ORIGINAL RESEARCH

The relationship of mechanical ocular trauma and the best-corrected visual acuity results in Dr. Soetomo General Academic Hospital, Surabaya, Indonesia

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Article Info

Article history:
Received Jun 14, 2020
Revised Oct 10, 2020
Accepted Dec 15, 2020
Published Jan 1, 2021

Keywords:
Ocular trauma
BCVA
Vision
Blindness
Healthy lifestyle
Human & Health

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ABSTRACT

Background: Ocular trauma is an accident caused by a foreign object that affects the eye tissue. Ocular trauma can cause pain and a decrease in the person's best-corrected visual acuity. Mechanical ocular traumas can cause morphological and functional eye changes that are serious enough to cause blindness. Blindness is often used to describe a severe visual impairment with the remaining visual function. **Objective**: To determine and to analyze the relationship between mechanical ocular trauma and the best-corrected visual acuity of the patients of Dr. Soetomo General Academic Hospital, Surabaya, Indonesia in 2016-2018. **Material and Method**: This study was an analytic study with a cross-sectional design. The data were collected using the medical records of the patients of Dr. Soetomo General Academic Hospital, Surabaya, Indonesia in 2016-2018. The population of this study consists of all patients with pure mechanical ocular trauma with a total of 198 subjects. **Results**: Fisher exact test results showed a value of p=0.054, showing that there was no significant relationship between the best-corrected visual acuity and mechanical ocular trauma. **Conclusion**: No significant relationship was present between mechanical ocular trauma and the best-corrected visual acuity (BCVA) based on the medical record of patients with ocular trauma in Dr. Soetomo General Academic Hospital, Surabaya, Indonesia, in 2016–2018. Most of the patients had BCVA 6/24 - 2 meter counting finger.

How to cite:
Benita, K.R., Soebagjo, H.D., Bintoro, S.U.Y. 2021. The relationship of mechanical ocular trauma and the best-corrected visual acuity results in Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. Majalah Biomorfologi, 31(1): 24-30.

Majalah Biomorfologi (Biomorphology Journal) p.ISSN:0215-8833, e.ISSN: 2716-0920
doi: 10.20473/mbiom.v31i1.2021.24-30

BACKGROUND

Ocular trauma is an accident caused by a foreign object hitting the eye tissue. Ocular trauma can be classified into three broad groups, namely mechanical, physical, and chemical trauma. Based on Bimingham Eye Trauma Terminology (BETT) and Ocular Trauma Classification Group, mechanical trauma is then divided into 2, namely open and closed trauma (Fuzikawa, et al., 2018).

In Indonesia, the incidence of injury or trauma to the eye is 0.5%, while in East Java it is 0.6% (Riskesdas, 2018). When compared to other types of injuries, eye injuries occupy a small proportion. However, eye injuries can cause a great burden on the sufferer (Padmanaban, et al., 2018). Ocular trauma is one of the most common causes of visual disturbances and can cause a permanent decrease in visual acuity if it is not treated promptly (Gelston, 2013). In Indonesia, based on the results of Basic Health Research in 2018, ocular trauma is one of the six most common types of trauma (RISKESDAS, 2018).

This is important because it can cause a burden on the patient both psychologically and financially (Padmanaban, et al ., 2018). Based on his research in 2018, Fujikawa, et al. stated that trauma to the eye accounted for 65% of the incidence of unilateral blindness in the world. Based on the results of Riskesdas in 2013, the prevalence of blindness (BCVA/Best Corrected Vision Acuity <3/60 bilaterally) nationally is 0.4%, while the prevalence of severe low vision (BCVA <6/60 - 3/60 bilateral or BCVA 6/60 - 3/60 unilateral accompanied by unilateral blindness) in the population aged $\geq$ 6 years in Indonesia is 0.9% (Padmanaban, et al., 2018).

OBJECTIVE

This study analyzed the relationship between mechanical ocular trauma and best corrected vision acuity of patients in Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. In addition, this research is expected to be a means of educating the public about the dangers of ocular trauma that causes blindness and the importance of using Personal Protective Equipment (PPE) on workers.

MATERIALS AND METHODS

This study is a retrospective analytic study with a cross-sectional approach which included data on age, sex, lateralization, best-corrected visual acuity and trauma location. These data are taken in the central medical record of Dr. Soetomo General Academic Hospital, Surabaya, Indonesia and has been approved by the Ethical Committee for Research and Development of Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. All patients with pure mechanical ocular trauma at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia in 2016-2018 was included in this study, except patients with eye physical trauma (for example, thermal trauma and radioactive material trauma), chemical trauma, and combined trauma (mechanical trauma and physical trauma or mechanical trauma and chemical trauma). The research subjects were then classified into six groups, namely age, gender, location of trauma, lateralization, BCVA and type of mechanical trauma based on the classification by Pagarra in 2017. The data obtained were then processed by testing chi square via SPSS.

RESULTS

The research data that met the inclusion criteria were 198 samples. Research Results showed that the average age of the sample is 35.45 years. The largest sample lies in the productive age with an age range of 22-45 years as many as 81 samples. The results showed that the largest sample was male with 152 (76.8%), while the female population was less, namely 46 (23.2%). The location of mechanical ocular trauma that most often occurs is accidents outside the home with a percentage of 33.3%.

The results showed the sample with the best corrected visual acuity (BCVA) was divided into six categories, namely $\geq$ 6/12, 6/15 - 6/19, 6/24 - 2 meter finger count, 1 meter finger count - LP, NLP, and DTE/UTE with the highest percentage was in the 6/24 category - 2 meter finger count, namely 51.5%. Based on the impact of mechanical trauma on the lateralization of ocular trauma, there were 91 samples that experienced trauma to the right eye and 94 samples that experienced trauma to the left eye, so that 185 samples (93.4%) experienced unilateral lateralization.

Among the 198 samples collected, there were 118 samples that experienced sharp trauma, 72 samples that experienced blunt trauma, and 8 samples that experienced bullet trauma. This shows that the most common mechanical trauma is sharp mechanical trauma with a percentage of 59.6%. The prevalence of incidence among age groups, sex, lateralization, BCVA and type of mechanical trauma was the same as a significance level of p = 0.000.

Table 1. Characteristics of eye mechanical trauma patient samples at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia in 2016-2018

Characteristics	N	%	p
Age			
0-11	23	11.6	0.000
12-21	32	16.2	
22-45	81	40.9	
>45	62	31.3	
Gender			
Male	152	76.8	0.000
Female	46	23.2	
Trauma Location			
Home	43	21.7	0.000
Outside the house	66	33.3	
Workplace	46	23.2	
Crime	2	1	
Traffic	23	11.6	
Sports	8	4	
Without explanation	10	5.1	
Lateralization			
Unilateral	185	93.4	0.000
Bilateral	13	6.6	
BCVA			
≥6/12	6	3	0.000
6/15 - 6/19	9	3.5	
6/24 – finger count of 2 m	102	51.5	
Finger count of 1 m - LP	38	19.2	
NLP	31	15.7	
DTE/UTE	12	6.1	
Types of Mechanical Trauma			
Sharp	118	59.6	0.000
Blunt	72	36.4	
Bullet		4	

BCVA = Best Corrected Visual Acuity p = Fischer exact test
LP = Light Perception
NLP = No Light Perception DTE = Difficult to Evaluate UTE = Unable to evaluate

Table 2. The relationship between eye mechanical trauma and BCVA of eye mechanical trauma patients in Dr. Soetomo General Academic Hospital, Surabaya, Indonesia in 2016-2018

BCVA	Trauma			p
	Sharp	Blunt	Bullet	
≥6/12	2 (1.7%)	3 (4.2%)	1 (12.5%)	
6/15 - 6/19	4 (3,4%)	5 (6.9%)	0 (0%)	
6/24 – finger count of 2 m	60 (50.8%)	41 (56.9%)	1 (12.5%)	0.054
Finger count of 1 m - LP	26 (22%)	8 (11.1)	4 (50%)	
NLP	17 (14.4%)	12 (16.7%)	2.25	
DTE/UTE	9 (7.6%)	3 (4.2%)	0 (0%)	

Based on the table above, it can be seen that the highest frequency of eye mechanical trauma is 60 samples (50.8%) that experienced sharp mechanical trauma and 41 samples (56.9%) that experienced blunt mechanical trauma with the best-corrected visual acuity (BCVA) ie 6/24 up to a two meter finger count. In addition, 4 samples (50%) were found to have experienced bullet mechanical trauma. The fisher exact test results showed p value = 0.054 ($p > 0.05$), which means that there is no relationship between the best- corrected visual acuity (BCVA) with this type of eye mechanical trauma.

DISCUSSION

Descriptively and statistically it can be seen that the frequency of mechanical trauma is the highest at this research. It was found that in the age group of 22-45 years there were 81 samples (40.9%). This is evidenced by Chi square test results that obtained $p = 0.000$ ($p < 0.05$) so that it can be said statistically that the highest prevalence of eye mechanical trauma is significantly located in the age group of 22-45 years. Based on Iqbal's research et al. in 2019 in Pakistan, the incidence of ocular trauma was highest in the 18-35 year age group. This is because the age of 18-35 years is of the productive age so that they are at risk of ocular trauma related to work.

Pradana, et al (2017) stated that 60% of ocular trauma sufferers in this study were 30 years old and under. Most cases were found in the age group of 21-30 years (20.9%). This study also found a relationship between age group and trauma incidence ($p = 0.006$). The high exposure to risky activities at a young age, such as sports, work, and the number of traffic accidents is closely related to the high incidence of ocular trauma (Aghadoost, 2014).

The sample in this study consisted of 152 male research samples (76.8%), while the female samples were 46 samples (23.2%). This is significant in statistical tests, as evidenced by Chi square test results that obtained $p = 0.000$ ($p < 0.05$) which indicates that the highest prevalence of eye mechanical trauma is significant in the male sample. Based on research by Pandita, et al. in 2019 that men (74%) have a higher incidence prevalence rate than women (26%), this result can be proven statistically by the Pearson Chi- squared test with $p < 0.001$. This can be caused by men doing more outdoor activities so they have a higher risk of experiencing ocular trauma (Maurya, et al., 2019)

Among the 198 samples, 91 samples experienced trauma to the right eye and 94 samples experienced trauma to the left eye. The results of this data indicate that most of the samples, namely 185 samples (93.4%) experienced unilateral lateralization, while only 13 samples (6.6%) experienced bilateral lateralization. Maurya et al., (2019) in India noted that most of the ocular trauma patients (91.5%) had unilateral lateralization, while a small proportion (8.5%) had bilateral lateralization.

Based on research in Nigeria, the incidence is related to the size and shape of the object that enters the eye, where a sharp object with a pointed tip and a small size has a more tendency to hit one eye (Ajayi, et al., 2014). Ocular trauma is one of the most common risk factors for unilateral blindness and most of these events can be prevented (Dogan, et al., 2019).

From this research, it was obtained Chi square test on lateralization with $p = 0.000$ ($p < 0.05$) so that it can be said statistically that the highest prevalence of eye mechanical trauma is significantly located in the unilateral lateralization sample. This is in line with Nofityari's research, et al (2019) at Dr. M. Djamil Hospital Padang which noted that the results of Lambda correlation test showed a value of $r = 0.026$ which indicates a relationship between the type of ocular trauma and trauma lateralization.

The distribution of the study sample based on the location of the ocular trauma is shown in table 1. The location of ocular trauma with the highest frequency was outside the home that is as many as 66 samples (33.3%), while the lowest frequency was crime incidence of 2 samples (1.0%). This was not in line with Zhang et al., (2017) who noted that the most frequently occurred ocular trauma is in the workplace (40.6%) because people did not use personal protective equipment (PPE) that could prevent ocular trauma (Al-Mahmoud, et al., 2019)

Al-Mujaini, et a.l (2019) in India reported that 34% of the scene of ocular trauma was at home that is as many as 402 samples, whereas that is different from the Soliman's study et al in 2011 in Egypt, which showed that the most frequent cause of trauma was outside the home, amounting to 54.7% of the total 150 study samples. However, research in Japan noted that the most frequent cause of trauma was accidents (37.5%) (Toshida, et al., 2016).

The highest frequency for the best-corrected visual acuity was in the category 6/24 - 2 m finger count that was 102 samples (51.5%), while the lowest frequency was in the category $\geq$6/12 as many as 6 samples (3%). In Ethiopia, only 12.23% with BCVA 6/6 and 65.90% are under the blind category

(BCVA <3/60) (Alem, et al., 2019). Likewise in a study conducted in Uttarakhand, India, it was found that 56.5% of patients had BCVA <3/60 (Kumar, et al., 2018). Sthat, et al (2012) in his study showed 83.92% of patients with BCVA > 6/12.

From this research, Chi square test result which is significant is p = 0.000 (p <0.05) so that it can be said statistically that the highest prevalence of eye mechanical trauma significantly lies in the sample category of 6/24 - finger count of 2 m. In a study in India, among 136 patients, the study sample was in sharp trauma and blunt trauma with the same BCVA that is 6/60 - LP. This can be proven from Chi square test result. There was a significant difference in BCVA between sharp trauma and blunt trauma (p <0.002) (Lavaju, 2018).

Based on the data in table 2, it can be seen descriptively and statistically that the highest frequency of mechanical trauma type is in sharp trauma, as many as 118 samples (59.6%). According to Movahedinejad et al., (2016) ocular trauma was the most common in sharp trauma (72.5%), but this is different from Kinderan et al.'s (2012) and Maurya et al.'s (2019) study in Nepal and India. It experienced that the most common type of trauma was blunt trauma, 73.3% and 56%. The study in Northern Ethiopia reported that there was no significant difference in the proportion between sharp trauma (47.07%) and blunt trauma (47.74%) (Alem, et al., 2019). According to research by Fujikawa, et al. (2018) in Japan, sharp trauma to the eye causes more hospitalization and has worse visual results than blunt trauma. Sharp ocular trauma has a higher risk of blindness compared to blunt ocular trauma (Dogan, et al., 2019).

In this study, the type of mechanical trauma has significant function in statistical tests, as evidenced by Chi square test results that obtained p = 0.000 (p < 0.05) so it can be said statistically that the highest prevalence of mechanical ocular trauma is significantly located in the sharp trauma category. Based on Nofityari's research et al (2019) at Dr. M. Djamil Hospital Padang with the results of Lambda correlation test that recorded a value of r = 0.000 which indicated that there was no relationship between BCVA and the type of ocular trauma.

Mechanical ocular trauma is divided into three types, namely sharp, blunt, and bullet trauma (Ilyas, 2005). Overall, the three types of trauma will cause a decrease in visual function, but based on the data obtained in this study, the type of mechanical trauma does not specifically affect best-corrected visual acuity (BCVA) results because fisher exact test results show p value of 0.054. This is in accordance with Madhushudan's research et al (2014) at Hostal Universiti Sains, Malaysia, which explains that the mechanism of ocular trauma can not affect visual acuity. Based on research at Dr. M. Djamil Hsopital Padang, it was obtained that a statistical test result of r = 0.000 showed no relationship between the type of ocular trauma and visual acuity (Nofityari, et al., 2019).

According to research conducted by Qi, et al., (2015) in China, sharp trauma and blunt trauma have different prognosis (<0.001, Pearson Chi-square test). At the final assessment, NLP's visual acuity was 8.0% in sharp trauma and 0.3% in blunt trauma. The final visual acuity of LP/HM was 24.5% in sharp trauma and 5.3% in blunt trauma. Final visual acuity at 20/40 was 5.7% in sharp trauma and 0.5% in blunt trauma. It can be concluded that blunt trauma has better visual acuity than sharp trauma. This is reinforced by research by Mao, et al,. (2012) in China that blunt trauma has better vision than sharp trauma.

The results of this study showed that sharp and blunt mechanical trauma occurred mostly in the best-corrected visual acuity (BCVA) 6/24 - 2 meter finger count. This is not in accordance with Wang's research et al (2017) which showed that patients with sharp mechanical trauma had better visual acuity than patients with blunt mechanical trauma. This is supported by a study in Nigeria which showed the highest frequency of sharp trauma is in BCVA 6/18 that was 43%, while the highest frequency of blunt trauma was BCVA <1/60 - LP at 42.9%. (Adenuga, et al., 2018). Research in Canada noted that the risk of vision loss or decreased visual acuity increases in the incidence of blunt trauma due to adequate pressure that can trigger eyeball rupture (Bunting, et al., 2019). Some of the factors that can cause a poor prognosis for final visual acuity are poor presentation of BCVA, relatively positive afferent pupil defects, old age, blunt trauma, and lens damage (Hung, et al., 2011).

CONCLUSION

There is no relationship between age and the best-corrected visual acuity based on table 1. There is also no relationship between gender and visual acuity with the best correction results in table 1. In this study, mechanical ocular trauma was not associated with the best-corrected visual acuity. Mechanical

ocular trauma patients at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia are mostly in the productive age group, so prevention efforts are needed to reduce the occurrence of trauma, especially to the eye. However, it is necessary to carry out further research related to several things such as the type of mechanical ocular trauma (sharp trauma, blunt trauma, and bullet trauma) which has an effect on decreased visual acuity.

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