Cataract formation is a well-recognized consequence of blunt and penetrating ocular trauma. Most often there is direct lens injury, contusive ocular damage, or lens dislocation and associated with traumatic injury to the cornea, iris, and vitreous.

**Pathophysiology**

Several mechanisms have been advocated in the pathogenesis of traumatic cataracts. Wolter and Weidenthal and Schepens have described the following main mechanisms responsible for ocular damage:

1. Traumatic coup
2. Traumatic contrecoup
3. Equatorial expansion of the globe
4. Penetrating Trauma

Coup injury refers to direct injury to the lens epithelium and capsule, resulting in either an abrasion, which may create focal, or progressive cataract formation, or rupture of the lens capsule, which often leads to rapid opacification of the lens (Figure 1).

Contrecoup injury refers to damage as a result of shock waves. Blunt trauma to the orbit may cause shock waves to pass through the eye, disrupting the anterior or posterior lens capsule and thus resulting in contusion cataract formation.

In blunt trauma, distortion of the globe in an anterior or posterior direction causes shortening of that meridian, with simultaneous equatorial scleral stretching. This may result in capsular rupture at the equator, causing lens opacification, or zonular dehiscence, with consequent lens subluxation or complete dislocation. Equatorial expansion can also disrupt the anterior hyaloid face, allowing vitreous to enter the anterior chamber through the disrupted zonules.

Penetrating trauma can cause total or localized cataracts. Penetrating trauma leading to capsular disruptions causes rapid opacification of the lens (Figure 2).

**Preoperative Evaluation**

In the case of penetrating trauma, the eye must be evaluated to determine the extent of open-globe injury prior to management of lenticular injuries. Open-globe injuries, especially those caused by blunt trauma, may be associated with subtle changes on examination, including decreased ocular motility, extensive bullous subconjunctival...
hemorrhage, chemosis, low intraocular pressure, shallow or excessively deep anterior chamber, or peaked pupil³.

The presence of lens dislocation, capsular tears, flocculent lens material, or vitreous in the anterior chamber should be noted. However, the presence and extent of lenticular damage is often difficult to determine because of poor visualization secondary to corneal damage, uveal irregularities, hyphema, and inflammation.

X-Ray/Computed tomography scan and ultrasonography can be helpful in ruling out the presence of an open globe and associated intraocular foreign body⁴.

The cataracts resulting from trauma are often evident on presentation; they may develop gradually over weeks to months after the injury (Figure 3). Patients may present with visual complaints of fluctuating vision, monocular diplopia, glare, or progressively worsening visual acuity.

When the extent of lens dislocation is out of proportion to the severity of trauma, a medical history of Marfan’s syndrome, Weill-Marchesani syndrome, homocystinuria, and syphilis may be elicited.

The lenticular examination should include determination of type (cortical, nuclear, capsular) and extent (focal or total) of lens opacity. The typical blunt trauma cataract is a star-shaped anterior subcapsular cataract, although other presentations, including a completely white, mature cataract, can also be seen. Evaluation of anterior chamber depth may reveal a deeper chamber with lens subluxation and a shallower chamber with an intumescent cataract or anteriorly displaced lens. Lens swelling and integrity of anterior and posterior capsule should also be noted. Lens dislocation may be subtle and may be detectable only with retro illumination after dilation. Examination of the patient in the supine position with a portable slit lamp may help to elucidate posterior lens subluxation with extensive zonular dehiscence. This may be helpful in deciding whether to remove the cataract through an anterior limbal approach or a posterior pars plana approach.

Intraocular inflammation may occur in traumatic cataract patients. The inflammation can be secondary to a traumatic iritis or posterior segment trauma or may be lens-induced. Acutely, lens-induced intraocular inflammation can result from lens particle release after capsular rupture.

One may also find, elevation of intraocular pressure due to intraocular inflammation, peripheral anterior synechiae, pupillary block, or angle recession deformity. The glaucoma may develop years later in cases of angle recession of more than 270°. Pupillary block glaucoma may result from posterior synechiae, phacomorphic changes, or lens dislocation. Gonioscopy is helpful in documenting angle and peripheral iris injuries.

When to do Surgery?

If visual acuity is good, patients may be observed for progression of symptoms due to the injury. Focal opacities outside the visual axis may cause glare or monocular diplopia. This may be treated with miotics aimed at maintaining a clear visual axis. Miotics are also helpful in the management of astigmatism and diplopia resulting from dislocated lenses. In cases of extensive subluxation, treatment with mydriatics may allow better vision with aphakic correction around the subluxated lens. Increased intraocular pressure and inflammation are often managed medically.

Surgical indications for the management of traumatic cataract include the following⁵:
Ocular Trauma

- Decrease in functional visual acuity
- Lens-induced glaucoma or inflammation
- Lens swelling from capsular rupture
- Poor visualization of posterior segment, which impedes management of injuries

Surgical Management

Surgical management of traumatic cataracts is performed through either an anterior limbal approach or a posterior pars plana approach. The choice is often based on the degree of lens injury and the likelihood of vitreous loss.

The anterior surgical approach is useful in the following circumstances: non-dislocated cataract with intact capsule, capsular rupture with cataract, subluxated lens with or without cataract, and anterior lens dislocation with or without cataract. The posterior surgical approach is useful in posterior capsular rupture with cataract, subluxated lens with or without cataract, and posterior lens dislocation with or without cataract.

Anterior Approach

Non-dislocated Cataract with Intact Capsule

Cataracts after blunt injury may develop long after the injury, which allows for scheduling of surgery under controlled conditions. Although the technique used for lens extraction is similar to that used for senile cataracts, the presence of glaucoma and associated iris injuries must be taken into consideration in planning the surgery.

Extracapsular cataract extraction or small-incision phacoemulsification may be performed. A large capsulorhexis is recommended. Capsular staining with trypan blue is recommended for performing continuous curvilinear capsulorhexis. Generous hydrodissection is important to avoid zonular stress during lens extraction. In young patients, the entire lens can be removed using irrigation-aspiration; however, more advanced nuclear sclerotic cataracts can be removed with a standard phacoemulsification technique or with extra capsular cataract extraction after wound enlargement.

Minimizing movement of the capsular bag with gentle phacoemulsification and aspiration with a manual irrigation-aspiration unit allow for more controlled lens extraction. This may help to minimize extension of any occult zonular dialysis and prolapse of vitreous into the anterior chamber during capsular staining.

Cataract and Associated Anterior Capsular Rupture

Rupture of the anterior or posterior capsule with either penetrating or blunt trauma leads to hydration of the lens cortex, which can be seen as flocculent material in the anterior chamber. With penetrating trauma, a primary lensectomy can be performed along with open-globe repair, with good visual outcomes. Without open-globe injury and in the presence of stable intraocular pressure and inflammation, surgical repair can be delayed to perform a thorough evaluation.

The surgeon must be prepared for zonular dehiscence and vitreous prolapse into the anterior chamber. Extracapsular cataract extraction or phacoemulsification may be performed. After the initial incision, viscoelastic should be placed in the anterior chamber to determine the extent of the anterior capsular rent and the presence of vitreous prolapse. Prior to nuclear extraction, a cutting-aspiration setting on vitrectomy cutter can be used to remove vitreous and flocculent cortical material from the anterior chamber to assess better the extent of capsular rent and zonular dehiscence. Diluted triamcinolone acetonide can be injected into the anterior chamber to detect the presence of vitreous. If not detected, automated irrigation-aspiration may be used. In minimal zonular dehiscence without posterior extension of the anterior capsular rent, the tear can be extended to can opener capsulotomy or continuous curvilinear capsulorhexis. The remaining lens material is extracted through a procedure similar to removal of cataract with an intact capsule.

Subluxated Lens with or without Cataract

Management of a subluxed lens depends on the degree of zonular dehiscence (Figure 4). An anterior approach may be used in cases wherein risk of posterior dislocation can be minimized. If the zonular dehiscence is small, with no overlying vitreous, the cataract can be managed with a routine anterior approach. When vitreous is present anterior to the lens, an anterior vitrectomy must be performed before lens removal. If zonular damage is 3-6 clock hours, without overlying vitreous, a capsular tension...
ring (CTR) may be used to stabilize the lens. With more extensive damage to the zonules, one or two sutured Capsule Tension Segment (CTS) or a Cionni Ring can be used along with a CTR. Where the lens cannot be salvaged due to extensive zonulolysis, intracapsular extraction should be considered. A secondary scleral fixated, iris fixated or anterior chamber IOL can be considered later in these cases.

The CTR may be inserted at any stage of the cataract procedure but typically is inserted before phacoemulsiﬁcation in traumatic zonular dehiscence. The CTR re-establishes the capsule’s contour, which protects the capsular fornix from being aspirated, avoids extension of the zonular dehiscence, and prevents vitreous prolapse secondary to the ﬂow of irrigation ﬂuid behind the posterior capsule. Postoperatively, the CTR also prevents capsular contraction and intraocular lens decentration. A modiﬁed CTR with a ﬁxation hook is also available for cases with severe or progressive zonular dehiscence. The hook arises from the loop, runs centrally, then curves anteriorly into a parallel plane, where it runs peripherally and ends in an eyelet for manipulation and suture placement. This allows for suture ﬁxation to the eye wall without distortion of the capsulorhexis opening.

Anterior Lens Dislocation with or without Cataract

Anterior dislocation of the lens (Figure 5) can lead to pupillary block and requires immediate surgical removal of the lens. Miotic drops may be used to trap the lens in the anterior chamber. If the lens is soft, irrigation-aspiration may be used through a small limbal incision. In the setting of a sclerotic nucleus and to prevent posterior dislocation of lens particles, the limbal incision can be enlarged to remove the entire lens using external pressure or an irrigating vectus. An anterior vitrectomy should be performed if there is vitreous in the anterior chamber after lens removal.

Posterior Pars Plana Approach

In cases with posterior capsular rupture with vitreous prolapse, posterior subluxation, or complete dislocation of the lens, a pars plana lensectomy with vitrectomy is the best approach. A complete vitrectomy with removal of the entire lens is important. Patients with dense nuclear sclerosis require ultrasonic fragmentation. A peripheral iridectomy is performed to prevent development of aphakic pupillary block.

Intraocular Lens Placement

Selection of lens material and implantation technique are dependent on the patient’s age, the optical and physical status of the contralateral eye, and the extent and nature of trauma to the involved eye. Refraction, A-scan ultrasonography, and keratometry readings of the contralateral eye may be helpful in determining the optical power of the lens to be implanted in cases with distorted anterior segment anatomy from the trauma. In the setting of an intact posterior capsule, a posterior chamber lens may be placed safely in the capsular bag. In eyes with localized zonular weakness, the intraocular lens can be placed in the capsular bag, with the haptics positioned perpendicular to the zonular defect, to expand and stabilize the capsular bag fully. In subluxations with only minor displacement of the lens, a CTR can also be used to center the lens in the optical axis. CTRs cannot recenter grossly decentered lenses and some form of suture ﬁxation such as CTS or Cionni Rings will be required for this purpose. If capsular bag implantation is unstable, the lens can be implanted in the ciliary sulcus with the 90-degree angle of the haptic toward the area of zonular dehiscence. An anterior chamber lens may be used in elderly patients with good iris support, no evidence of glaucoma, and an anterior chamber free of vitreous. However, given the high incidence of traumatic cataracts in young patients, anterior chamber lenses should be avoided because of the high risk of corneal endothelial injury and glaucoma from further angle injury. Simultaneous open-globe repair, cataract extraction, and posterior chamber intraocular lens implantation can be performed, with successful outcomes. Transscleral sutured posterior chamber lenses may be used at the time of cataract extraction or at a later date, with good results. Use of intraocular lenses in children with traumatic cataract repair has also been reported to produce good results. In children, the intraocular lens may be placed in the capsular bag or with transscleral suture ﬁxation.

References