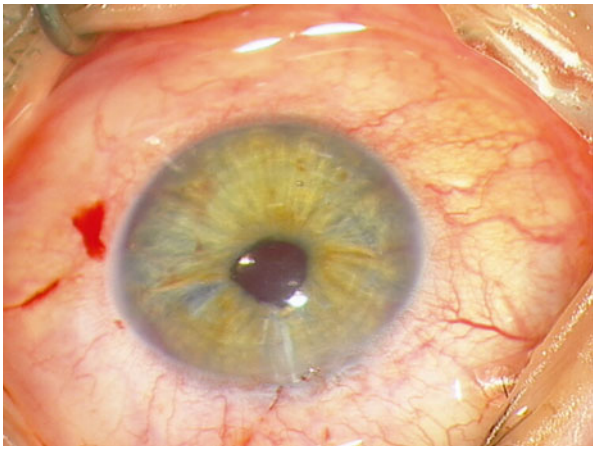


Fig. 10.39 Then knot the suture. It helps to push the knot with a push-pull instrument to the pupillary edge

10.6 Implantation of an Iris Prosthesis

Eyes with mydriasis/aniridia and aphakia secondary to trauma can be provided with an iris prosthesis. The company Human Optics produces a colour-matched iris prosthesis (hand painted (Fig. 10.40)). This iris prosthesis is foldable and can be implanted with a regular IOL injector. The companies Morcher and Ophtec offer a combined iris and IOL prosthesis, whereas Morcher offers hand-painted iris prosthesis and Ophtec a range of four colours (Fig. 10.46). Both prosthesis are PMMA and not foldable.

The iris prosthesis from Human Optics can be implanted through a 2.4-mm main incision whereas the Morcher and Ophtec iris and IOL prosthesis require an 8.0-mm broad main incision.

There are different surgical scenarios:

1. Iris defect/aniridia with intact nucleus and capsular bag
2. Iris defect/aniridia and aphakia
3. Iris defect/aniridia and pseudophakia

In the first scenario you remove the nucleus and implant a normal IOL and then the foldable iris (both in the capsular bag). The size of the prosthesis should be 10 mm. The obvious advantage is a small incision. Or you implant a PMMA iris-IOL prosthesis into the capsular bag. In the latter case you require a large 8.0-mm incision.

In the second scenario you can implant a scleral-fixated IOL with a foldable iris prosthesis fixated to the haptics (see YouTube videos). The advantage is a small incision. The alternative is the implantation of a scleral-fixated iris-IOL prosthesis with a large incision.

In the last scenario the iris prosthesis is implanted into the sulcus. The size of the prosthesis is cut according to the white-to-white measurement.

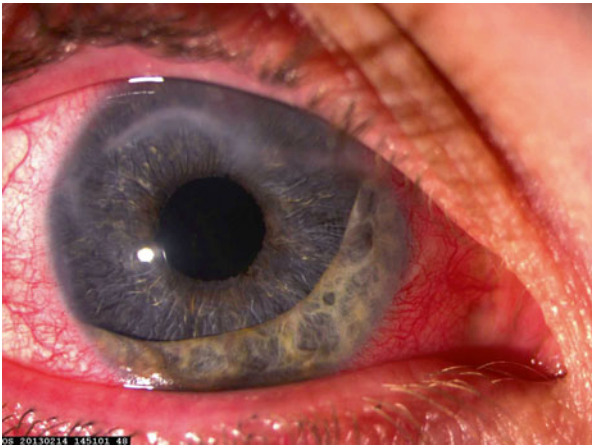


Fig. 10.40 Implantation of an artificial iris in an eye with traumatic iris trauma

10.6.1 Implantation of a Foldable Iris Prosthesis

Video 10.45: Implantation of a foldable iris prosthesis

Instruments
1. Phaco set
2. Corneal punch (e.g. Geuder)
3. 2.4-mm tunnel incision knife
4. IOL injector

Material
Iris prosthesis (Human Optics)

Individual Steps
1. Preparation of the iris prosthesis
2. Phacoemulsification
3. Implantation of iris prosthesis
4. Centration of iris prosthesis

Operation Step by Step
1. Preparation of the iris prosthesis
   The iris prosthesis needs to be cut with a trephine according the white-to-white value (Figs. 10.41 and 10.42). Read the instructions of the company (www.artificial-iris.com). Then an iridectomy must be performed. Follow again the instructions of the company.
2. Phacoemulsification
3. Implantation of iris prosthesis
   Fold or roll the prosthesis and insert it into an IOL cartridge and finally into an injector (Alcon). Continue with a 2.4-mm main incision and a phacoemulsification. Implant then a standard one-piece or three-piece IOL. Implant above the IOL the iris prosthesis. Centre the prosthesis with a manipulator and remove the viscoelastic (Fig. 10.43).

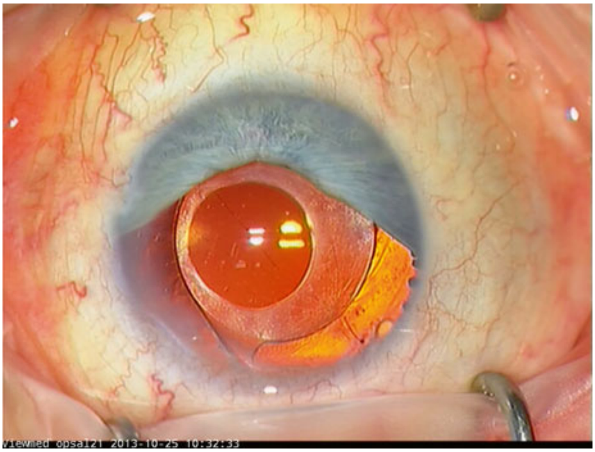


Fig. 10.41 Immediate preoperative status of an eye with iris defect after a complicated cataract surgery

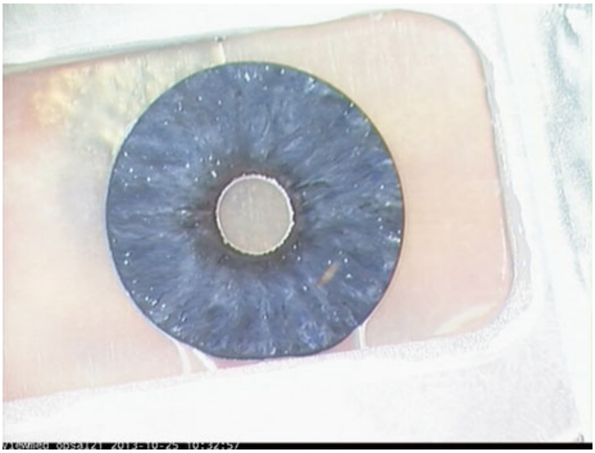


Fig. 10.42 The colour-matched foldable iris prosthesis

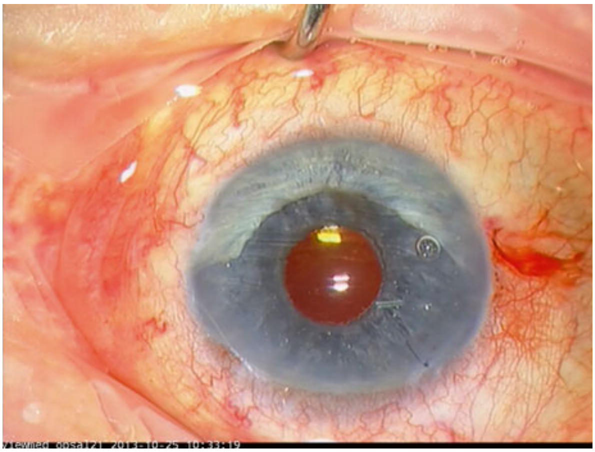


Fig. 10.43 Immediate postoperative status after implantation of the iris prosthesis with an IOL injector

10.6.2 In-the-Bag Implantation of an Iris and IOL Prosthesis

The iris prosthesis can be implanted into the capsular bag (Figs. 10.44, 10.45, 10.46, and 10.47) or it can be scleral fixated (Figs. 10.48, 10.49, 10.50, and 10.51).

This eye had a traumatic mydriasis since it was hit by a plastic ball during hockey (Fig. 10.44). The lens capsule is intact and there is only a mild cataract. The patient suffered very much from photophobia and therefore an iris prosthesis with IOL was offered.

Instruments
1. Phaco set
2. Iris and IOL prosthesis
3. Caliper (Fig. 2.21)
4. 15° knife (Fig. 2.5)
5. Crescent-angled bevel up knife (Fig. 2.7)
6. 2.4-mm tunnel incision knife (Fig. 2.6)

Material
Ethilon 10-0

Individual Steps
1. Limbal peritomy
2. Sclerocorneal tunnel incision
3. Lens removal
4. Implantation of an iris prosthesis
5. Suturing of tunnel incision

Operation Step by Step
1. Limbal peritomy
2. Sclerocorneal tunnel incision
3. Lens removal
   Perform a limbal peritomy from 11 to 1 o'clock. Mark an 8-mm broad incision with the caliper 1.5 mm behind the limbus. Make a 0.3-mm-deep incision with the 15° knife (50 % scleral thickness). Then incise a sclerocorneal tunnel with the crescent-angled bevel up knife. Inject viscoelastics into the anterior chamber, continue with a rhexis, and remove the lens either with phaco or with ECCE technique.
4. Implantation of an iris prosthesis
5. Suturing of tunnel incision
   Open the main incision with a 2.4-mm blade. Implant the iris prosthesis inside the lens capsule (Fig. 10.45). Suture the main incision with an interrupted Ethilon 10-0 stitch (Fig. 10.46). Close the conjunctiva with Vicryl 8-0 or Ethilon 10-0 (Fig. 10.47).

10.6.3 Scleral Fixation of an Iris and IOL Prosthesis

This eye had a traumatic mydriasis after a corneal perforation from a screwdriver (Fig. 10.48). The perforation was horizontal in the centre of the cornea. The patient suffered from photophobia.

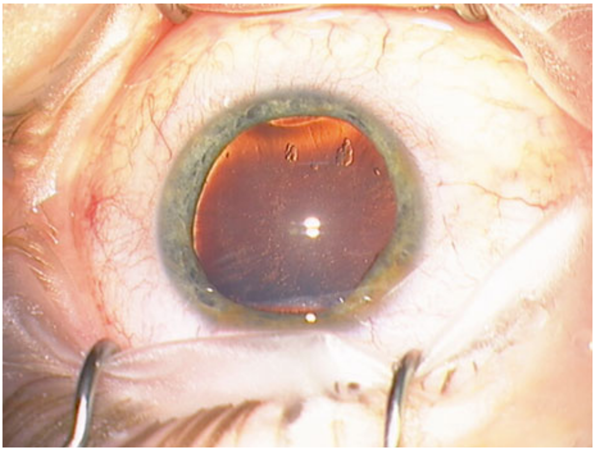


Fig. 10.44 Immediate preoperative status of an eye with traumatic aniridia after an eye contusion

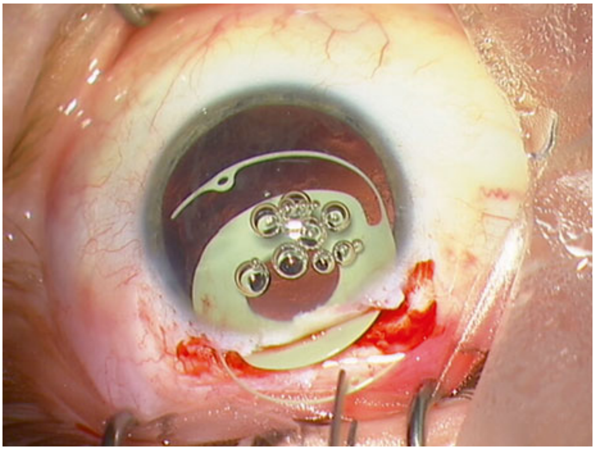


Fig. 10.45 Limbal peritomy from 10 to 2 o'clock. Mark an 8-mm broad incision with the caliper. Dissect a scleral flap. Implantation of an iris prosthesis (Ophtec) into the bag

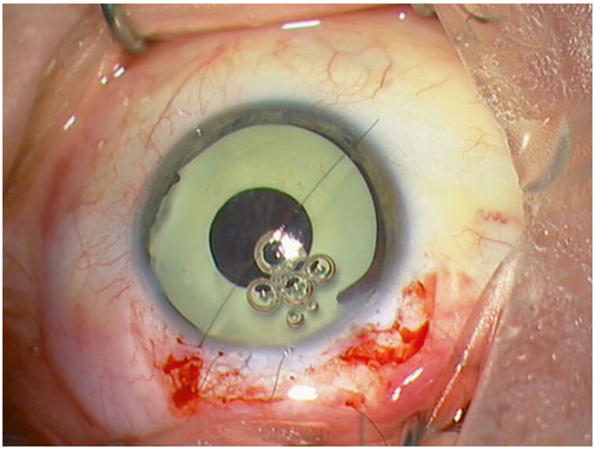


Fig. 10.46 Suture the scleral flap with an Ethilon 10-0 interrupted stitch

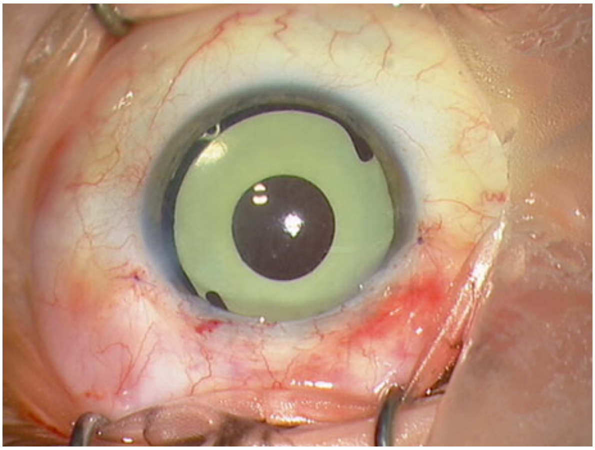


Fig. 10.47 Immediate postoperative status

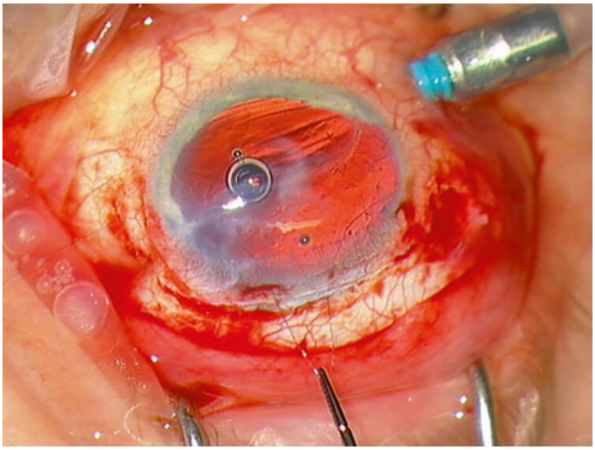


Fig. 10.48 An eye with aniridia and aphakia after a corneal perforation. Perform a limbal peritomy. Stab the straight needle through the sclera at 9 o'clock. Stab a 27-G needle at 3 o'clock through the sclera and place the tip of the suture needle into the lumen of this 27-G needle. Extract the 27-G needle and the straight needle at 3 o'clock. Then retrieve the middle of the suture at 12 o'clock

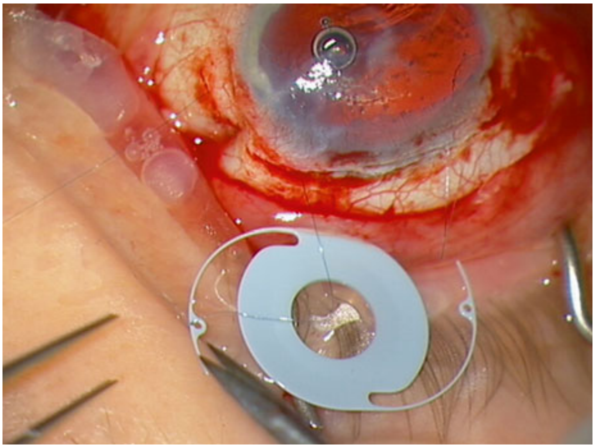


Fig. 10.49 Cut the suture in two halves and knot each end to one haptic of the iris prosthesis

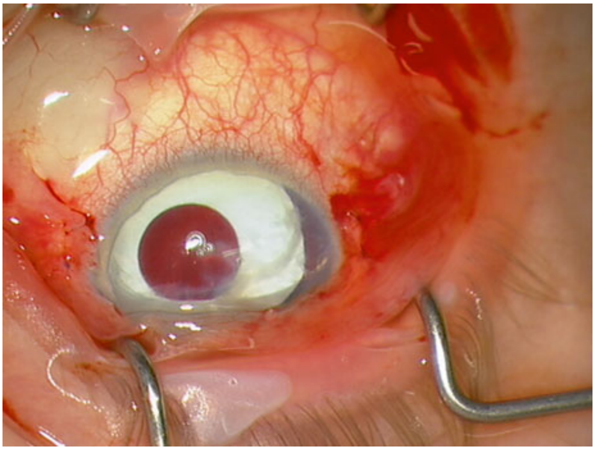


Fig. 10.50 Immediate postoperative status

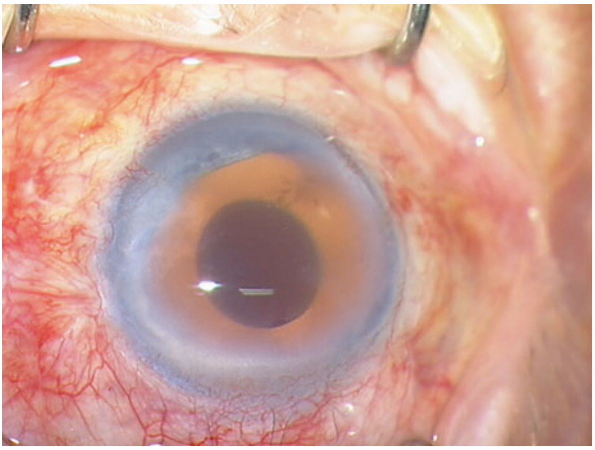


Fig. 10.51 Two-year postoperative follow-up. The natural iris is located anteriorly to the brown iris prosthesis

Instruments

1. Iris and IOL prosthesis
2. Caliper (Fig. 2.21)
3. 15° knife (Fig. 2.5)
4. Crescent-angled bevel up knife (Fig. 2.7)
5. 2.4-mm tunnel incision knife
6. Push-pull instrument (Kuglen hook) (Fig. 2.15).

Material

1. Ethilon 10-0
2. Polypropylene 10-0 suture with a curved needle and a straight needle (i.e. Alcon. Polypropylene, blue monofilament, double armed. 8065304901) and a 27-G grey cannula

Individual Steps

1. Limbal peritomy
2. Insertion of polypropylene 10-0 suture
3. Sclerocorneal tunnel incision
4. Scleral fixation of iris prosthesis
5. Suturing of tunnel incision

Operation Step by Step

1. Limbal peritomy at 12 o'clock, at 3 o'clock and at 9 o'clock
2. Insertion of polypropylene 10-0 suture
3. Sclerocorneal tunnel incision

   Perform a limbal peritomy at 12 o'clock, at 3 o'clock and at 9 o'clock. Mark the sclera 1.5 mm behind the limbus at 3 and at 9 o'clock. Insert the straight needle with a needle holder into the marked sclera at 9 o'clock. Insert the grey cannula attached to a 2-ml syringe at the marked sclera at 3 o'clock. Join the grey cannula and the needle in the middle of the pupil. Pull the cannula with the needle out at 3 o'clock.

   Mark an 8-mm broad incision with the caliper 1.5 mm behind the limbus. Make a 0.3-mm-deep incision with the 15° knife (50 % scleral thickness). Then incise a sclerocorneal tunnel with the crescent-angled bevel up knife. Inject viscoelastics into the anterior chamber and open the main incision with the 2.4-mm blade. Retrieve the Ethilon 10-0 suture with a forceps or a manipulator (e.g. push-pull instrument) (Fig. 10.49).
4. Scleral fixation of iris prosthesis
5. Suturing of tunnel incision

   Cut the suture in two halves. Suture the one end to one haptic of the IOL and the other end to the second haptic of the IOL (Fig. 10.49). Insert the iris prosthesis and centre it by drawing the sutures. Suture the main incision with an interrupted Ethilon 10-0 stitch (Fig. 10.50). Close the conjunctiva with Vicryl 8-0 or Ethilon 10-0 (Figs. 10.50 and 10.51).

Materials and Companies 11

Materials (In Alphabetical Order)

15° knife. Indication: Paracentesis. Alcon. 8065921501

Acetylcholin, (Miochol®, Novartis). Indication: Pupil constriction.

Backflush instrument: 23G disposable Eckardt backflush. DORC 1281.A5D06

Calipers, Castroviejo Geuder No.: 19135

Capsular tension ring with injector: CROMA, DORC, Morcher and Arcadophta

Capsule scissors after Kampik. The instrument fits through a paracentesis. Indication: Cutting of capsule or iris. Geuder 38215

Capsulorhexis forceps. Geuder No.: 31299 or 31308

Chandelier light of Synergetics: 25G Awh Chandelier 56.20.25; of ALCON: Constellation Chandelier Chandelier Accurus 8065751574 or 8065751577; DORC of: 27-gauge twin light of Eckardt 3269.MBD27

Chopper: (1) Combined instrument with push pull and chopper. Chopper by Neuhann, Geuder 32162; (2) Chopper by Agarwal. Indication: Chopping of a hard nucleus. Geuder 32282

Crescent bevel up blade. Indication: Dissection of a frown incision. Crescent-angled bevel up. Alcon. 8065990002

Double-barreled cannula 23G for injecting PFCL: DORC. Eftiar Dual Bore Cannula EFD.06

Fragmatome: Alcon (Accurus fragmentation handpiece), DORC fragmatome 3002.M and 20-G or 23-G phaco fragmentation cannula DORC 3005.F106

Fragment forceps. Fragment forceps Gaskin. Geuder, No: 31624; fragment forceps Kelman-McPherson, G-31623, Gaskin fragment forceps to Kansas. B & L. E-2030

Intravitreal scissors. 23G. Indication: Cutting of tissue in anterior or posterior chamber. DORC 1286.J06

Intravitreal serrated jaws forceps. 23G. Indication: Grasping of tissue in anterior or posterior chamber. DORC: 1286.C06

U. Spandau, G. Scharioth, *Complications During and After Cataract Surgery*,
DOI 10.1007/978-3-642-54449-1_11,

Iris prosthesis, foldable: Human Optics
Iris prosthesis, non-foldable: Morcher, Opthec
Iris retractors: Alcon//Grieshaber: Flexible iris retractors REF 611.75
Kuglen hook. Katalyst: Kuglen push-pull hook, angled (katalystsurgical.com)
Lens extraction hook: Lens extraction hook after Henning/Friedrich, Geuder 32034
Malyugin ring (6.25 mm) with injector: MST, (USA) MAL-0001
Ocucoat® (humidification of cornea): Bausch & Lomb
Push pull: Iris hook Dardenne (push-pull), Geuder 16175
Regular capsulotomy scissors. The instrument fits only through a main incision. Geuder 19776
Stiletto 23G. Indication: Lamellar sclerotomy. Beaver Visitec
Suture for scleral-fixated IOL: 2 curved needles. Alcon. Polypropylene, blue monofilament, double armed. 8,065,307,601th
Suture for scleral-fixated IOL: 1 straight needle, 1 curved needle. Alcon. Polypropylene, blue monofilament, double armed. 8065304901
Sutures: Ethicon (www.ecatalog.ethicon.com/contact-us)
Suturing forceps. Castroviejo suturing forceps, Geuder, 19023
Triamcinolone acetonide (Volon A®): Pfizer
Trocar forceps for removal of trocars. DORC No: 1278
Tunnel incision knife, 2.4 mm wide. Indication: Main incision. Slit knife. Alcon. 8065992445
Tying forceps. Indication: Manipulation of suture or iris retractor. Tying forceps, Geuder, 19032
Trocars

1. Valved trocar system by Alcon: 23G, 8065751657;
2. Valved trocar system by DORC: 23G, 1272.ED206

V-lance. 1.3-mm-wide scleral and corneal diameter. Indication: Paracentesis and 20-G sclerotomy. 20-G V-lance. Alcon. 8065912001
Vannas scissors. Limbal peritomy. Geuder G-19760
VisionBlue® (trypan blue): DORC

Companies Directory (In Alphabetical Order)

Alcon
Alcon Pharma GmbH
Blank Reute Address 1
79108 Freiburg/Breisgau
Tel: 0049/761/13040
www.alcon-pharma.de

Arcadophta
293, route de Seysses
F-31100 Toulouse
Tel: 0033/561/405235
Fax: 0033/5617 408 466
info@arcadophta.com
www.arcadophta.com

Bausch & Lomb
Brunsbütteler Damm 165–173
13581 Berlin
Tel: 030/330 935 702
Fax: 030/330 935 712
www.bausch-lomb.de

Beaver-Visitec International, Ltd
Centurion Court
85c Milton Park
Abingdon, Oxfordshire
OX14 4RY
UK
www.Beaver-Visitec.com

CROMA GmbH
Industrial Line 6
2100 Leobendorf
Österrreich
Tel: +43/2262/684680

DORC
D.O.R.C. Germany GmbH
Charlottenstr. 80
10117 Berlin
Tel: 030/20188364
Fax: 030/20188365
Website: DORC.nl

Ethicon
Johnson & Johnson Medical GmbH
ETHICON Endo-Surgery Deutschland
Hummelsbütteler Steindamm 71
22851 Norderstedt
Deutschland
www.ethicon.com

Eye Technology Ltd.
19 Totman Crescent
Brook Road Industrial Estate
Rayleigh
Essex SS6 7UY
United Kingdom
sales@eye-tech.co.uk

Fluoron GmbH
Magirus-Deutz-Straße 10
89077 Ulm

Tel: 0731/20559970
Fax: 0731/205 599 728
info@fluoron.de
www.fluoron.de

Geuder
Hertzstr. 4
69126 Heidelberg
Tel: 06221/3066
Fax: 06221/303122
info@geuder.de
www.geuder.de

Human Optics
Dr. Schmidt Intraocularlinsen GmbH
Westerwaldstraße 11–13
53757 Sankt Augustin
Germany
e-mail: iris@humanoptics.com
www.artificial-iris.com

Katalyst Surgical Inc.
754 Goddard Avenue
Chesterfield, MO 63005
USA
www.katalystsurgical.com

Medone Surgical Inc.
Sarasota, FL 34243
USA
www.MedOne.com

Möller-Wedel GmbH
Rosengarten 10
22880 Wedel
Germany
Phone: +49 4103 709 01
Fax: +49 4103 709 355
e-mail: sales@moeller-wedel.com
www.moeller-wedel.com

MorcherGmbH
Kapuzinerstrasse, 12
70374 Stuttgart
Phone: +49(0)711/95320-0
e-mail: info@morcher.com
www.morcher.com

MST (Microsurgical technology)
8415 154th Ave NE,
Redmond, WA 98052
USA
www.microsurgical.com/

OASIS® Medical, Inc.,
Sales & Marketing Office
OASIS Medical, Inc.
635 West Allen Avenue
San Dimas, CA 91773
www.oasismedical.com

Oculus Optic device GmbH
Münchholzhäuser Strasse 29
D-35582 Wetzlar
Phone: 0641/20050
Fax: 0641/2005255
e-mail: sales@oculus.de
www.oculus.de

Opthec BV
Schweitzerlaan 15
9728 NR Groningen
Netherlands
Phone: +31 050 5251944
www.opthec.com

Synergetics Germany GmbH
Körnerstraße 59
58095 Hagen
Phone: 0641/20050
Fax: 0641/2005255
e-mail: blangohr@synergeticsusa.com
www.synergeticsusa.com

Compilation of All Pits and Pearls

12

Pits and Pearls No. 1 Optics and constant irrigation during phaco and I/A
Pits and Pearls No. 2 Soft nucleus
Pits and Pearls No. 3 Unsuccessful cracking
Pits and Pearls No. 4 Conjunctival chemosis
Pits and Pearls No. 5 Epinucleus during phaco
Pits and Pearls No. 6 Removal of phaco handpiece from anterior chamber
Pits and Pearls No. 7 Unsuccessful quadrant removal
Pits and Pearls No. 8 Residual cortex
Pits and Pearls No. 9 Unstable anterior chamber
Pits and Pearls No. 10 Flat anterior chamber
Pits and Pearls No. 11 Small pupil and white nucleus
Pits and Pearls No. 12 Pressure from behind
Pits and Pearls No. 13 Wound assisted IOL implantation
Pits and Pearls No. 14 Shape of frown incision
Pits and Pearls No. 15 Enclavation of iris-claw IOL
Pits and Pearls No. 16 Intrascleral IOL fixation
Pits and Pearls No. 17 23-G vitreous cutter for Infinity
Pits and Pearls No. 18 Anterior chamber maintainer
Pits and Pearls No. 19 Insertion of trocars
Pits and Pearls No. 20 Anterior chamber maintainer
Pits and Pearls No. 21 Dropping nucleus
Pits and Pearls No. 22 Incarcerated vitreous strand
Pits and Pearls No. 23 IOL scaffolding
Pits and Pearls No. 24 Capsular tension ring
Pits and Pearls No. 25 IOL extraction
Pits and Pearls No. 26 Removal of capsular fibrosis
Pits and Pearls No. 27 Choroidal detachment

U. Spandau, G. Scharioth, *Complications During and After Cataract Surgery*,
DOI 10.1007/978-3-642-54449-1_12, © Springer-Verlag Berlin Heidelberg 2014

Pits and Pearls No. 28 Subepithelial located infusion
Pits and Pearls No. 29 Blood in the anterior chamber
Pits and Pearls No. 30 Cornea and humidification
Pits and Pearls No. 31 Small pupil
Pits and Pearls No. 32 Triamcinolone and PVD
Pits and Pearls No. 33 Suturing of sclerotomy
Pits and Pearls No. 34 IOL capture

Index

U. Spandau, G. Schariothm, *Complications During and After Cataract Surgery*,
DOI 10.1007/978-3-642-54449-1, © Springer-Verlag Berlin Heidelberg 2014