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An Update on Ocular Trauma in Children with Behavioral Disorders

Mehrdad Motamed Shariati[1]*, Maryam Naghib[2]

[1] Eye Research Center, Mashhad University of Medical Sciences, Mashhad, Iran
[2] Psychiatry and Behavioral Sciences Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

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ABSTRACT

Ocular trauma is a major cause of visual impairment in children, and those with behavioral disorders may be at greater risk because of impulsivity, limited hazard awareness, and difficulty adhering to safety instructions. This narrative review provides an updated overview of the epidemiology, risk factors, clinical presentations, and management of ocular trauma in children with behavioral disorders, with emphasis on prevention strategies and long-term outcomes. A comprehensive literature search was conducted to identify studies investigating the association between behavioral disorders, such as attention-deficit/hyperactivity disorder (ADHD), autism spectrum disorder (ASD), and conduct disorders, and ocular injuries in children. The available evidence was synthesized to highlight recent findings, clinical challenges, and advances in management approaches. Children with behavioral disorders appear to have a higher incidence of ocular trauma and often present with more severe injuries, partly because of delayed recognition and treatment. Common causes include accidental self-inflicted injuries, falls, and object-related trauma. Diagnostic and management challenges arise from communication difficulties, sensory sensitivities, and limited behavioral cooperation. Recent evidence suggests that tailored preventive interventions, caregiver education, and multidisciplinary management may reduce the burden of ocular trauma in this vulnerable population.

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Introduction

Ocular trauma is a major health concern in children and remains a leading cause of acquired visual impairment and preventable blindness (1). Beyond the immediate physical damage, these injuries impose substantial socioeconomic burdens and may also increase parental anxiety. Identifying the major risk factors is essential because many pediatric ocular injuries are preventable with appropriate protective measures (2). In recent years, increasing attention has been directed toward the potential association between behavioral disorders, particularly attention-deficit/hyperactivity disorder (ADHD), and a higher risk of accidental injuries, including ocular trauma (3). Core features of certain behavioral disorders, such as impulsivity and hyperactivity, may place children in situations that increase their susceptibility to injury (4). This review aims to examine the frequency of ocular trauma among children with behavioral disorders, particularly ADHD, and to evaluate the evidence suggesting that these conditions may increase the risk of injury.

Methods

A comprehensive literature search was conducted to evaluate the relationship between behavioral disorders and ocular trauma in children. Relevant articles were identified through searches of PubMed, Scopus, Web of Science, and Google Scholar using combinations of the following keywords: ocular

***Corresponding author**: Dr.Mehrdad Motamed Shariati, MD, Eye Research Center, Khatam Al-Anbia Eye Hospital, Gharani Boulevard, Mashhad, Iran.
Tel: +989377388690 **E-mail:** Mehrdad_shariati2005@yahoo.com
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trauma, eye injury, pediatric ophthalmology, behavioral disorders, attention-deficit/hyperactivity disorder (ADHD), autism spectrum disorder (ASD), conduct disorder, self-injurious behavior, and prevention strategies.

The inclusion criteria comprised peer-reviewed studies, meta-analyses, case reports, and clinical guidelines published in English from 2015 onward. Priority was given to studies addressing ocular trauma in children with specific behavioral disorders. Exclusion criteria included studies focusing exclusively on adults, traumatic eye injuries unrelated to behavioral disorders, and articles lacking sufficient clinical detail.

The extracted data included epidemiologic trends, risk factors, common mechanisms of injury, clinical presentations, management approaches, and prevention strategies. The findings were synthesized to provide an updated perspective on ocular trauma in children with behavioral disorders, with emphasis on current challenges and emerging management strategies. In addition, gaps in the existing literature were identified to highlight priorities for future research.

Prevalence of Ocular Trauma in the General Pediatric Population

Ocular trauma is common in children. According to data from the American Academy of Pediatrics (AAP), 66% of all eye injuries occur in individuals aged 16 years or younger (5). In addition, children account for a substantial proportion of hospital admissions related to eye injuries, with reported rates ranging from 12.5% to 33.7% (5). Ocular trauma is also recognized as a leading preventable cause of monocular blindness in this age group (3). The annual incidence of pediatric ocular trauma has been estimated at approximately 15 per 100,000 children. However, this rate may be considerably higher in developing countries and in populations with lower socioeconomic status (6). In contrast, a population-based study conducted in Olmsted County, Minnesota, between 2000 and 2009 reported an annual incidence of 203 ocular or adnexal injuries per 100,000 children (4). Globally, pediatric ocular trauma accounts for 8% to 14% of all trauma-related hospital admissions (3). In a study from Turkey, pediatric ocular trauma represented 0.72% of all trauma-related emergency department admissions among children (3). This figure should be interpreted as a proportion of trauma admissions rather than as an incidence estimate in the general pediatric population. In Saudi Arabia, individuals younger than 18 years accounted for more than one-third of all reported ocular trauma cases (7). Taken together, these findings indicate that ocular trauma in children represents an important public health concern. However, reported rates vary substantially across studies depending on geographic setting, socioeconomic conditions, study design, and case definitions.

Demographic patterns consistently indicate that boys are more likely than girls to sustain ocular trauma, with reported male-to-female ratios ranging from 3:1 to 5.5:1 (5). This difference has often been attributed to greater participation in physically vigorous play, increased outdoor activity, and engagement in higher-risk behaviors among boys. The age group most commonly affected is typically between 9 and 11 years. However, some studies have reported a higher risk among younger children (<5 years) or older adolescents (11-15 years), particularly for sports-related injuries (5). Variations in the peak age of incidence across studies may reflect differences in activity patterns, exposure risks, and the characteristics of the populations studied.

The settings in which these injuries occur and their underlying mechanisms also follow recognizable patterns. A substantial proportion of pediatric ocular injuries occur outdoors, followed by injuries sustained in the home environment (5). Younger children are more likely to be injured in household accidents, whereas older children more commonly sustain ocular trauma during sports and recreational activities (6). Common causes and mechanisms of injury include sharp objects, toys, wooden sticks, pencils, sports participation, stones, fireworks, and toy guns (3). Although many of these injuries are accidental, a proportion may result from interpersonal violence or, more concerningly, child abuse (5). Reports indicate that up to 40% of physically abused children may present with ocular injuries, underscoring the importance of considering non-accidental trauma in the evaluation of pediatric ocular injuries (6). The shift in the predominant setting of injury from the home to outdoor and sports-related environments with increasing age likely reflects greater independence and broader participation in physical and recreational activities (6). This age-related pattern has important implications for the design of targeted prevention strategies.

Ocular Trauma in Children with ADHD

Research has demonstrated a significant association between ADHD and an increased risk of various types of injury. Individuals with ADHD have been reported to have up to a twofold higher risk of sustaining injuries overall than their neurotypical peers (8). In a study specifically involving adolescents aged 14 to 18 years, the frequency of any ocular injury was higher among those with ADHD than among those without ADHD (5.37% vs. 3.08%), with an odds ratio of 1.78 (95% CI: 1.739-1.829; $p < 0.001$) (8). These findings indicate a statistically significant increase in the risk of ocular injury among adolescents with ADHD. The same study also identified several less severe ocular conditions that were more common in the ADHD

group, including conjunctival hemorrhage, conjunctivitis, keratitis, and burns or corrosive injuries of the eye and adnexa. However, the incidence of lacerations did not differ significantly between the two groups (8).

Another study examined the frequency of ADHD among children aged 5 to 15 years who had sustained penetrating eye injuries (PEIs). The study reported a substantially higher rate of ADHD in the PEI group than in the healthy control group (48.7% vs. 17.5%; $\chi^2 = 7.359$, $p = 0.007$) (9). Logistic regression analysis further suggested that children with PEIs had a higher likelihood of having ADHD (OR = 3.538, 95% CI: 0.960-13.039; $p = 0.058$), although this association did not reach conventional statistical significance (9). These findings suggest a possible association between ADHD and penetrating eye injuries, a more severe form of ocular trauma, in younger children. Consistent with these findings, another study evaluated the relationship between penetrating eye injuries and ADHD-related symptoms in children aged 3 to 18 years using the Conners' Parent Rating Scale (CPRS). All CPRS subscale scores were significantly higher in the group with penetrating eye injuries than in the control group (all $p < 0.05$) (10). This finding indicates a greater burden of ADHD-related behaviors among children who had sustained penetrating eye injuries.

The increased susceptibility to ocular trauma in children with ADHD may be attributed to several factors related to the core features of the disorder. These children often have difficulty anticipating the potential negative consequences of risky behaviors. In addition, hyperactivity, impulsivity, distractibility, and impaired motor coordination may contribute to a greater likelihood of accidents, including those resulting in ocular injury. Adolescents with ADHD may also show a greater tendency to engage in high-risk behaviors, further increasing their risk of trauma (7). Together, these behavioral characteristics may place children with ADHD in situations that increase their risk of ocular injury.

Ocular Trauma in Children with Other Behavioral Disorders

Although most of the available evidence has focused on ADHD, existing reports also provide insight into the relationship between ocular trauma and other behavioral disorders in children.

In autism spectrum disorder (ASD), the mechanism of ocular injury appears to differ from that reported in ADHD. A case report described three children with ASD and self-injurious behavior (SIB) who developed bilateral cataracts secondary to self-inflicted blunt ocular trauma (11). One of these children also had a diagnosis of ADHD. Another case report described a 14-year-old boy with ASD and a history of self-injurious behaviors, including vigorous eye rubbing and head banging, who developed cataracts and retinal detachment (12). Although visual problems such as refractive errors and strabismus are known to be more common in children with ASD (13), current evidence does not clearly support a direct association between ASD and accidental ocular trauma unrelated to self-inflicted injury. Nevertheless, self-injurious behaviors in some children with ASD may result in severe ocular complications, including cataracts and retinal detachment (11,12). It is also possible that the higher prevalence of underlying visual abnormalities in children with ASD could indirectly increase the risk of accidental injury through impaired spatial awareness or depth perception; however, this possibility remains speculative and requires further investigation.

Risk Factors and Mechanisms

The increased risk of ocular trauma in children with behavioral disorders is multifactorial (Table 1). In ADHD, the core features of the disorder, including inattention, hyperactivity, and impulsivity, may substantially increase the likelihood of accidental injury (10). These characteristics may lead to impulsive actions without adequate appreciation of potential danger, increased physical activity in unsafe settings, and difficulty attending to safety instructions. In addition, the reported association between penetrating eye injuries and conduct disorder suggests that behaviors such as defiance, aggression, and disregard for rules may also contribute to risk-taking behaviors that increase the likelihood of ocular injury (10).

In ASD, self-injurious behaviors represent a distinct and important mechanism of ocular trauma (11). Repetitive behaviors such as hitting the head or face and vigorous eye rubbing may result in serious ocular complications, including cataracts and retinal detachment.

Beyond these disorder-specific mechanisms, children with behavioral disorders may be at increased risk of ocular trauma because of reduced supervision or difficulties understanding and following safety instructions. Their problems with attention, impulse control, and behavioral regulation may necessitate more structured and consistent supervision than that required for typically developing children. In addition, the interaction between behavioral disorders and established risk factors for pediatric ocular trauma, such as age, sex, socioeconomic status, and the play environment, may further increase the overall risk. For example, a hyperactive child with ADHD engaged in outdoor play without adequate supervision may be at particularly high risk of injury.

Table 1. Summary of ocular trauma in children with behavioral disorders

Behavioral Disorder	Main Mechanisms of Injury	Reported Ocular Injuries	Key Risk Factors	Clinical/Management Challenges
ADHD	Impulsivity, inattention, hyperactivity, and poor motor coordination	Conjunctival hemorrhage, keratitis, burns, and penetrating eye injuries	Risk-taking behavior, lack of supervision, and difficulty following safety rules	Delayed recognition, higher risk of severe trauma, and non-compliance with treatment
ASD	Self-injurious behaviors (eye rubbing, blunt trauma, head hitting)	Cataract, retinal detachment, and blunt trauma complications	Sensory sensitivities, vision problems, and reduced spatial awareness	Communication barriers, difficulty with examinations, perioperative protection
Conduct Disorder	Aggression, defiance, risk-taking behavior	Penetrating eye injuries, blunt trauma	Non-adherence to safety, violent play	Resistance to medical care, higher recurrence risk
General Pediatric Population (for comparison)	Accidents during play, sports, or home activities	Corneal abrasions, blunt trauma, foreign body, sports-related injuries	Male sex, 9–11 years old, outdoor play	Variable depending on the setting

Prevention Strategies and Safety Guidelines

Prevention of ocular trauma in children, particularly those with behavioral disorders, requires a multifaceted approach that combines general safety measures with strategies tailored to the challenges associated with each condition (Figure 1). General preventive measures include selecting age-appropriate toys, avoiding projectile toys such as darts, arrows, BB guns, and fireworks, and ensuring the use of protective eyewear during sports and other activities associated with a high risk of eye injury (14). Additional precautions include keeping hazardous chemicals and sharp objects out of reach and providing adequate supervision during activities that may pose a risk of ocular injury. Education for both children and caregivers about the importance of eye safety is also a key component of prevention.

For children with ADHD, impulsivity and inattention may necessitate closer supervision (14). Clear, repeated instructions regarding safe play and the appropriate handling of potentially hazardous objects are important. Environmental modifications, such as padding sharp corners or reducing access to hazardous items, may also help reduce the risk of injury. Encouraging participation in structured and supervised activities may further limit unsupervised risk-taking behaviors. Ongoing reinforcement of safety rules and of the potential consequences of unsafe behaviors is also likely to be beneficial.

In children with ASD and self-injurious behavior, a multidisciplinary approach involving ophthalmologists, psychiatrists, and behavioral therapists is essential (11). Interventions aimed at reducing and managing self-injurious behaviors are central to the prevention of ocular trauma in this population (11). The use of protective devices, such as safety goggles or helmets with face shields, may be required, particularly during the postoperative period following ocular surgery (11,15,16). Environmental modifications to reduce triggers for self-injurious behaviors, together with visual supports and consistent routines to improve understanding of safety-related expectations, may also be beneficial (15).

Regular comprehensive ophthalmic examinations are important for all children, but especially for those with behavioral disorders, because they facilitate early detection of injury and monitoring for potential complications (14). Early recognition and timely intervention may improve visual outcomes and reduce the risk of long-term sequelae.

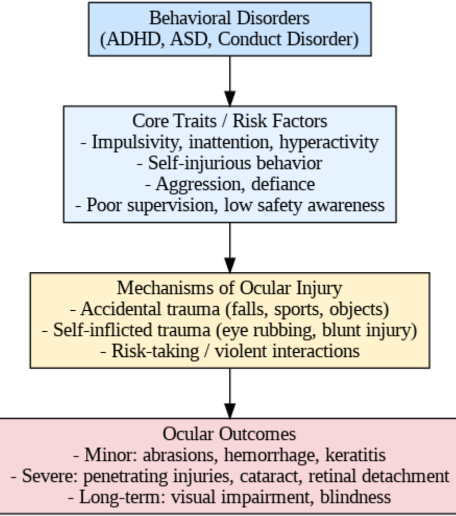

Figure 1. Conceptual framework indicating how behavioral disorders predispose children to ocular trauma through core traits and risk factors, leading to injury mechanisms and a spectrum of ocular outcomes.

Conclusion

The available evidence suggests that children with behavioral disorders, particularly ADHD, are at increased risk of ocular injury. Core features of these disorders, including impulsivity, hyperactivity, and inattention, may increase the likelihood of accidents resulting in ocular trauma. In children with ASD and self-injurious behaviors, ocular injury may occur through self-inflicted mechanisms and may lead to serious complications such as cataracts and retinal detachment. Recognition of this increased risk by parents, caregivers, educators, and healthcare professionals is essential for implementing targeted prevention strategies and safety measures tailored to these children's needs. Such strategies should address both general eye safety and the disorder-specific factors that contribute to injury risk. Further research is needed to clarify these associations and to inform more effective prevention and intervention approaches aimed at protecting vision in this vulnerable population.

Competing interests:

The authors declare no competing interests.

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Author Contribution:

Mehrdad Motamed Shariati was involved in the work's conception and design. Mehrdad Motamed Shariati and Maryam Naghib were involved in data acquisition and literature review. Mehrdad Motamed Shariati contributed to manuscript drafting. Both authors have read and approved the manuscript.

All authors have read and approved the submitted version of the manuscript and have agreed to be personally accountable for the author’s contributions and the accuracy and integrity of any part of the work.

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