Jurnal Profesi Medika : Jurnal Kedokteran dan Kesehatan
DOI: https://doi.org/10.33533/jpm.v18i2.9087
Vol 18 No 2 (2024) ISSN 0216-3438 (print); ISSN 2621-1122 (online)

ARTICLE

CLINICAL CHARACTERISTICS AND MANAGEMENT OF PEDIATRIC EYE TRAUMA IN NATIONAL TERTIARY EYE HOSPITAL IN INDONESIA

Alya Putri Axa[1*], Primawita Oktarima Amiruddin[1], Sesy Caesarya[1]

[1]Fakultas Kedokteran, Universitas Padjajaran, Bandung, Indonesia

***Correspondence email** : alyaaxa1611@gmail.com

ABSTRAK

Eye trauma is a major cause of vision problems in children, leading to visual impairment and blindness. This issue has significant global implications, affecting children psychologically and socially. According to the American Academy of Pediatrics, 66% of all eye traumas occur in individuals under 16, with the highest occurrence between ages 9 and 11. We conducted a retrospective descriptive study using medical records of pediatric patients aged 0 - 18 years who experienced eye trauma from January to December 2022 at the National Eye Center-Cicendo Eye Hospital. There were 190 patients included in this study. The majority of patients were male (69.47%) and the most common age group affected was 6 - 12 years (33.16%). Leading causes of eye trauma were blunt trauma (58.95%). The common management for eye trauma in this study is operative or medical procedures (67,37%) This study provides valuable information on the characteristics and management of eye trauma in children, which can contribute to the development of prevention strategies and appropriate interventions. Understanding the patterns of eye trauma and implementing comprehensive care can help prevent blindness and minimize visual impairment.

Keywords: Eye trauma; Children; Management

АБСТРАКТ

Травма глаза является основной причиной проблем со зрением у детей, приводящей к ухудшению зрения и слепоте. Эта проблема имеет значительные глобальные последствия, влияя на детей в психологическом и социальном плане. По данным Американской академии педиатрии, 66% всех травм глаза случаются у лиц в возрасте до 16 лет, причем самая высокая частота — в возрасте от 9 до 11 лет. Мы провели ретроспективное описательное исследование с использованием медицинских карт детей в возрасте от 0 до 18 лет, которые получили травму глаза с января по декабрь 2022 года в Национальном глазном центре — глазной больнице Чичендо. В это исследование было включено 190 пациентов. Большинство пациентов были мужчинами (69,47%), а наиболее распространенной затронутой возрастной группой была 6–12 лет (33,16%). Основными причинами травмы глаза были тупые травмы (58,95%). Обычным лечением травм глаз в этом исследовании является оперативное или медицинское лечение (67,37%). Это исследование предоставляет ценную информацию о характеристиках и лечении травм глаз у детей, что может способствовать разработке профилактических стратегий и соответствующих вмешательств. Понимание закономерностей травм глаз и реализация комплексного ухода могут помочь предотвратить слепоту и минимизировать нарушения зрения

Ключевые слова: Травма глаз; Дети;Лечение

Submitted: 5 August 2024 ; Received in revised form: 21 August 2024 Accepted: 30 October 2024 ; Available online ; 17 December 2024
Published regularly: December 2024

INTRODUCTION

Eye trauma is a major cause of monocular visual impairment and unilateral congenital blindness in children, and it is a significant problem worldwide with psychological and social effects that impact children.[1,2] Prevention of Blindness America estimates that 35% of the approximately 2.4 million ocular injuries occur in children under 17 years of age.[3,4]

American Academy of Pediatrics (AAP) reported that 66% of all eye trauma occurred in individuals less than 16 years of age, with the highest frequency occurring between the ages of 9 to 11 years.[2] According to Riset Kesehatan Dasar (Riskesdas) Kementerian Kesehatan Indonesia in 2018, eye trauma is among the six most common types of trauma. The estimated number of eye trauma cases in Indonesia is 46,488 cases per year.[5]

The impact caused by eye trauma varied, ranging from mild to severe physical impacts, psychological, social, to material impacts.[6]

Prognosis for the eye that experienced trauma depends on the type of trauma, location of the injury, extent of the wound, involvement of the posterior segment, and the presence of infection. Prompt and appropriate measures in managing eye trauma can prevent blindness, visual impairment, and damage. It is crucial to have a thorough understanding of the patterns of eye trauma to implement effective prevention and treatment strategies. It is known that up to 90% of eye traumas can be prevented through improved education, proper supervision, and the use of appropriate eye protection.[7,8]

From January to December of 2022, the National Eye Center-Cicendo Eye was the location where this study was conducted with the intention of determining the clinical characteristics of eye trauma in pediatric patients and the management of such injuries. In order to prevent eye injuries in youngsters, it is anticipated that the data will serve as information and a reference.

MATERIAL AND METHODS

This study is a descriptive retrospective study that obtained data from the medical records of new pediatric patients aged 0 - 18 years at the National Eye Center-Cicendo Eye Hospital during the period from January 1st to December 31st, 2022, who experienced eye trauma. Ethical approval for this research has been obtained from the Ethics and Research Committee of Padjadjaran University with protocol number 358/UN6.KEP/EC/2023. Inclusion criteria for this study were the medical records of pediatric patients with eye trauma aged 0-18 years and pediatric patients who experienced eye trauma with various etiologies. Exclusion criteria for this study were incomplete data, cases of pediatric eye trauma with unknown etiology, and patients who did not attend follow-up appointments at least 1-month post-operation. The data collected in this study included demographic characteristics, clinical characteristics, and management.

The demographic characteristics in this study encompassed age, gender, domicile, payment method (BPJS is a National Health Insurance that consist of non-PBI if members independently pay the insurance fee and PBI if the insurance fee is covered by the Government), onset of trauma, and patient status. The clinical characteristics included initial and final visual acuity, etiology of trauma, type of trauma, and laterality.

The initial and final best corrected visual acuity, collected from the patient's medical records, was assessed based on the visual acuity at their first visit and their last follow-up. Visual acuity was categorized using verbal and preverbal classification. For the verbal group, the BETT (Birmingham Eye Trauma Terminology) classification was used, which includes the following categories: ≥0.5, 0.4 to 0.2, 0.19 to 0.025, 0.02 to light perception, and no light perception. The preverbal group included counting fingers close to face (CFFC), blink reflex, and fix and follow, and non-cooperative patients.[9]

Etiology of trauma is categorized into sharp trauma, blunt trauma, chemical trauma, and

 DOI: https://doi.org/10.33533/jpm.v18i2.9087 Vol 18 No 2 (2024)

thermal trauma.[10] Onset refers to the time takes for patients to seek medical care to Cicendo National Eye Hospital. In this study, the distribution of onset is divided into the following categories: less than 24 hours, 24 hours - 3 days, 4 days - 2 weeks, and more than 2 weeks.11Laterality in this study included unilateral (ocular dextra and ocular sinistra) and bilateral. Management in this study was categorized into operative or medical procedures, medicines, and conservative. The data was analyzed using Microsoft Excel 2019 software and then presented descriptively.

RESULT

The results obtained from this study consisted of 336 data. Among them, 190 children met inclusion criteria, while 146 were excluded due to a lack of follow-up visits. Analysis presented in Table 1 indicates a higher prevalence of eye trauma among male patients comprising 132 cases (69.47%), compared to female patients, who accounted for 58 cases (30.53%). In terms of age distribution, the most common age group affected by eye trauma was children aged 6-12 years, with 63 cases (33.16%), followed by the age range of 25 months to 5 years, which accounted for 59 cases (31.05%). The data also revealed that West Bandung Regency had the highest number of cases, with 72 children (37.89%), followed by Bandung City with 60 children (31.58%). Most of the eye trauma patients used non-BPJS payment methods, totaling 101 cases (53.16%), followed by BPJS non-PBI with 70 cases (36.84%). The patients in the National Eye Center-Cicendo Eye Hospital can be categorized into two groups based on their arrival status. Out of the total, 86 children (45.26%) were referred patients. The remaining 104 children (54.74%) arrived at the hospital independently and come directly to the hospital without a referral. The majority of patients in this study arrived within 24 hours, with a total of 128 children (67.37%), followed by 36 children (18.95%) who came between 24 hours - 3 days after the incident.

Table 1. Demographic Characteristics

Demographic Characteristics	Frequency (n=190)	Percentage (%)
Age		
0 - 12 month	16	8.42%
13 – 24 month	14	7.37%
25 month - 5 year	59	31.05%
6 - 12 year	63	33.16%
13 - 18 year	38	20.00%
Gender		
Female	58	30.53%
Male	132	69.47%
Place of Origin		
Bandung Area	60	31.58%
West Java (Exclude Bandung Area and West Bandung Regency)	54	28.42%
Outside West Java	4	2.11%
West Bandung Regency	72	37.89%
Payment Method		
BPJS non PBI	70	36.84%
Non-BPJS	101	53.16%
BPJS-PBI	19	10.00%
Referral Status		
Referral	86	45.26%
Initial visit	104	54.74%
Onset		
>2 weeks	7	3.68%
4 days–2 weeks	19	10.00%
24 hours-3 days	36	18.95%
<24 hours	128	67.37%

Table 2 presents a number of etiologies that were discovered during this research. Blunt trauma was detected in 112 children (58.95%), making it one of the most common etiologies. Sharp trauma was observed in 53 children (27.37%), making it the second least common. The form of trauma that occurred most frequently was lamellar laceration, which affected a total of 49 children (22.63%). Contusion, which affected 38 children (20.00%), rupture, which affected 37 children (19.47%), and non-mechanical trauma, which affected 26 children (13.68%), were the other different types of trauma that occurred. The right eye was the eye that was affected the most frequently, with a total of 94 children (49.47%), followed by the left eye, which had 84 children experiencing the condition (44.21%).

 DOI: https://doi.org/10.33533/jpm.v18i2.9087 Vol 18 No 2 (2024)

Table 2. Clinical Characteristics

Clinic Characteristics	Frequency (n=190)	Percentage (%)
Etiology		
Blunt Trauma	112	58.95%
Sharp Trauma	52	27.37%
Chemical	16	8.42%
Thermal	10	5.26%
Type Of Trauma		
Mechanical		
Closed Globe		
Laserasi Lamellar	43	22.63%
Contusio	38	20.00%
Mix	9	4.74%
Open Globe		
Ruptur	37	19.47%
Penetrasi	17	8.95%
Perforasi	14	7.37%
IOFB	6	3.16%
Non-Mechanical	26	13.68%
Laterality		
Unilateral		
OD	94	49.47%
OS	84	44.21%
Bilateral (ODS)	12	6.32%

IOFB: Intraocular foreign body

As shown in Table 3, toys are the main cause of eye trauma with a total of 24 children (12.63%) followed by household appliances with 22 children (11,58%).

Table 3. Causes of Trauma

Causes	Frequency (n=190)	Percentage (%)
Toy	24	12.63%
Household appliance	22	11.58%
Floating Objects	20	10.53%
Household Buildings	18	9.47%
Fall	15	7.89%
Animal	11	5.79%
Part of body	11	5.79%
Chemicals	11	5.79%
Scissors	10	5.26%
Plant	9	4.74%
Traffic Accident	8	4.21%
Glass	5	2.63%
Wire	5	2.63%
Glue	4	2.11%
Cigarette	4	2.11%
Stick	4	2.11%
Fireworks and Fire	4	2.11%
Stationery	3	1.58%
Knife	2	1.05%

As shown in Table 4, cornea (26,74%) and palpebra (25,58%) are the most commonly injured part of the eye.

Table 4 Location of Trauma

Location	Frequency (n)	Percentage (%)
Cornea	69	26.74%
Eyelid	66	25.58%
Conjunctiva	36	13.95%
Iris	30	11.63%
Lacrimal System	33	12.79%
Lens	8	3.10%
Sclera	8	3.10%
Orbital Bone	4	1.55%
Retina	2	0.78%
Optic Nerve	2	0.78%

In Table 5, the distribution of initial and final best-corrected visual acuity values for patients with eye trauma is presented, comprising a total of 202 eyes. Eye trauma involving only the right eye was found in 33 cases (35.11%), with visual acuity values ≥ 0.5 being observed, followed by visual acuity fix and follow object 17 cases (18.09%). The final visual acuity assessment for the right eye showed improvement, with 44 cases (46.81%) having visual acuity values ≥ 0.5, followed by 14 cases (14.89%) fix and follow objects. Eye trauma involving only the left eye was found in 35 cases (41.67%), with visual acuity values ≥ 0.5 being observed, followed by 8 cases (9.52%) with visual acuity values of 0.025-0.19. The final visual acuity assessment for the left eye showed improvement, with 40 cases (47.62%) having visual acuity values ≥ 0.5, followed by 14 cases (16.67%) with visual acuity values of 0.2-0.4.Eye trauma involving both eyes was found in 11 cases (45.83%) with visual acuity values ≥ 0.5 being observed, followed by 4 cases (16.67%) with visual acuity values of 0.2-0.4. The final visual acuity assessment for eye trauma involving both eyes showed improvement, with 15 cases (62.50%) having visual acuity values ≥ 0.5, followed by 2 cases (8.33%) with visual acuity values of 0.025-0.19. The recorded management in this study included operative or medical procedures (Table 6), totaling 128 children (67.37%). The most common procedure was eyelid suturing

 DOI: https://doi.org/10.33533/jpm.v18i2.9087 Vol 18 No 2 (2024)

(Table 7), 45 cases (22.50%), followed by corneal suturing in 30 cases (15.00%). Medicine was conducted in 58 children (30.53%), while 3 children (1.58%) refused treatment due to financial constraints, and 1 child (0.53%) underwent conservative management was a case of phthisis bulbi with an onset of 1 month and a referral case.

Table 5. Best Corrected Visual Acuity

BCVA	Initial BCVA		Final BCVA	
	Frequency (n=202)	Percentage (%)	Frequency (n=202)	Percentage (%)
OD				
Verbal				
≥ 0,5	33	35.11%	44	46.81%
0,2 – 0,4	13	13.83%	10	10.64%
0,025 – 0,19	8	8.51%	7	7.45%
LP - 0,02	12	12.77%	8	8.51%
NLP	2	2.13%	3	3.19%
Preverbal				
CFFC	3	3.19%	2	2.13%
blink reflex	1	1.06%	1	1.06%
fix and follow object	17	18.09%	14	14.89%
Uncooperative	5	5.32%	5	5.32%
OS				
Verbal				
≥ 0,5	35	41.67%	40	47.62%
0,2 – 0,4	7	8.33%	14	16.67%
0,025 – 0,19	8	9.52%	6	7.14%
LP - 0,02	5	5.95%	5	5.95%
NLP	1	1.19%	1	1.19%
Preverbal				
CFFC	1	1.19%	1	1.19%
blink reflex	0	0.00%	0	0.00%
fix and follow object	19	22.62%	10	11.90%
Uncooperative	8	9.52%	7	8.33%
ODS				
Verbal				
≥ 0,5	11	45.83%	15	62.50%
0,2 – 0,4	4	16.67%	1	4.17%
0,025 – 0,19	3	12.50%	2	8.33%
LP - 0,02	0	0.00%	0	0.00%
NLP	0	0.00%	0	0.00%
Preverbal				
CFFC	0	0.00%	0	0.00%
blink reflex	0	0.00%	0	0.00%
fix and follow object	6	25.00%	4	16.67%
Uncooperative	0	0.00%	2	8.33%

Table 6. Management of Eye Trauma

Management of Eye Trauma	Frequency (n=190)	Percentage (%)
Operative or Medical	128	67.37%
Procedures	58	30.53%
Medicine	3	1.58%
Refused Treatment	1	0.53%
Conservative		

Table 7. Operative or Medical Procedures

Operative or Medical Procedures	Frequency (n)	Percentage (%)
Eyelid suturing	45	22.50%
Corneal suturing	30	15.00%
Irrigation	24	12.00%
Washout of the anterior	23	11.50%
chamber (COA)	19	9.50%
Canaliculus repair	18	9.00%
Iris repositioning	8	4.00%
Scleral corneal suturing	7	3.50%
Extraction of the foreign	6	3.00%
body	4	2.00%
Eyelid margin repair	3	1.50%
Conjunctival suturing	2	1.00%
Synechiolysis	2	1.00%
Lens extraction	2	1.00%
vit tap + IVAB	2	1.00%
Sclera suturing	1	0.50%
PPL + PPV + EL	1	0.50%
AI+	1	0.50%
sycheolisis+pupilopasty+/-		
VA+/-IOL	1	0.50%
Core virectomi	1	0.50%
Corneal patch graft+		
pupilloplasty + fine needle		
diathermy		
ORIF + release muscle		
Cantotomy cantolysis		

DISCUSSION

From January to December 2022, a total of 190 pediatric patients and 202 eyes presented to the National Eye Center-Cicendo Eye Hospital with a history of eye trauma. Several studies have indicated that the occurrence of eye trauma is more common in developing countries.[12] The age group that experienced the highest number of eye trauma cases was children aged 6 to 12 years, with a total of 63 children (33.16%), compared to other age groups. Research conducted in India by Madan also revealed that children aged 6 to 11 years had the highest percentage of hospitalizations due to eye trauma (39.3%).[1] This is because school-aged children are more susceptible than younger age groups, and incidents often

 DOI: https://doi.org/10.33533/jpm.v18i2.9087 Vol 18 No 2 (2024)

occur accidentally due to their natural curiosity and clumsiness.[8]

Eye trauma is more commonly observed in boys compared to girls. A similar trend was identified in a study conducted by Bayar in Turkey, where a higher proportion of boys experienced eye trauma compared to girls, accounting for 61.9% and 38%.[14] since boys are generally more susceptible to eye trauma because their adventurous and aggressive nature, and perhaps being less supervised by their families.[3,15]

West Java Regency and Bandung City are the first and second highest origins of pediatric eye trauma cases, closely linked to the management of eye trauma based on the time it takes for patients to reach the appropriate treatment center, whether it is the National Eye Center-Cicendo Hospital or the nearest healthcare facility. Research conducted by Molly indicated that residing in rural areas significantly raises the risk of mortality from traumatic injuries compared to non-rural residents when receiving treatment at Level I or II trauma centers, even after accounting for factors such as injury severity and comorbidities.[16]

Non-BPJS payment method became the most common transaction method, with a total of 101 transactions (53.16%). This correlation is plausible because eye trauma cases are considered emergencies that require prompt treatment.[3]

A total of 45.26% of patients with eye trauma were referred to the National Eye Center-Cicendo Eye Hospital, either from other hospitals or clinics indicating that they have received initial care before being referred. This shows that there are limitations and difficulties in managing patients with eye trauma, which are related to the constraints of human resources and healthcare facilities in handling such cases.[17]

The most common onset of eye trauma in this study was less than 24 hours before admission to the hospital. The time gap between the injury and the initial intervention had a substantial impact on the final visual outcome. Additionally, this timing greatly influenced the visual prognosis.[13]

Blunt trauma (58.95%) was the most commonly found etiology in this study, followed by sharp trauma (27.37%). This differs from a study conducted at RSUD Bima NTB, where the most common cause of trauma was sharp objects, accounting for 39.3% of cases.[18], the differences comes up from the different cultures and society. However, this study is consistent with the research conducted at Philipines by which also found that blunt trauma was the most common type, accounting for 54.65% of cases.[8,12]

The most commonly found type of trauma in this study is Lamellar Laceration (22.63%), followed by Contusion (20.00%). This is because the majority of cases are caused by blunt objects, which is related to the diagnosis and mechanism of trauma occurrence. Consistent with the research conducted in Kashan, the incidence of Lamellar Laceration trauma was 55.8%. However, it differs from the study conducted by Martina, which found that the most common type was Contusion (74%), followed by Lamellar Laceration (10.4%).[3]

Eye trauma is generally unilateral, involving only one eye, but involvement of both eyes can also occur. The right eye was found to be the most commonly affected eye in cases of eye trauma in this study at 49.47%, followed by the left eye at 44.21%, and both eyes at 6.32%. Park reported that the right eye was the dominant eye in eye trauma, accounting for 39%.[19] This is hypothesized to be since the majority of children predominantly use their right hand, which leads to a higher likelihood of right eye involvement in cases of eye trauma.[19]

In this study, it was found that toys were the primary cause of eye trauma cases (12.63%). Toys are closely associated with children, and it is not uncommon for toys to be made of or contain sharp parts that can injure the eyes. Therefore, close supervision by parents or teachers is crucial to prevent unwanted incidents. When it comes to using toys safely, it's important to check age labels, avoid choking hazards by selecting toys with no

 DOI: https://doi.org/10.33533/jpm.v18i2.9087 Vol 18 No 2 (2024)

detachable parts or small sizes, steer clear of toxic materials like lead and phthalates, choose sturdy constructions without sharp edges, monitor electronic toys with secure battery compartments, consider the child's skill level to prevent frustration or injury, provide adult supervision during playtime, verify the reliability of the manufacturer, and always prioritize safety by following the provided usage instructions. Prioritizing these measures ensures safe and enjoyable playtime for children.[20]The second leading cause is household objects (11.58%). In contrast, in Park's study, the main cause of eye trauma in Korea was reported to be traffic accidents, resulting in major trauma (56.7%).[19]

Eye trauma is often accompanied by associated injuries related to the underlying mechanism of the trauma. Some patients may have one or more associated injuries simultaneously, and a comprehensive examination is necessary for patients with eye trauma to evaluate the possibility of other orbital organ injuries. This is consistent with a study conducted by Terill et al., which explains the interconnection of other organs in orbital trauma that is closely related to the mechanism of the underlying trauma.[17,21]

After obtaining information about the demographic and clinical history of eye trauma, it is important to evaluate the visual system. Visual assessment should be performed using methods appropriate for the patient's age. Although the same type of trauma occurs, its impact on vision can vary depending on the patient's age.[11]

This study shows that the majority of patients with eye trauma in the right eye, left eye, or both eyes had an initial and final best-corrected visual acuity (BCVA) of ≥ 0.5. The improvement in visual acuity is likely due to some children being uncooperative during the examination. However, there were still cases with a final visual acuity of no light perception, which accounted for 4 patients with a history of onset ranging from 3 days to 2 weeks. It is suggested that having good best corrected visual acuity at the time of presentation and prompt primary repair are critical for achieving a better final visual outcome. Generally, variety of involvement of the eye segment negatively impacts visual prognosis.[14]

The management of pediatric eye trauma requires various specific considerations. Evaluation and treatment often become more challenging as children tend to be active and cry during examinations. Even in school-age children, those who have experienced trauma tend to refuse any approach to their eyes. When initial evaluation indicates the need for surgical intervention, it is preferable to delay detailed eye examination until the patient is in the operating room under general anesthesia. The fundamental goal of treating pediatric eye trauma is to restore the integrity of the eye while optimizing visual potential through four methods aimed at risk avoidance and outcome optimization: reducing the risk of further trauma, reducing the risk of infection, minimizing psychological trauma to the victim and their family, and addressing legal issues. Different protocols need to be implemented for the pediatric age group due to the risks of amblyopia, intraocular inflammation, and significant vitreoretinal adhesions.[22]

This study had certain limitations, including the exclusion of a significant number of children who did not attend follow-up visits. Additionally, the study did not investigate the seasonal patterns of eye trauma occurrences. The researchers recommend that future studies focus on examining and monitoring the factors contributing to children's reluctance to attend follow-up visits.

CONCLUSION

Children are more susceptible to eye trauma due to their immature motor skills, limited common sense, and natural curiosity. A safe environment should be maintained for children. The majority of pediatric eye trauma can be prevented, highlighting the importance of prevention education, adult supervision, and the implementation of appropriate measures to reduce the incidence and severity of trauma.

ACKNOWLEDGMENT

We did not have any financial support

DECLARATIONS

The authors declare no conflict of interest.
No additional information is available for this paper.

REFERENCES

1. Madan AH, Joshi RS, Wadekar PD. Ocular trauma in pediatric age group at a tertiary eye care center in central Maharashtra, India. Clinical Ophthalmology. 2020;14:1003–9. DOI: https://doi.org/10.2147/OPTH.S244679
2. Bućan K, Matas A, Lovrić JM, Batistić D, Borjan IP, Puljak L, et al. Epidemiology of ocular trauma in children requiring hospitadmission: A 16-year retrospective cohort study. J Glob Health. 2017 Apr 29;7(1). DOI: https://doi.org/10.7189/jogh.07.010415
3. Oiticica-Barbosa MM, Kasahara N. Eye trauma in children and adolescents: Perspectives from a developing country and validation of the ocular trauma score. J Trop Pediatr. 2015 Aug 1;61(4):238–43. DOI : https://doi.org/10.1093/tropej/fmv010
4. D'Antone V, Flórez DCP, García CJL, Manrique FDMC, Barbosa NL. Epidemiological findings of childhood ocular trauma in a public hospital in Colombia. BMC Ophthalmology. 2021 Dec 1;21(1). DOI: https://doi.org/10.1186/s12886-021-02014-1
5. Widjaja SA, Hiratsuka Y, Ono K, Yustiarini I, Nurwasis N, Murakami A. Ocular trauma trends in indonesia: Poor initial uncorrected visual acuity associated with mechanism of injury. Open Access Maced J Med Sci. 2021 Dec 26;9:903–8. DOI: https://doi.org/10.3889/oamjms.2021.6862
6. Kuhn F, Pieremici DJ. Ocular Trauma Principle and Practice. Thieme Medical Publishers; 2002. 3–68 p. DOI: https://doi.org/10.1055/b-002-51011
7. Bayar SA, Öztürker ZK, Yılmaz G. Clinical characteristics and outcomes of ocular injuries in pediatric patients. 2022 May 1;28(5):654–61. DOI: https://doi.org/10.14744/tjtes.2021.54524
8. Gladiola T, Merca B, Valbuena M, Oftalmologico S, Rizal J, Hospital PG. Epidemiology and Visual Outcomes of Pediatric Ocular Trauma Cases in a Tertiary Hospital. Vol. 39, Philipp J Ophthalmol. 2014.
9. Kuhn F, Morris R, Witherspoon CD, Mester V. The Birmingham Eye Trauma Terminology system (BETT). J Fr Ophtalmol. 2004;27:206–10. DOI: https://doi.org/10.1016/S0181-5512(04)96122-0
10. Ilyas S, S. R. Ilmu Penyakit Mata Edisi Kelima. Jakarta: Badan Penderbit FKUI; 2014.
11. Wahyuni L, Sari M, Kartasasmita AS. Characteristics and Management of Pediatric Ocular Trauma. Vol. 41, Original Article. 2015. DOI: https://doi.org/10.35749/journal.v41i1.12
12. Pradana PASP, Yuliawati P, Djelantik AAAS, Manuaba IB, Triningrst AA, Utari NM. Karakteristik Pasien Trauma Okuli di RSUP Sanglah Denpasar Juli 2011- Februari 2015.Medicina (B Aires). 2017;48(Number 3: 174-180). DOI: https://doi.org/10.15562/medicina.v48i3.148
13. Shah, Mehul & Shah, Shreya & Shah, Shashank & Patel, Utsav. (2011). Effect of Interval between Time of Injury and Timing of Intervention on Final Visual Outcome in Cases of Traumatic Cataract. European journal of ophthalmology. 21. 760-5. 10.5301/EJO.2011.6482.DOI: https://doi.org/10.5301/EJO.2011.6482
14. Bayar SA, Öztürker ZK, Yılmaz G. Clinical characteristics and outcomes of ocular injuries in pediatric patients. Ulusal Travma ve Acil Cerrahi Dergisi. 2022 May 1;28(5):654–61.
15. Bayar SA, Öztürker ZK, Yılmaz G. Clinical characteristics and outcomes of ocular injuries in pediatric patients. Ulusal Travma ve Acil Cerrahi Dergisi. 2022 May 1;28(5):654–61.
16. Jarman MP, Castillo RC, Carlini AR, Kodadek LM, Haider AH. Rural risk: Geographic disparities in trauma mortality. In: Surgery (United States). Mosby Inc.; 2016. p. 1551–9. DOI: https://doi.org/10.1016/j.surg.2016.06.020
17. Riza A, Kartiwa RA. Karakteristik Klinis Pasien Laserasi Kelopak Mata Akibat Trauma di Pusat Mata Nasional Rumah Sakit Mata Cicendo. Vol.4, No.2. Jurnal Oftalmologi 2022. DOI: https://doi.org/10.11594/ojkmi.v4i2.32
18. Mega P, Dhamasari A, Kusuma Nintyastuti I, Geriputri NN. Karakteristik Pasien Trauma Mata di RSUD Provinsi NTB Tahun 2019. Vol. 1, Lombok Medical Journal. 2022. DOI: https://doi.org/10.29303/lmj.v1i1.549
19. Park J, Yang SC, Choi HY. Epidemiology and Clinical Patterns of Ocular Trauma at a Level 1 Trauma Center in Korea. J Korean Med Sci. 2021 Jan 4;36(1). DOI: https://doi.org/10.3346/jkms.2021.36.e5
20. Pendidikan K, Teknologi Direktorat Jenderal Pendidikan Anak Usia Dini dan, Dasar dan Pendidikan Menengah Direktorat Pendidikan Anak Usia Dini P. Panduan APE Aman bagi Anak Usia Dini [Internet]. Available from: https://paudpedia.kemdikbud.go.id/

21. Terrill SB, You H, Eiseman H, Rauser ME. Review of ocular injuries in patients with orbital wall fractures: A 5-year retrospective analysis. Clinical Ophthalmology. 2020;14:2837–42. DOI: https://doi.org/10.2147/OPTH.S274567
22. Rahman S, Hossain A, Alam S, Rahman A, Sultana C, Khan YJ, et al. Mechanical Eye Trauma Epidemiology, Prognostic Factors, and Management Controversies—An Update. Open J Ophthalmol. 2021;11(04):348–6. DOI: 348–6. DOI: 10.4236/ojoph.2021.114029