

Traumatic Cataract: A Review

Keywords: Traumatic cataract; Ocular trauma; Intraocular lens; Capsular tears

Abstract

Purpose: Cataract formation is common following ocular trauma and is a major cause of vision loss worldwide. The purpose of this review article is to discuss the current approaches to treatment of traumatic cataracts.

Methods: Review of the recent literature regarding traumatic cataract was performed.

Results: The mechanisms behind cataract formation, as well as surgical indications, surgical planning and approach in the acute setting are discussed.

Conclusions: Uniformity in the classification and reporting of surgical results is needed to provide better care to patients with traumatic cataracts.

Introduction

Ocular trauma is frequently associated with the formation of a traumatic cataract [1-3]. Both blunt and penetrating trauma can cause damage to the crystalline lens. Cataract is estimated to occur in up to 65% of eye trauma cases, and is a major cause of acute and longstanding visual loss worldwide [1,4].

Cataract Formation

Opacification of the crystalline lens may occur immediately after trauma or may not appear for years [5]. The type of cataract formed is related to the nature and extent of the trauma [6]. The morphology of cataracts formed due to penetrating trauma is typically related to the size of the opening in the lens capsule. No standard morphologic classification exists [7]. Large capsular openings may cause the entire lens to rapidly become cataractous, while smaller openings may self-seal leaving only a focal opacity localized to the site of penetration. Cataracts may also form without any loss of capsular integrity due to forces of the original trauma or subsequent inflammation. Anterior subcapsular cataracts are formed when damage to the lens causes peripheral epithelial cells to undergo fibrous metaplasia, which creates an anterior fibrous plaque. Cataracts formed from blunt trauma often have a rosette or flower-shaped appearance, the petals of which correspond to sectors of cortical opacity [8]. Posterior subcapsular cataracts are also commonly associated with trauma [9].

Acute Assessment

In the setting of acute ocular trauma, a thorough assessment is made to determine the extent of ocular injury. This includes visual acuity, pupils, intraocular pressure, slit lamp biomicroscopy, dilated fundus examination, and ancillary imaging depending on the nature of the injury (frequently CT scan and B scan ultrasound). Obvious signs of zonular damage such as phacodonesis, iridodonesis, vitreous prolapse and lens subluxation should be looked for but may not be present. Subtle signs may include visibility of the lens equator during eccentric gaze, decentered nucleus in primary position, iridolenticular gap, changes in the contour of the lens periphery and



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focal iridodonesis [10]. The initial task is to determine whether a surgical or other acute emergency exists.

Surgical Indications and Timing

In the acute setting, surgery to remove a traumatic cataract has not traditionally been recommended [11]. Where a penetrating or perforating globe injury is present, the standard recommendation is primary globe closure, followed later by a “secondary” procedure to remove the cataract and place an intraocular lens (IOL). There are several advantages to this approach [12]. First, in the acute setting, the degree of cataract and its visual significance may not be readily apparent. Even with penetrating injuries that clearly involve the lens capsule; a small focal opacity may ultimately be visually insignificant once the eye has healed from the initial trauma [11]. Second, a “primary” procedure in conjunction with globe repair may not allow for a thorough assessment of associated injuries to the adjacent ocular structures, which are critically important in pre-operative cataract surgical planning. The surgery itself may be made technically more difficult due to poor visualization from resulting media opacities in the cornea, anterior and posterior segments. A primary approach may also limit an adequate assessment of retinal or optic nerve damage that, if severe, may make cataract surgery inconsequential. In addition, calculations for placement of an IOL and decisions about the type of lens and positioning may be compromised in the acute setting. One study has shown significant improvement in visual acuity in patients with open globe injury, following placement of a secondary IOL. The subsequent IOL implantation was performed at a mean of 4.63 months following the last surgical procedure related to the initial ocular injury [13]. Finally, a non-ideal operating room setting may have to be used with less experience staff, particularly when performed outside of standard operating hours, as is often the case with penetrating globe repair. Despite the above, and although no clear consensus exists, primary cataract removal in the acute setting may be preferred in certain situations and has been more frequently proposed in recent literature [3-4,7,14,15]. Some studies have shown a relationship between earlier surgical intervention and visual outcome [16]. In the acute setting, extensive lens capsular rupture can release flocculent cortical material into the anterior chamber. This may cause a significant inflammatory response and intraocular pressure elevation, which can improve with primary cataract removal

[1]. Another benefit of primary removal is earlier direct visualization of the posterior segment and optic nerve. In these settings, primary cataract removal combined as necessary with limited anterior vitrectomy may be preferred. Whether to also place an IOL during primary cataract removal is subject to debate, but favorable outcomes have been shown in several small case series where primary cataract removal with IOL placement was performed [4].

Considerations in Children

Children account for approximately one third of serious eye injuries [7,17]. In pediatric patients, consideration must be given to the timing of clearing the visual axis to prevent stimulus deprivation amblyopia, especially in children less than 5 years old. Cataract surgery should be performed within one year of the ocular trauma, as the risk of amblyopia can significantly increase with longer delay [18]. In addition, in pediatric eyes, a swollen cataractous lens can lead to pupillary block, which further supports prompt extraction to prevent phacomorphic glaucoma. Primary cataract removal, therefore, with or without IOL placement, may be more of a consideration in these cases [19]. Posterior capsule opacification (PCO), however, develops faster in eyes with traumatic cataract. Primary posterior capsulectomy and vitrectomy should therefore be considered for children having traumatic cataract surgery [20]. Other common complications include high positive pressure during surgery and fibrinous uveitis [21]. Epilenticular IOL implantation is one option that can help avoid these common complications, and studies have obtained clear visual pathways and improved visual acuity using this technique [21].

Of note, the use of contact lenses for unilateral aphakia is not an option for children in many parts of the world due to cost, inadequate sanitation and lack of availability. One study of children in sub-Saharan Africa supports the use of posterior chamber IOLs as the standard of care in all children older than the age of two, as this produces the best visual acuity results [22]. The same study reported that IOLs placed in the capsular bag were significantly less likely to require capsulotomy in the future, further decreasing the risk of amblyopia from the development of PCO. In cases from India where the posterior segment was not involved, it was shown that, following extracapsular CE with PCIOL implantation, visual acuity in children was better following blunt trauma versus penetrating trauma [23]. Of course, the presence of a non-congenital cataract in a child with a vague history of trauma should also raise the suspicion of possible child abuse.

Surgical Planning and Ancillary Testing

Cataract surgery for traumatic cataracts is frequently more complex than standard cataract surgery. This is due to associated damage to the lens capsule and zonules, the presence of synechiae and reduced media clarity leading to the increased risk of intra-operative lens dislocation, capsular rupture and vitreous loss. Thorough preoperative assessment and planning is key to achieving successful surgical outcomes. In the acute setting, where significant corneal and other media opacities obscure visualization, CT imaging may be helpful in initially suggesting the presence of a traumatic cataract [19,24]. Anterior and posterior lens capsular tears can occur simultaneously or separately [25]. Traditional B scan ultrasound is helpful in identifying a broad range of ocular pathology, but lacks

the resolution to image the integrity of the posterior capsule or zonular structures [26]. Alternatively, ultrasound echography using a 20-MHz frequency is an effective imaging modality for detection of occult posterior lens capsular rupture [26,27]. Ultrasound biomicroscopy is an effective method for identifying occult zonular damage in patients with anterior segment trauma [28], and may also be helpful in identifying small occult posterior capsular ruptures [29]. More recently, anterior segment OCT and Scheimpflug imaging [30,31] have been useful in determining the presence and extent of posterior capsular rupture and zonular integrity. These modalities, when available, have the advantage over ultrasound modalities of being noncontact. The disadvantage, however, is that they are limited by optical clarity that is often compromised after ocular trauma. Scheimpflug imaging has also demonstrated utility in localizing intraocular foreign bodies [32].

IOL Calculations

In the acute setting one may not be able to obtain accurate IOL calculations. Options include using data from the traumatized eye (where able), the fellow eye, or deferring IOL placement to a later secondary procedure. Several small studies show that acceptable IOL calculations can be obtained from the fellow eye in most cases. One study of 30 patients with open globes found that it was more accurate to use biometry of the injured eye after primary repair than to use the fellow eye for IOL calculations [15]. Some have suggested a role for light adjustable IOLs where the power can be changed post implantation to improve refractive outcomes in difficult cases such as trauma [33].

Surgical Approach

The choice of surgical approach is dependent on, among other things, the expertise and preferences of the surgeon, the status of the capsular bag, zonular support, synechiae and the presence of vitreous prolapse. A prospective randomized controlled trial of 120 patients has shown that performance of posterior capsulectomy and anterior vitrectomy as part of the primary procedure improves the final visual outcome. Therefore, this might be considered when forming the surgical approach [34]. In eyes with concomitant posterior segment abnormalities, pars plana lensectomy can be used to remove the traumatic cataract at the time of repair of the posterior pathology. This approach, however, has been associated with an increased risk of complications, including macular pucker, cystoid macular edema and secondary glaucoma [35]. In addition, general anesthesia is frequently preferred in the setting of open globe injuries, uncooperative patients, complex multi-step procedures and pediatric patients.

Pre-existing Anterior Capsular Tears

Pre-existing tears in the anterior capsule can usually be outlined using trypan blue staining. Capsulorhexis may be performed as in routine cataract surgery, with preference towards a complete circular capsulorhexis over a can-opener type opening. In some cases, a thick fibrotic capsule may require vannas scissors. It is important to avoid injuring the zonules, which may be aided by the use of flexible iris retractors to fixate the capsule and/or placement of a fixated capsular tension ring. In a few cases, femtosecond laser-assisted capsulorhexis has been performed in the setting of trauma and may prove beneficial

in achieving a more predictable capsulorhexis and in reducing zonular stress [36].

Pre-existing Posterior Capsular Tears

The management strategies for preexisting posterior tears depend on the type and size of the tear [22]. In Type 1 tears, which develop over time, the margins of the tear are thickened and fibrosed and the size of the tear is less prone to extension with irrigation. Type 2 tears are present when surgery is performed soon after the trauma. They have thin, transparent margins that may rapidly enlarge during irrigation-aspiration. Tears larger than 6mm are generally unable to support an in-the-bag IOL. Successful outcomes have been described using both posterior and anterior approaches. When using an anterior approach, precautions must be taken to not further hydrate the vitreous and extend the size of preexisting posterior tears. The methods for this are thoroughly addressed in the literature, but generally involve prevention of lens matter mixing with vitreous, establishment of a semi-closed system, dry aspiration techniques, meticulous control of infusion and anterior vitrectomy. Phacoemulsification, when used, is done with low flow rate and low ultrasound settings. Identification and thorough removal of vitreous prolapsed into the anterior chamber may be aided by the use of triamcinolone staining [37,38].

Zonular Support and IOL Positioning

Compromised zonular support may increase surgical complexity and lead to inadequate support for placement of an in-the-bag IOL. Pre-existing zonular compromise can easily be further weakened during surgery, particularly during capsulorhexis and cortical removal. Capsular tension rings (CTR) may be beneficial both as a support tool during surgery or as a long-term implant device for IOL fixation [39]. Preservation of the capsular bag, even in cases of traumatic subluxation, has been successfully demonstrated using fixated CTR [40,41]. In the presence of a small posterior capsular tear with capsular support, a foldable IOL can be placed in the bag [42]. Where capsular support is adequate, a three-piece IOL can also be positioned in the ciliary sulcus [43]. It has been shown; however, that improvement in visual acuity is statistically significantly higher when the IOL is placed in the bag compared to in the sulcus [44]. One explanation for this finding is those sulci IOLs incite a greater inflammatory response. When capsular support is not adequate, other options include an anterior chamber IOL, as well as iris and scleral suture fixated IOLs. In addition, newer techniques for glued sutureless scleral-fixated IOLs appear promising [45,46].

Outcomes and Unresolved Questions

Visual gain after traumatic cataract surgery is complex, dependent on many factors, and largely unpredictable. Utilization of the Ocular Trauma Score to predict visual acuity remains controversial as a recent study of 80 patients did not support its usefulness [44]. A lack of uniformity in the classification and reporting of most results limits their usefulness in addressing several unresolved questions, including: (1) primary vs. secondary cataract removal, (2) primary vs. secondary IOL placement, and (3) optimal surgical approaches. Methods to standardize classification and reporting of results in traumatic cataract outcomes are important steps to answering these unresolved questions, and, ultimately, to providing better care to patients with traumatic cataract [47-51].

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