2.7 Lens

Ferenc Kuhn and Viktória Mester

2.7.1 Introduction

Lens injury is much more common than one would presume from literature reports (Table 2.7.1). While the prognosis of the lens pathology itself is excellent, the outcome is generally much poorer because of the associated injuries (Table 2.7.2). Furthermore, several issues related to the management of eyes with lens injury remain controversial. Fig. 2.7.1 provides an overview of the trauma-related lens conditions. If the eye was pseudophakic at the time of injury, additional pathologies, such as IOL dislocation or haptic breakage, can occur.

2.7.2 Evaluation

The slit lamp is by far the most reliable method of diagnosing virtually all lens abnormalities.[1] The slit lamp is also crucial for the detection of important accompanying lesions such as vitreous prolapse into the AC in an eye with dislocated lens (see Chap. 2.5). Uneven depth of the AC may be the only sign of a slightly subluxed lens, although its edge may also be visible

1 Possible exceptions include a subconjunctivally extruded lens (see Fig. 2.12.2) or a deeper/shallower AC (see Chap. 2.5), which may be more readily recognizable by the naked eye.

Table 2.7.1 The incidence of lens injury in the USEIR database (%)

Injury type (*n*)	Cataract	All other types of lens trauma combined
Contusion (1497)	14	9
Rupture (2117)	17	20
Penetrating (4220)	34	10
IOFB (1235)	46	7
Perforating (464)	29	13
Total	2682	1139

Based on 14,523 injuries involving the globe

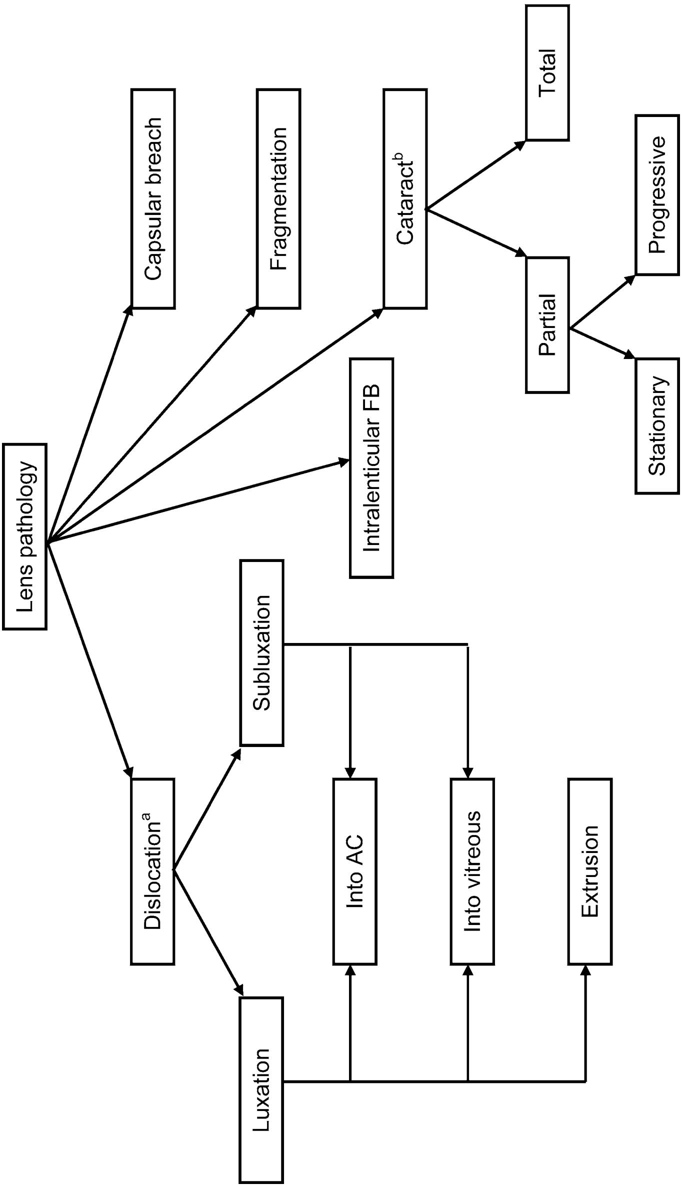
Table 2.7.2 The significance of lens trauma as related to posterior segment damage

Variable (source)	Lens damage present (%)	Lens intact (%)	Statistical significance
Endophthalmitis [23]	14	1	$p < 0.004$
Vitreous hemorrhage (USEIR)	42	23	$p < 0.0001$
Retinal detachment (USEIR)	12	7	$p < 0.0001$
Final vision of <20/40 [15]	72	34	$p < 0.0001$
Final vision of <5/200 [15]	30	11	$p < 0.0001$

Fig. 2.7.1 Trauma-related lens pathologies. The lesions can occur alone or in combination.

[a] This term is used in some literature reports to describe luxation, as opposed to subluxation, of the lens.

[b] May be accompanied by lens swelling. Intralenticular FBs are discussed in Chap. 2.13


Lens pathology
Capsular breach
Fragmentation
Cataract[b]
Total
Partial
Progressive
Stationary
Intralenticular FB
Dislocation[a]
Subluxation
Luxation
Into AC
Into vitreous
Extrusion

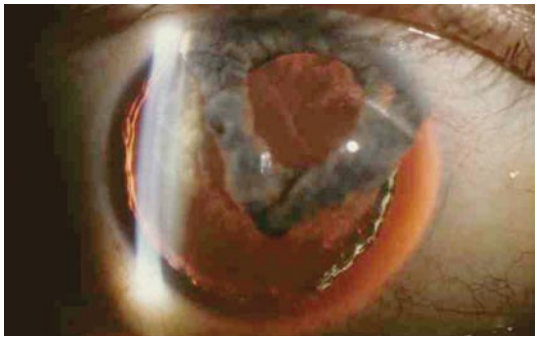


Fig. 2.7.2 Lens subluxation with iridodialysis. The lens is dislocated toward 10 o'clock; the iris is torn from its root between 2 and 11 o'clock. Red reflex is visible through the pupil as well as in the area of the iridodialysis. The edge of the lens is easily discernible

on retroillumination if the pupil is wide (Fig. 2.7.2). Typically, the lens and the iris show characteristic oscillatory movements when the eye or head moves (phacodonesis and iridodonesis, respectively). Depending on the site and area of zonular damage, the symptom may be present when the patient is in the erect but not in the supine position [10]. Vitreous prolapse is common: in the HEIR database, 34% of eyes with lens trauma showed vitreous prolapse into the AC.

The ophthalmoscope can supplant information if the lens is luxated into the vitreous. Ultrasonography may help to identify lens dislocation, posterior capsular rupture, or the presence of lens particles in the vitreous cavity. The CT is able to reveal lens damage even if the clinical examination is negative [4]. As always, injuries to any and all tissues of the eye must be suspected and sought.

It is important to realize that the preoperative and intraoperative findings may be quite different (Table 2.7.3); this has a major impact on surgical planning (see Chap. 1.8). As mentioned previously, intracamerally injected TA is able to show the presence and configuration of vitreous in the AC;

Table 2.7.3 Comparison of pre- and intraoperative findings (%) among 196 eyes undergoing extraction of a traumatic cataract

Capsule	Breach presence	Finding	
		Preoperative	Intraoperative
Anterior	Definite	69	71
	Questionable	3	0
Posterior	Definite	23	45
	Questionable	10	8

From the HEIR database

it reveals for the surgeon when the incarcerated vitreous has been severed (see Chap. 2.5).[2]

Table 2.7.4 provides a summary of questions that need to be answered during the examination.

2.7.3 Specific Conditions

2.7.3.1 Dislocation

The lens is either partially (subluxation) or completely (luxation) torn from the zonules; in the latter case, it may be still inside the eye or extruded[3]. Both subluxation and luxation can occur anteriorly (AC) or posteriorly (vitreous cavity), and both can happen in the context of open or closed globe trauma.

2 This is especially important in a phakic eye with corneal open globe trauma: traction on the peripheral retina must be prevented by severing the vitreous bridge reaching into the wound, but iatrogenic lens damage should also be avoided (see Chap. 2.5).

3 The lens may be under the conjunctiva (see Fig. 2.12.2) or completely lost.

Table 2.7.4 Diagnostic questions related to lens injury

Is the lens extruded?
Is the lens dislocated/luxated into the AC?
Are there lens particles in the AC?
Is the lens swelling?
Has vitreous prolapsed into the AC? If yes, is it also incarcerated into the wound?
Has the anterior capsule been breached?
What additional anterior segment pathologies are present? What is the IOP?
Is there an IOFB inside the lens?
Is there a cataract? If yes, is it partial or complete?
Has the posterior capsule been breached? If yes, has the vitreous prolapsed into the lens?
Is the lens subluxated/luxated into the vitreous cavity? If luxated, is the lens fragmented?
What posterior segment pathologies are present?

If the eye has an open globe injury, many of these questions will be answered during, rather than before, surgery

Whether, when, and what type of intervention is necessary are primarily determined by the type of injury[4], the visual acuity, the position of the lens, and the severity of secondary complications including vitreous prolapse, cataract, and glaucoma. Obviously, the range of independently coexisting pathologies is endless.[5]

4 Open vs closed globe (see Chaps. 2.10, 2.11)

5 Indications for, and types of, intervention for pathologies other than the lens are discussed in the appropriate chapters; this chapter focuses on the implications of the lens trauma itself.

2.7.3.1.1 Subluxation

If the visual acuity is normal and there is no vitreous incarceration into the wound, no treatment is necessary. If the lens needs to be removed, the type of intervention should be determined by a careful consideration of all variables.

- *Phacoemulsification* or *ECCE* is acceptable if there is no vitreous prolapse into the AC or into the lens – this is why it is crucial to preoperatively determine whether the posterior capsule is intact.
- If there is a small vitreous prolapse into the AC and it can first be removed with the vitrectomy probe, or if only a small posterior capsular lesion is present and viscoelastics[6] can effectively keep the vitreous from prolapsing, careful phacoemulsification may be attempted. The surgeon must keep in mind that the viscoelastic plug covering the capsular breach may be dislodged and the vitreous prolapse may recur; TA should periodically be used to check for vitreous reprolapse.
- A capsular tension ring can be inserted if the area of zonular rupture is verifiably small. A Cionni ring may be used if the zonular damage extends for a few clock hours.[7] Since the ring, and thus the capsule, is suture-fixed to the sclera, the capsular bag is given extra stability [1, 5].

6 A small amount of cohesive viscoelastic injected behind the lens capsule. Such use of viscoelastics, however, is a double-edged sword. It may be able to keep the vitreous behind the posterior capsule, but it also makes recognition of vitreous reprolapse even more difficult.

7 The damaged zonular area must not exceed 12 clock hours.

Cave

If the surgeon cannot be absolutely certain that vitreous has not prolapsed into the lens, phacoemulsification or ECCE must not be the method of choice to remove a subluxated or cataractous lens. Lensectomy using vitrectomy instrumentation is recommended to avoid exerting traction on the peripheral retina via aspirating vitreous. It must also be emphasized again that once lens removal has started, recognition of vitreous presence becomes difficult, and when it is recognized, it is often too late.[8]

- *Intracapsular cataract extraction* is recommended if most or all of the zonules are torn; again, the surgeon must make sure that there is no vitreous present before the cryoapplicator is applied.
- *Lensectomy* is the preferred method if vitreous is confirmed or suspected to have prolapsed into the lens.[9] Lensectomy is very safe and can be combined with IOL implantation [7].
  - If the *limbal* route is used, the posterior capsule can usually be preserved.
  - If the *pars plana* approach is chosen, the anterior capsule is preserved.[10] The pars plana route has distinct advantages: increased maneuverability and access to potential posterior segment abnormalities.[11]

8 The editor recently operated on an eye whose injury (*corneal penetrating trauma with an intravitreally located FB causing a visible anterior capsule lesion and cataract; Fig. 2.7.3*) made it obvious that the posterior capsule had also been breached. Lensectomy was therefore the selected lens removal method, but the probe malfunctioned: aspiration was applied without cutting (i.e., as if phacoemulsification or ECCE had been done). This was soon realized and the probe was replaced; nevertheless, during vitrectomy (performed in the same surgical setting), a large inferior retinal dialysis was found: an iatrogenic complication, not one caused by the original injury.

9 Prolapse of vitreous into the AC is easier to deal with (see above).

10 A three-piece IOL can be implanted into the sulcus on top of the retained capsule(s).

11 In the HEIR, 48% of eyes undergoing removal of a traumatic cataract had coexisting posterior segment injury, and 79% of these eyes had to undergo vitrectomy.

- Infusion is always needed: an AC maintainer is suitable in all cases. If a pars plana infusion is used, this should not be turned on unless the cannula's position can be verified (see Chap. 2.9). If the surgeon is experienced in bimanual surgery, a good alternative solution is to keep inside the capsular bag a needle attached to the infusion line: this method assures that the vitreous is not unnecessarily violated, the eye remains pressurized, and the lens gets hydrated, making removal easier.

Pearl

The usual vitrectomy settings need to be modified for the lensectomy procedure.[12] The aspiration should be somewhat higher (200 mmHg), as should the infusion pressure be (40 mmHg), and the cut rate is significantly reduced (200 cpm). The low cut rate prevents the escape of lens particles from the aspiration port and the collapse of the globe[13], should the port become unoccluded.

2.7.3.1.2 Luxation

A *subconjunctivally* extruded lens [21] is easily removed with forceps or a cryoapplicator. *Anterior* luxation of the lens is rare; this, however, requires rather urgent intervention to prevent endothelial damage. *Posterior* luxation, even if the lens capsules are intact, triggers an inflammatory response; removal is not an emergency but should not be deferred indefinitely. The removal technique depends on the hardness of the nucleus (mostly determined by the age of the patient) and on the surgeon's personal preference.

- *Phacofragmentation.*[14]
  - The energy of the ultrasound should be set at no more than 20%.
  - The infusion pressure must be set at no less than 40 mmHg.

12 As in virtually every trauma case, 20-g systems are recommended (see Chap. 2.9).
13 A preferred alternative is a flow-based system (peristaltic pump; see Chap. 2.9).
14 An ultrasonographic handpiece designed for intravitreal use.

- The aspiration must be linear; if the port is not occluded, instantaneous globe collapse occurs.
- The lens should be lifted into the midvitreous cavity using minimal aspiration and then the ultrasound is turned on. A second instrument,[15] inserted into the lens, is very helpful in keeping the lens from falling back onto the retina – even then, smaller lens particles will be falling down and need to be picked up repeatedly. The ultrasound must always be off when the probe is close to the retina. The lens often resembles Emmental ("Swiss") cheese before removal is completed.
- If phacofragmentation is performed for complications[16] of cataract surgery, the postoperative retinal detachment rate is around 5% [17]; in trauma-related cases the rate is probably significantly higher.

Pitfall

To reduce the risk of retinal detachment, a complete vitrectomy must be done *before* the onset of phacofragmentation. If a retinal dialysis or horseshoe tear and then detachment develop shortly after phacofragmentation, the surgeon may conveniently blame the complication on the original injury. Such retinal complications, however, may well have been caused by improper surgical techniques.[17] As a general rule, the shorter the time between injury/cataract removal[18] and the development of retinal detachment, the more suspect the technique of lens extraction is.

- *Lensectomy*. The vitrectomy probe can also be used to remove the lens, even if the nucleus is hard (e.g., in patients in their sixties). The nucleus is crushed into small pieces between the vitrectomy probe and another

15 e.g., pick light probe
16 i.e., "dropped nucleus" (see below)
17 e.g., the selection of an inappropriate method of lens removal (e.g., phacoemulsification instead of lensectomy)
18 Using phacoemulsification or ECCE

instrument (even the light pipe suffices), and the small pieces are removed one by one. The process is lengthy[19] but reduces the risks associated with intravitreal ultrasound use.

- Removal *in toto*. The lens can be extracted using an intraocular cryoprobe or with a vectis after floating it up with PFCL [14]. In the latter case, a complete PFCL fill is necessary, and the initial injection of the PFCL must be carefully done so that it gets underneath, not on top of, the lens. During fill-up, the lens may temporarily disappear from view: the initial shape of the enlarging PFCL bubble is more of a sphere, making the lens slide sideways. For *in toto* lens removal, a large limbal incision is necessary. Obviously, the eye must be aphakic.[20]

2.7.3.2 Capsular Breach

A breach in the *anterior* capsule is usually easy to see at the slit lamp, although good dilatation is needed if the lesion is peripheral. A posterior capsular breach is much more difficult to visualize, although it is often detectable on ultrasonography [12] or even at the slit lamp if posterior cortical material has "sunk" into the vitreous: an empty space is seen in the anterior cortex of the cataract. It is important to remember that a posterior capsular rupture can occur in isolation, i.e., without any other lens or even ocular pathology [16].

Common sense must be used: in the presence of an anterior capsular lesion and a posterior segment IOFB, it is very unlikely that the posterior capsule is intact (Fig. 2.7.3). The surgeon must be prepared for intraoperative surprises regarding capsular injury (Table 2.7.3).

Regarding management, no treatment is necessary for the breach itself, and its presence does not imply that subsequent cataract formation is inescapable since the break may spontaneously seal.

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19 Especially because the vitrectomy probe may get clogged and needs flushing repeatedly.

20 This is why in case of a "dropped nucleus" IOL implantation may be ill-advised before the lens is removed (see below).

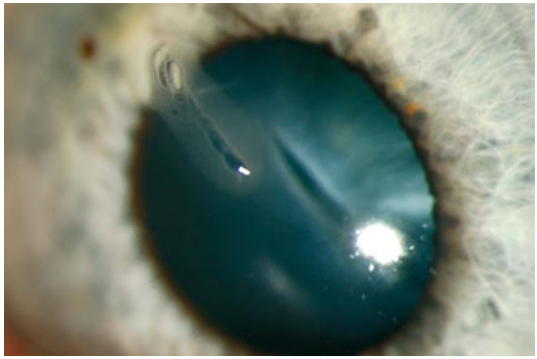

Fig. 2.7.3 Injury to the anterior lens capsule. The FB caused a corneal penetrating wound, an anterior capsule lesion, and a cataract. The corneal and capsular injuries provide trajectory information: a straight line drawn from the corneal wound and through the two capsular lesions should indicate the location of the potential impact site in the retina

2.7.3.3 Fragmentation

If the lens is in pieces, this always causes major inflammation and IOP elevation (see Chap. 2.18). Intervention is urgent.

Regarding management, all lens particles must be removed; the method depends on the location of the particles, the coexisting pathologies, the hardness of the nucleus, and the surgeon's personal preference (see above). Intense anti-inflammatory treatment must accompany the surgical intervention. An admixture of lens particles, vitreous, and blood is a uniquely potent inciter for PVR development.

2.7.3.4 Cataract

This is the most common type of lens injury and the one with the most significant visual consequence.[21] It can occur as a result of mechanical as

21 It must be noted that it is not always easy to definitely establish that a cataract is present; even experienced surgeons can err on either side: diagnosing a traumatic cataract when the lens is clear or declaring the lens to be clear when in fact there is cataract.

well as nonmechanical[22] trauma. The cataract can be partial (localized, focal) or total; the former may be stationary or progressive. The progression from minor to total lens opacity may take only hours (especially short in children; see Chap. 2.16) or may take years. Swelling with consequent IOP elevation is another factor to consider when the management options (i.e., removal or observation) are contemplated. The decision whether and when to intervene should also be influenced by the presence of, or potential for, posterior segment pathologies (Table 2.7.2).

Regarding management, the various techniques of lens removal have been described previously.

Pitfall

The different implications of removing an age-related (elective) cataract vs a traumatic cataract must clearly be understood by the surgeon. In an elective case, preservation of the capsular bag is important; for the trauma surgeon, avoiding iatrogenic damage to the retina is the main goal. It is not whether the IOL is in the bag[23] that determines the visual outcome but the integrity of the retina.

If vitrectomy is performed in an injured eye that has a risk high of, or already developed, PVR, and the lens needs to be sacrificed, both capsules must also be removed to reduce the surface ("scaffold") available for the proliferative cells. Preserving the capsule further increases the risk of anterior PVR as well as of phthisis (see Chaps. 2.9, 2.19).

- The lens is removed using a technique required by the eye's condition (see above) or the surgeon's preference. Depending on the surgical technique employed, one of capsules is left intact.
- A complete vitrectomy is performed.
- A capsulectomy is made with the vitrectomy probe or the MVR blade.

22 e.g., electricity/lightning; laser, microwave, thermal, and UV energy
23 As opposed to being in the AC, iris-fixated, or in the sulcus

- Utilizing the capsulectomy, the capsule is grabbed with a forceps, slowly rolled up ("spaghetti technique"[24]), and carefully removed. If the zonules are especially strong,[25] alpha-chymotrypsin[26] should first be injected under the iris, then removed by thorough irrigation. If the capsule tears, the other sclerotomy can be used to regrasp it.
- Scleral indentation is performed to assure that all of the capsule has been removed and the ciliary processes have been freed of all tissues.

The *timing* of lens removal must be carefully considered. If the injury is a contusion, and the IOP elevation and inflammation can be controlled medically, the decision is easily deferred. If, however, a wound is present and requires acute surgery, the surgeon must weigh the benefits and risks of primary vs secondary lens removal (Table 2.7.5; the flowchart in Fig. 2.7.4 explains the surgical strategy).

If lensectomy is performed and the anterior capsule is retained, it must be polished with the vitrectomy probe at low vacuum (flow)[27] and without cutting. The best method to visualize the efficiency of the polishing is to switch off the microscope light, hold the endoilluminator at the limbus, and aim its light at the capsule.[28] Preserving the anterior capsule means that the risk of iris damage and constriction of the pupil is reduced during the procedure, and, at least theoretically, the incidence of postoperative synechia formation is also decreased.

2.7.3.5 Iatrogenic Lens Damage

Although the discussion of surgeon-induced trauma is beyond the scope of this book, two important issues deserve to be mentioned briefly here:

24 A term coined by C. Forlini, Ravenna, Italy
25 Such as in young patients
26 See Chap. 2.4
27 If such a vacuuming is carried out, the surgeon must continually keep the probe moving on the back surface of the anterior capsule to avoid aspirating it into the port.
28 i.e., the endoilluminator is outside the eye, and its light enters the eye through the peripheral cornea

Table 2.7.5 Arguments for and against primary removal of a cataractous lens

For	Against
Single surgery: convenience and cost	Diagnosis may be false
Posterior segment immediately visible and surgery can planned according to the injuries found	Optimal surgical conditions not always available: proper equipment, experienced surgeon
Prevention of secondary complications (e.g., IOP elevation)	Increased inflammation
Immediate visual rehabilitation possible	Difficulty to determine optimal IOL power
Postoperative synechia formation will make secondary IOL implantation more difficult	Increased risk of secondary complications such as inflammation (especially if primary IOL implantation is also performed)

- A *dropped nucleus* during phacoemulsification should not be appreciated as a dreaded complication; inappropriate management of the complication should. Ideally, when lens is lost into the vitreous, the cataract surgeon instantly becomes an ocular traumatologist – or immediately calls for such a colleague's help.
  - The only acceptable management is vitrectomy, as described previously; never should "fishing" for the lens particles be performed [2].
  - If vitrectomy in the same session cannot be performed, the eye should be closed, anti-inflammatory therapy instigated, and vitreoretinal consultation sought.
  - The cataract surgeon may implant an IOL[29], but its disadvantages must be understood: it limits the removal options of the lost lens particle(s) (see above), and may make it more difficult to thoroughly clean the capsular bag.

29 Since it was the original goal of surgery, there is a strong desire on the surgeon's and the patient's part to have an IOL implanted at the termination of a cataract surgery.

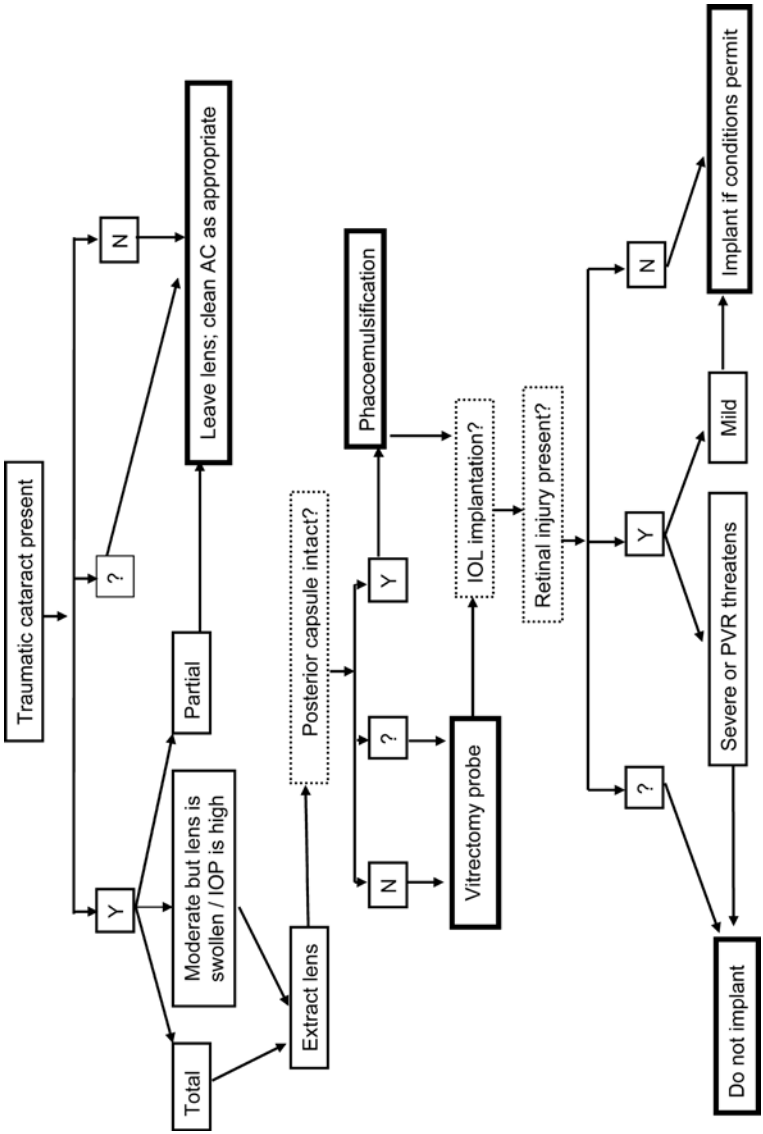
Traumatic cataract present
Y
?
N
Total
Moderate but lens is swollen / IOP is high
Partial
Extract lens
Leave lens; clean AC as appropriate
Posterior capsule intact?
N
?
Y
Vitrectomy probe
Phacoemulsification
IOL implantation?
Retinal injury present?
?
Y
N
Do not implant
Severe or PVR threatens
Mild
Implant if conditions permit

Fig. 2.7.4 The management flowchart for eyes with traumatic cataract. *Y* yes, *N* no

Lens touch during vitrectomy is a rare complication. The risk is higher if anterior PVR or retinal detachment is the indication because a judicious anterior vitrectomy is one of the goals of surgery. Paradoxically, wide-angle viewing systems have increased the risk since they make it more difficult to visualize the posterior capsule.

Pearl

Injecting a small air bubble into the anterior vitreous helps identify the plane of the posterior capsule and reduce the risk of lens touch.

If lens touch has occurred, the surgeon should not panic: unless the capsule is actually broken, cataract formation is not inevitable. If, however, major lens opacity does develop intraoperatively and interferes with visualization, cataract extraction must be performed to allow completion of the vitrectomy and unhindered postoperative viewing of the retina.

Lens "feathering" is described in Chap. 2.9.

2.7.3.6 IOL

2.7.3.6.1 Implantation

There are several methods to restore the eye's lost refractive power after cataract extraction.[30] Of these methods, the IOL is the one that is most convenient for the patient, although it has its own disadvantages.[31] Details of

30 Prescription glasses, contact lens, epikeratophakia

31 e.g., the optimal power is difficult to determine in children whose eye is still growing (see Chap. 2.16), and implantation represents additional trauma to the eye, especially if the IOL needs to be sutured into the sulcus

IOL implantation are beyond the scope of this book; only a few important issues are discussed briefly here:

- *Timing*. Whether primary [11, 13] or secondary [6] implantation should be performed remains a controversial issue. Primary implantation is important for a child in the amblyopic age, or if the patient is unable to afford a second procedure or return for one. Primary implantation causes increased postoperative inflammation and may interfere with subsequent retinal procedures due to visibility issues.[32] A careful individual decision must be made, but as a general rule, secondary implantation is recommended.

Cave

Primary IOL implantation should not be performed if the eye has a serious retinal injury or if the risk of PVR is high (see Chap. 2.9).

- *Type of implant*. Ideally, the IOL is placed in the bag; however, if this is not possible for the lack of adequate capsular support, the lens can be placed in the AC [20], fixated to the iris [22], or sutured into the sulcus.
- *Material of the implant*. Silicone IOLs should to be avoided, especially if posterior segment surgery with silicone oil use is expected; the oil may adhere to the IOL surface, making its removal very difficult [19].
  - One method to deal with silicone oil that is coating the IOL's surface is to grab a small piece of cotton[33] with a vitrectomy forceps, and wipe the IOL's surface with it. The oil cannot be removed completely, but it can be pushed toward the IOL's periphery to reduce its interference with the patient's vision.
  - If the zonules are weakened, use of a *capsular tension ring* may be considered; however, in a trauma case there are several unknowns,

32 The IOL's edge can be disturbing; opacification of the capsule is another issue to consider.

33 e.g., torn from a cotton-tipped applicator

and late, "unexplained" luxation of the IOL or even of the capsular tension ring itself may occur [9] if the zonules are weaker than expected.

2.7.3.6.2 Trauma to the IOL Already in Situ

Subluxation is usually treatable by simple repositioning; often it is only the haptic that is partially dislodged. If one of the scleral-fixated IOL's haptics is loose because its suture is broken, the intravitreally hanging haptic can be resutured using a simple technique.

- Prepare a scleral bed in the area where the IOL haptic needs to be fixated.
- Introduce a long, straight intracameral needle (see Chap. 2.6) 1 mm from the limbus through the scleral bed; the needle must be passed *behind* the haptic and *in front of* the optic of the IOL, and then partially[34] out of the AC on the other side.
- A 27-g hypodermic needle is passed into the AC 1 mm from the limbus through the scleral bed at some distance from the suture. This needle is passed *in front of* the haptic *and* optic of the IOL.
- The straight needle is pushed back into the barrel of the 27-g needle. The polypropylene suture is now looped around the free-hanging haptic.
- The 27-g needle is withdrawn from the eye, bringing the suture with it: the suture can now be tied, trimmed, and the scleral flap reattached.

Luxation into the vitreous may involve only the IOL or the IOL may still be inside the capsule (Fig. 2.7.5). The IOL luxation does not itself represent a major complication: erosion of the retina is unlikely, but vision is compromised because of the lost IOL power and because of the presence of a large floating object inside the vitreous cavity.

34 The suture end of the needle remains in the AC, only about a half of the needle is externalized.

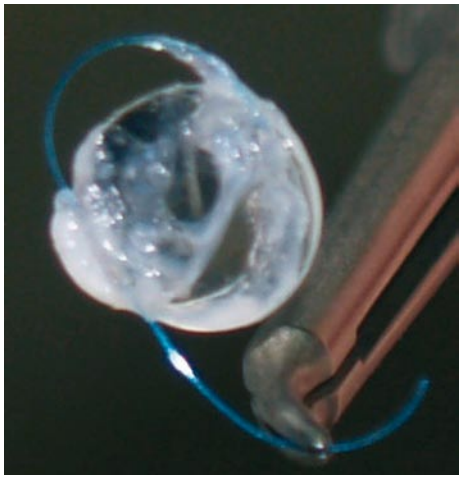

Fig. 2.7.5 Luxation of an IOL and its capsular bag. This IOL was removed from the vitreous cavity after a contusion injury; the IOL is still in the bag (Courtesy of Z. Slezak)

- If the capsular bag is sufficiently strongly held by the zonules and there is a large enough capsule left, the IOL can be replaced into or onto the bag. The following is a simple and effective technique:
  - Use an independent light source[35] so that a second instrument can be utilized if necessary.
  - Complete the vitreous removal, including that of the posterior hyaloid face.
  - Coat the endothelium with a dispersive viscoelastic.
  - Grab the *distant* haptic of the IOL with forceps: the forceps is in front of the optic of the IOL.[36]

35 e.g., Torpedo (Insight Instruments Inc., Stuart, Fla.).

36 Carefully avoid injuring the retina with the forceps as the haptic is grasped and not dragging the IOL over the retina.

- Rotate the IOL 180° so that the forceps is now *underneath* the optic of the IOL.[37]
- Place the proximal (superior) haptic into the capsular bag.[38]
- Bring the distant (inferior) haptic into the bag and release it.[39]
- The IOL can be removed through the pars plana [20] or the limbus [24]. If the lens is a foldable one, it can be re-folded or transected so that a smaller removal incision is needed.

Controversial

It remains to be determined whether intracameral manipulations to reduce IOL size (cutting or folding) so that a smaller incision is needed for extraction or the creation of a larger limbal wound is more traumatic to the eye long term.

- The IOL can also be sutured into the sulcus ("lasso" technique [8]) or fixed to the iris with a suture [3]. An excellent alternative[40] to suturing the IOL in a vitrectomized eye is to prepare two sclerotomies with a 24 g needle 1.5 to 2 mm from the limbus at 180° apart. The needles are also used to prepare two limbus-parallel sceral tunnels next to these sclerotomies. The haptics of the IOL are first externalized through the sclerotomies with a 25 g intravitreal forceps, and then buried into the tunnels, followed by final positioning of the IOL. This technique allows for great IOL stability without the need for keeping the eye open for extended periods of time during manipulations such as those necessary for sulcus-fixation. Instead of a pars plana approach, this technique can

37 The Revolution handle from Alcon (Fort Worth, Texas) or the "Syntrifugal" handle from Synergetics (Synergetics, East Windsor Hill, Conn,) offers easy rotation after grabbing.

38 Into the AC if the IOL must be removed.

39 The IOL can also be removed if both of its haptics are brought into the AC: a limbal wound is prepared and the IOL extracted. A replacement IOL can be inserted through the same wound.

40 The "sutureless intrascleral PCIOL fixation" technique was developed by Gaber B. Scharioth, Recklinghausen, Germany.

also be performed via corneal side port incisions and with the help of an AC maintainer.

The endoscope is of great help when dealing with a displaced IOL [18].

DO:

- carefully evaluate the lens to determine the nature of its injury so that the most optimal type of treatment can be selected
- be careful during cataract removal not to aspirate vitreous, presuming that vitreous prolapse is not present

DON'T:

- rush to remove the lens: what appears as cataract at the slit lamp may be fibrin only
- try to preserve at all cost the posterior capsule for in-the-bag IOL implantation; the eye may have a much better prognosis if the capsule is removed
- rush to implant an IOL primarily; secondary IOL implantation has distinct advantages

Summary

The vast majority of ophthalmic surgeons are knowledgeable about the elective removal of an age-related cataract. Treating an eye with a lens pathology caused by trauma, however, is different: the surgeon must not force his own favored extraction method on the eye but select an option that is optimal for the eye's specific condition, even if this means referral of the patient to a colleague more experienced in ocular traumatology.

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