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REVIEW ARTICLE

Pediatric ocular trauma and visual repercussions, Systematic review

Trauma ocular pediátrico y repercusiones visuales. Revisión sistemática

Trauma ocular pediátrico e repercussões visuais. Revisão sistemática

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ABSTRACT

Introduction: in 2016, approximately 55 million patients worldwide suffered eye injuries. The burden of suffering after eye injuries is very high, especially due to the consequences of these injuries, which are largely responsible for monocular blindness. **Objective:** to systematize the theoretical references on pediatric ocular trauma and its impact on visual results.**Method:** a systematic review of pediatric ocular trauma and its impact on visual outcomes was carried out, based on the literature published in PubMed, Trip Medical Database and British Medical Journal in the period 2018-2022. The level of evidence found was evaluated using the Oxford scale and the sex, age, type of ocular injury, place of occurrence of the ocular trauma and reported post-injury sequelae were determined. **Results:** the evidence collected was mainly from retrospective cross-sectional studies that correspond to the level of evidence according to the Oxford 2b scale. Ocular trauma was more common in boys (77%) than in girls (23%) and the average age was 10.5±1.96 years. There was a higher incidence of blunt ocular trauma (56%). Places outside the home were the most reported (64%). Regarding the consequences of ocular trauma in pediatric ages, it could be observed that the highest frequency reported was the absence of sequelae (52.16%), compared to 48.47% of those refueled with sequelae. **Conclusions:** there are basic considerations that can be communicated to the patient that can prevent serious or permanent effects on vision. Professional ophthalmological examination allows early evaluation and avoids complications due to underestimation of acute eye injury.

Keywords: ocular trauma; emergency; orbit; children; consequences; aftermath; pediatrics

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RESUMEN

Introducción: en 2016, aproximadamente 55 millones de pacientes en todo el mundo sufrieron lesiones oculares. La carga de sufrimiento tras las lesiones oculares es muy alta, sobre todo por las consecuencias de estas lesiones, que son en gran parte responsables de la ceguera monocular. **Objetivo:** sistematizar los referentes teóricos sobre el trauma ocular pediátrico y su impacto en los resultados visuales. **Método:** se realizó una revisión sistemática del trauma ocular pediátrico y su impacto en los resultados visuales, basada en la literatura publicada en PubMed, TripMedical Database y British Medical Journal en el periodo 2018-2022. El nivel de evidencia se evaluó mediante la escala de Oxford y se determinó el sexo, la edad, el tipo de lesión ocular, lugar de ocurrencia del trauma ocular y secuelas pos-lesión reportadas. **Resultados**: la evidencia recolectada fue principalmente de estudios retrospectivos de corte transversal que corresponde a nivel de evidencia según escala de Oxford 2b. El trauma ocular fue más común en niños (77 %) que en niñas (23 %) y la edad promedio fue de 10,5±1,96 años. Hubo mayor incidencia de trauma ocular cerrado (56%). Los lugares fuera del domicilio fueron los más reportados (64%). En lo que refiere a las consecuencias de los traumatismos oculares en edades pediátricas se pudo observar que la mayor frecuencia reportada fue la no presencia de secuelas (52,16%), contra el 48,47% de los repostados con secuelas.**Conclusiones**: existen consideraciones básicas que se pueden comunicar al paciente que pueden prevenir efectos graves o permanentes en la visión. El examen oftalmológico profesional permite una evaluación temprana y evita complicaciones por subestimar la lesión ocular aguda.

Palabras clave: trauma ocular; emergencia; órbita; niños; consecuencias; secuelas; pediatría

RESUMO

Introdução: em 2016, aproximadamente 55 milhões de pacientes em todo o mundo sofreram lesões oculares. A carga de sofrimento após lesões oculares é muito elevada, especialmente devido às consequências destas lesões, que são em grande parte responsáveis pela cegueira monocular. **Objetivo:** sistematizar os referenciais teóricos sobre trauma ocular pediátrico e seu impacto nos resultados visuais. **Método:** foi realizada uma revisão sistemática sobre trauma ocular pediátrico e seu impacto nos resultados visuais, com base na literatura publicada no PubMed, Trip Medical Database e British Medical Journal no período 2018-2022. O nível de evidência encontrado foi avaliado pela escala de Oxford e foram determinados sexo, idade, tipo de lesão ocular, local de ocorrência do trauma ocular e sequelas pós-lesão relatadas. **Resultados:** as evidências coletadas foram principalmente provenientes de estudos transversais retrospectivos que correspondem ao nível de evidência da escala Oxford 2b. O trauma ocular foi mais comum em meninos (77%) do que em meninas (23%) e a idade média foi de 10,5±1,96 anos. Houve maior incidência de trauma ocular contuso (56%). Os locais fora de casa foram os mais relatados (64%). Quanto às consequências do trauma ocular em idade pediátrica, pôde-se observar que a maior frequência relatada foi a ausência de sequelas (52,16%), contra 48,47% dos reabastecidos com sequelas. **Conclusões:** Existem considerações básicas que podem ser comunicadas ao paciente e que podem prevenir efeitos graves ou permanentes na visão. O exame oftalmológico profissional permite avaliação precoce e evita complicações por subestimação da lesão ocular aguda.

Palavras-chave: trauma ocular; emergência; órbita; crianças; consequências; consequências; pediatria

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INTRODUCTION

According to the World Health Organization (WHO), in 2016, approximately 55 million patients worldwide sustained eye injuries.(1)

The burden of suffering following eye injuries is very high, especially because of the consequences of these injuries, which are largely responsible for monocular blindness.(2) These consequences are even more worrisome when analyzed in the context of pediatric patients who, because of their young age, present significant visual limitations that impair their quality of life. Blindness due to ocular trauma is one of the leading causes of visual impairment worldwide.(3)

Ocular and orbital trauma can exist in infants in isolation or appear in association with orbitocraniofacial trauma and are the second most frequent cause of pediatric emergency ophthalmologic care.(4)

It is important to consider that the etiology of eye trauma in pediatric patients is varied and includes physical abuse, so much so that in the United States it is estimated that 1-2% of pediatric patients suffer abuse and that nearly 1,000 children die annually as a result of abuse.(5) Previous data show that approximately 40% of children who have been physically abused develop some ophthalmologic sign or repercussion.(6)

Ophthalmologic manifestations of child abuse include: conjunctival and palpebral ecchymosis, periorbital lacerations and burns, exophthalmos, corneal erosions, hyphema, glaucoma, lens dislocation or subluxation, penetrating ocular trauma, retinal detachment and retinoschisis, among others.(7) These findings are part of the criteria of the so-called "battered child syndrome", therefore, in view of these findings, child abuse should be considered within the diagnostic algorithm of our patients.

Previous reports indicate that the hospitalization rate of children diagnosed with ocular trauma is approximately 15 per 100,000 ocular trauma patients.(7)

In recent years, there has been an increase in the incidence of eye injuries in emergency Ophthalmology services worldwide, and these injuries vary in presentation from mild superficial injuries to severe injuries. Therefore, the ophthalmologic examination of these patients should be rigorous and attempts should be made to exclude serious eye injuries.(6)

It is estimated that nearly 500 000 eye trauma patients go blind each year and trauma is the leading cause of monocular blindness worldwide, making eye trauma a global public health problem.(7)Blindness is one of the most dreaded disabilities and, of all etiologies of blindness, that of traumatic origin is the most sudden and dramatic.(8)

One of the most important considerations is that ocular trauma has a recurrent presentation pattern, after a first trauma there is a three times greater probability of suffering a second ocular trauma.(1)

Ocular trauma in pediatric patients is considered preventable injuries, with adult supervision being the determinant that most reduces the incidence; on the other hand, low educational or socioeconomic status is associated with an increased risk of presenting these injuries.[9]

Background

Eye injuries are one of the leading causes of vision loss and account for up to 90% of cases, most of the affected population groups are of reproductive age with severe social and economic consequences.[1]

It is estimated that approximately 1.6 million people are blind due to eye injury, which manifests as reduced vision in both eyes and, in some cases, blindness in both eyes due to the injury.[8]

Eye injuries are very common in infants, according to a study in Cuba, which showed that in addition to the prevalence of injuries, the age group with the highest risk of eye injuries is 6 to 9 years old. In 64.5 % of male patients, the most frequently reported etiology was trauma with stones, wood or toys while playing sports, suggesting an incidence of blindness after eye trauma in infants ranging from 1 % to 34 %.[9]

Previous studies have confirmed that the most frequently reported ocular injuries after eye injuries in children are: corneal laceration, scleral laceration and lens damage, with less reported palpebral lacerations, uveal prolapse, anterior chamber anomalies, retinal detachment and optic nerve damage.[1] The epidemiology of ocular injuries depends on several factors, such as lifestyle, socioeconomic conditions, sports and recreational activities.[10]

Eye injuries, even minor ones, represent a significant financial burden due to the need for special attention and care for affected patients, high medical care costs, long-term follow-up and the need for vision rehabilitation. In Ecuador, statistical figures on eye trauma have not been established; however, they account for a high percentage of daily emergency room visits in the country, with approximately 40% of all patients treated for different types of trauma.[11]

Justification

The eye occupies only 0.27% of the total body surface and is the third most injured organ after the hands and feet,[12] but previous studies have shown that eye injuries account for 10% of bodily injuries.[13]

Ecuador has published studies on ocular trauma in pediatric patients in previous years, such as Legrá Nápoles (2014), who refers an interesting study in Pediatric Ophthalmology developed at the Eugenio Espejo Hospital in Ecuador, where he demonstrates that open ocular trauma is frequent and severe, and has persistent consequences for the quality of vision of affected patients.[13]

More recently, in 2018, Avila K.[14]in his work on the prevalence and associated factors of eye injuries in Cuenca, reported that the prevalence of eye injuries was 29.9% and males accounted for 57.32%. Most of the patients were between 27 and 65 years of age.

In 2021 Páez A, et al.[15]addressed eye trauma in children in a general way, by including it in their analysis in their article "Traumatismo craneoencefálico leve en población infantil. Experience at the Baca Ortiz Hospital, Quito-Ecuador, 2016-2019". During that period, 105 children were diagnosed and treated with mild ECT, being this more frequent in the male sex (62.85%) and during the preschool stage (51.42%); it is also concluded that mild cranioencephalic trauma is one of the main reasons for pediatric hospital consultation in our environment.

Pediatric ocular trauma and its consequences on visual outcomes

Ocular trauma is defined as trauma originated by an object that contuses the eyeball causing tissue damage. Depending on the degree of involvement, ocular trauma can be classified as mild-moderate-severe, and will compromise visual function, temporarily or permanently.[16]

In the pathophysiology of ocular trauma, the eyeball is a soft and slightly flexible structure that suddenly compresses forward and backward after impact, compensating for these changes expands the medial region and then returns to its normal shape with further trauma. These phenomena account for the damage to the anterior and posterior segments of the eyeball.[17]

The variety and diversity of structures affected necessitates the development of a standardized taxonomy of case reports. Thus, in the 1990s the BETTS classification was established, derived from Birmingham Eye Trauma.[18]

Ocular traumas

These are the ones that mainly damage the eyeball and are divided in order: injuries in closed eyes and injuries in open or penetrating eyes.

Closed ocular traumas: the eyeball after receiving the trauma remains closed, it does not present total thickness rupture of the ocular wall. They are subdivided into: lamellar lacerations (partial thickness injury to the eye wall) and contusions (without injury to the eye wall).[19]

Open ocular trauma: the eyeball after receiving the trauma presents a full-thickness rupture in the ocular wall, which is composed of the sclera and cornea.[20]

Periocular lesions: they mainly affect the structures surrounding the eyeballs and include: a) preseptal lesions: When the ocular trauma affects the periocular skin, eyelids, lacrimal or nasolacrimal canals, peri ocular ecchymosis[21] and b) Orbital conditions: When the ocular trauma affects the orbital septum, as in cases of: orbital fractures, periorbital muscle involvement, orbital compartment syndrome, orbital foreign bodies, periorbital muscle involvement, orbital foreign bodies, traumatic optic nerve neuropathy, optic nerve avulsions, ophthalmic artery lesions.[22]

Ocular trauma classifications

BETTS System

Mentioned above, it consists of the Birmingham Eye Injury Terminology System (BETTS) was established by Kuhn,et al. in 1996 to provide simple and clear definitions of all types of injuries and their locations through a comprehensive framework.

The BETTS classification standardized the terminology used in relation to eye injuries and gave way to the definition of eye injuries in terms of their causal mechanisms and injury prognosis. According to the BETTS classification, eye injuries are classified according to their damaged structures into ocular injuries and periocular injuries.[22,23]

Although attempts have been made to improve the BETTS systems, none have been consistently included. It includes fracture, penetrating injury, punctures injury, intraocular foreign body, and mixed in an open eyeball injury and defines an open eyeball injury as a full-thickness injury to the eyeball caused by a sharp or blunt instrument that causes the eyeball to open.[22,23]

OTS System

Subsequently, Kuhn himself and other eye injury experts at the University of Alabama at Birmingham, USA, developed a new practical system for visual prediction based on initial injury assessment and BETTS, which provides estimates of potential visual range.

The system, known as the Ocular Trauma Score (OTS), allows specialists to inform patients of their chances of sight recovery using first sight and other variables related to injury type and eye test results, with some accuracy.[24,25,26]

This is mainly because, prior to this classification, prognosis was always based on expert experience, as there were no specific predictor variables to create and reproduce prognoses objectively. Both the standardized BETTS classification and the OTS system now allow for accurate prognostication of lesion classification and visual acuity.[27,28]

The correct application of OTS offers the potential to predict the final functional outcome with 77% certainty, 90.9% sensitivity and 100% specificity in terms of final visual acuity.[29]

Epidemiological characteristics of pediatric ocular trauma

Gender and age

Ocular trauma consultations are predominantly male in all age groups (M/F=2/1). This is due to increased physical contact, more aggressive behavior, and the nature of men's work and is more common among young people under 30 years of age.[4]

Among pediatric patients, males and school-aged children are more common, with the lowest incidence of eye damage in children under 2 years of age, which may be explained by greater parental protection.[30]

Location of occurrence

Some studies show that locations outside the home are more dangerous, with higher reports of eye injuries in pediatric patients.[31] With this in mind, one might think that eye injuries increase during the warmer months of the year as children play more and go outside, but various studies show that this varies by season.[32]

Types of eye trauma

The causes of eye injuries are often related to sports and play. Previous studies have reported that approximately 59% of cases are due to accidental falls and/or collisions, and 37% and 12% are due to injuries to the hands or feet of another child.[33]

Trauma can be of closed or open type, open trauma also called incised trauma is a form of presentation of trauma, where it is generally recognized the existence of an object (sharp or not) that causes the injury, which can produce palpebral laceration, partial or total thickness with involvement of the free edge or without it or, on the contrary, palpebral tearing with loss of substance.[34,35]

Ocular post-traumatism

Ocular trauma is the main cause of acquired monocular blindness in children, so it is requested to join efforts to identify the factors related to the etiology of these pathologies in order to reduce its incidence.[36]

There is evidence that shows that the final outcome and subsequent decrease in vision or permanent blindness is more prevalent in patients with socioeconomic limitations, mainly due to the difficulty of access to specialized health services.

Other risk factors for ocular trauma are poverty, race (black and Hispanic), drug use, violation of traffic rules, unemployment, lack of adequate eye protection in sports and workplaces, lack of parental supervision of their children's activities.[37]

According to WHO, 90% of people with visual impairment live in low-income countries and 28% of people with moderate and severe visual impairment are of working age. These visual impairments affect a person's ability to lead a productive life and impair employment prospects. Although it is estimated that 80% of most cases of visual impairment are preventable or treatable, access to prevention, education, treatment, and rehabilitation services is very limited.[38]

The lack of use of personal protective equipment in motor vehicle accidents or occupational accidents speaks of the lack of regularization in this area and represents a fertile field for preventive medicine.[39]

However, no large-scale epidemiological studies of ocular trauma in pediatric patients have been carried out in Ecuador so far. For this reason, the present study is relevant and pertinent and aims to close a knowledge gap in Ecuadorian health care, providing quality evidence to better understand the causes of pediatric ocular trauma and its consequences and, thus, establish evidence-based strategies to improve the care of these patients.

METHOD

This is a systematic review of the literature, concerning ocular trauma in pediatric patients and its consequences on visual outcomes, based on scientific evidence published in indexed databases such as PubMed, Trip Medical Database and British Medical Journal (BMJ) in the period 2018-2022.The present work follows the guidelines of the PRISMA 2020 statement.[40]

For information extraction, a database was designed in Microsoft Excel 2019. The analysis of the level of evidence and grades of recommendation of the included studies was performed using the Oxford Classification of the Levels of Evidence (OCEBM).[41]

The variables: sex, age, place of occurrence of trauma, type of trauma, and consequences of pediatric ocular trauma most frequently reported in the evidence analyzed were analyzed.

Inclusion criteria:

- Studies published in databases indexed in PubMed, Trip Medical Database, and British Medical Journal (BMJ).
- Studies published in the last five years.
- Retrospective, cross-sectional studies.
- Studies conducted in pediatric patients (0 to 21 years old). Studies published in English language.

Exclusion criteria:

- Adult patients.
- Studies published in languages other than English.
- Literature published before 2018.
- Other types of studies, other than retrospective cross-sectional studies.

To conduct the research, a five-step procedure was established (Figure 1):

1) Initial Search based on MESH terms and Boolean operators: ((ocular) AND (trauma)) AND (pediatric)).

This search strategy was replicated in the three selected meta-search engines.

2) Once the results were obtained, the established inclusion and exclusion criteria were applied.
3) The articles obtained from the previous step were subjected to an initial review of abstracts and summaries, selecting the desired studies.

4) Once the studies were selected, they were subjected to an extensive full-text review.
5) Once the studies were completely reviewed, the final analysis was performed and the data necessary for the present work were obtained.

A total of 10,895 articles were identified for primary review; the final review was performed on 16 articles.

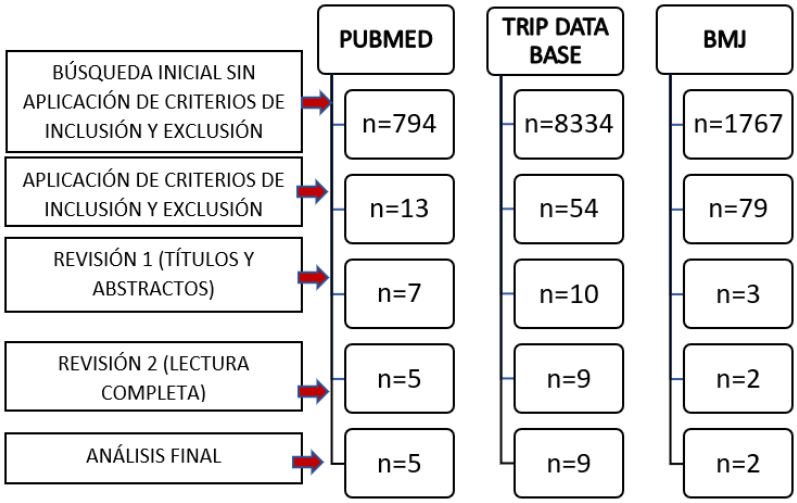

Fig. 1 Procedure used for study selection

The level of evidence was assessed using the OXFORD Evidence Rating Scale, Extended Medical Use Scale, which is characterized by evaluating the evidence according to the specialty or clinical setting and the type of research that addresses the clinical question in question.[41] This has the advantage of evaluating the evidence according to the best design for each clinical setting, adding intentionality and systematic reviews in different settings. In the specific case of prognosis for the event of interest, evidence is available from one of the cross-sectional prevalence studies or, failing that, a single cohort with at least 80% cohort follow-up obtained from research.[42,43]

In order to measure the risk of bias, the following aspects of the study were taken into account: selection, conduct, detection, attrition, modification, among others; these steps have been described by the Cochrane Collaboration tool for assessing the risk of bias.

As this was a qualitative study, it was possible not to include summary measures; however, the synthesis of search results is shown in the PRISMA model.[40] For better illustration, a synthesis was subsequently made using simile means of central tendency for all the results presented, in addition to a descriptive summary of the results. The results were expressed in a frequency table.

RESULTS

Detailed results reflected in tables can be found in the Supplementary file (at the end of the article).

Of the articles included in the present work (n=16) have reported sex/gender data as percentages in a total of (n=14) studies, the overall percentages of male patients was 77% and of female patients 23%.

Of the articles included in the present work (n=16) have reported median age data in a total of (n=16) studies, the overall median age percentages of all patients included was 10.5 years, with a variance of ±1.96 years.

Of the articles included in the present work (n=16) have reported ocular trauma type data in a total of (n=15). These were summarized in two general categories according to the BETTS classification: closed ocular trauma and open ocular trauma. The overall percentages of closed ocular trauma were 56% and open ocular trauma 44%.

Of the articles included in the present study (n=16), a total of (n=7) reported data on the place of occurrence of ocular trauma. These were summarized in two general categories according to data from previous studies: at home and other places. The overall percentages of ocular trauma occurring in the patients' homes were 34% and in other places was 64%.

Of the articles included in the present work (n=16) have reported data on ophthalmic sequelae following ocular trauma in a total of (n=16). These were summarized into two general categories according to data from previous studies, into: without sequelae and with sequelae. Generally, the percentages of patients without sequelaewere 52.16% and with sequelae was 48.47%.

CONCLUSIONS

Once the general results have been obtained, we can say that male children are more likely to present eye trauma, and we can also identify that the age of presentation of most of the cases reported is around 10 years of age (school age) and in places other than the home; For these reasons, based on the evidence reviewed, we can recommend education and awareness plans for the prevention of activities with high risk of ocular trauma, in medical units and educational establishments at the local level. This will allow us to have an impact on the population with the highest risk of presenting this type of diagnosis and prevent them, in addition to visualizing the importance of preventing ocular trauma which, as this work indicates, leaves sequelae in a significant percentage of patients.

It is important to mention that several reports consider that visual sequelae in patients who have received ocular trauma will always be present, with greater intensity in patients who have suffered open ocular trauma, but in several studies that have evaluated the visual acuity of their participants; all have reported some chronic decrease in visual acuity secondary to ocular trauma. This is important to consider because, although these are not serious sequelae, tissue involvement is present and may exacerbate previous or chronic conditions such as myopia, astigmatism, retinal detachment or chronic ophthalmopathy.

On the other hand, there are basic considerations that can be communicated to the patient that can prevent serious or permanent effects on vision. This means active parental supervision, use of appropriate protective equipment when participating in high-impact sports activities, and immediate search in case of trauma. Professional ophthalmologic examination allows for early evaluation and avoids complications from underestimating acute eye injury.

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Base de datos de revisión sistemática sobre trauma ocular pediátrico y repercusiones visuales