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The effect of injury type and location on the prognosis of the patients with open globe injuries

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Abstract

Objective: Investigation of the effect of the globe injury site and the globe injury type on the postoperative results in the patients with a relatively softer open globe injury (OGI) was aimed.

Methods: Medical records of the patients with OGI due to blunt or penetrating trauma were analyzed retrospectively. The patient cohort was divided into laceration and rupture groups. The location of injury was evaluated in zones (I-II-III). Presence and type of the complication (cataract, retinal detachment, etc.) were evaluated. Final best corrected visual acuity (BCVA) was evaluated as the primary outcome measure.

Results: Seventy eyes of 70 patients with OGI were included in the study. While 58 eyes (82.9%) had lacerations, 12 eyes (17.1%) had ruptures. Among the 52 patients with lacerations for whom there was an available BCVA data, 13 (25%) patients showed no change, 32 (61.5%) showed an increase, and 7 (13.5%) showed a decrease in BCVA. Among the 11 patients with ruptures, 2 (18.2%) patients showed no change and 9 (81.8%) showed an increase in BCVA. A complication was observed in 23 (44.2%) patients with laceration and 4 (33.3%) patients with rupture (p: 0.474). No difference was detected in terms of the complication rate between the patients having a different zone of injury. However, final BCVA was lower in those with Zone III injury in comparison to those with Zone II injury (p: 0.028).

Conclusion: Although the injury type was thought to have an effect on the final BCVA of the patients with OGI, no difference was detected between the patients with laceration and rupture. Zone III injuries resulted in lower preoperative BCVA values. However, despite a significant difference between Zone II and III injuries, no significant difference was observed in terms of the final BCVA between the patients with Zone I and those with Zone III injuries.

Keywords: open globe injury; injury location; laceration; rupture; penetrating trauma

Introduction

Ocular traumas are one of the most common ophthalmological emergencies and can cause globe injuries with varying severities. The type of trauma (mechanical, thermal, and chemical) is important in the prognosis of the globe injury. Mechanical traumas can cause lacerations (with a sharp object) or ruptures (caused by a blunt object) leading to open or closed globe injuries. In case of a full-thickness injury within the wall of the globe (cornea and sclera), it is called open globe injury, whereas partial-thickness injury is observed in case of a closed globe injury. In case of an open globe injury, the patient should be surgically managed urgently by primary closure of the wound. Because of a full-thickness injury, post-traumatic complication rates are higher in comparison to closed globe injuries (1,2).

Thus, open globe injuries possess a higher risk of blindness in comparison to closed globe injuries. Globe injuries are among the most common risk factors for unilateral blindness and most of them are preventable. According to the World Health Organization (WHO), approximately 1.6 million blind people, 2.3 million people with bilateral low vision, and almost 19 million people with unilateral blindness or low vision from injuries were observed (3).

Numerous studies have been conduced to predict the prognosis of patients with open globe injuries (4–6). Risk factors to show poor prognosis were reported including but not limited to age, preoperative visual acuity (VA), mechanism of injury, location and extent of damage (zone of injury), afferent pupillary defect, time lapse between the injury and surgery, presence of complications such as

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traumatic cataract, severe intraocular hemorrhage, choroidal damage etc., presence of endophthalmitis (5,7–10). Although some studies linked the blunt trauma to a poor prognosis, Schmidt et al. showed that patients with penetrating trauma resulted in a worse final VA (11). To investigate this conflict, the effect of different injury mechanisms on the final VA should be studied.

In this study, investigation of the effect of the globe injury site and the globe injury type on the postoperative results in the patients with a relatively softer open globe injury was aimed.

Methods

The patients who were referred to the Department of Ophthalmology in Cerrahpasa Medical Faculty with open globe injury due to blunt or penetrating trauma between 2010 - 2018 were analyzed retrospectively. Since it was a retrospective study, it was not necessary to obtain informed consent from the patients. The study has been carried out in accordance with the Declaration of Helsinki.

Only the patients with mechanical injuries were included in the study. The patients with caustic injuries or thermal injuries were excluded from the study. The patients with coexisting injuries other than globe injury such as the eyelid, orbital, and optic nerve injuries were also excluded from the study. Additionally, military or terror-related injuries were excluded from the study to create a group of patients with softer injuries. Then the patient cohort was divided into two groups; laceration (1) secondary to penetrating trauma and rupture (2) secondary to blunt trauma according to Birmingham Eye Trauma Terminology (12).

The age, gender, preoperative and final best corrected visual acuity (BCVA) testing with the logarithm of the minimum angle of resolution (logMAR) measurements, presence of complication and type of complication (formation of traumatic cataract, retinal detachment, vitreous hemorrhage, posterior synechia, peripheral anterior synechia) were recorded for all patients. The patients were categorized according to their best corrected visual acuity (BCVA) into three groups; (1) increased BCVA, (2) decreased BCVA, and (3) no change in BCVA. The patients with no light perception were excluded from the statistical analysis of logMAR equivalent of BCVA.

Repair of the perforated area with primary suturing was performed for seventy eyes of 70 patients included in the study. Detailed slit-lamp and funduscopic examination were done for all of the patients. B-scan ultrasonography was performed to reveal the posterior segment pathologies for the patients who had a pathology preventing the visualization of the posterior segment. Phacoemulsification and intraocular lens implantation were performed for patients with traumatic cataract who were thought to benefit from cataract surgery in terms of an increase in the BCVA.

Additionally, the location of injury was determined according to the Ocular Trauma Classification Group (2). Injuries located to the cornea and limbus were defined as Zone I injuries. Zone II injuries involved the anterior 5 mm of the sclera (not extending into the retina). Zone III injuries involved full-thickness scleral defects more posterior than 5 mm from the limbus.

Statistical analysis

A chi-square or Fisher test was utilized to compare the ratios. A Mann Whitney U test was used to compare the means of the independent groups. Kruskal Wallis test was used for the comparison of multiple independent groups and a Mann Whitney U test with Bonferroni correction was utilized for post hoc analysis. p value below 0.05 was considered statistically significant. SPSS (version 21.0) software was used in all statistical analyses.

Results

Seventy eyes of 70 patients with open globe injury were included in the study. While 58 eyes (82.9%) had lacerations, 12 eyes (17.1%) had ruptures. The mean age of the patients with lacerations were 28.7±20.7 (3-82) years and it was 37.2±20.3 (2-74) years for the patients with ruptures. While 41 (70.7%) of 58 patients with lacerations were male and 17 (29.3%) were female, 9 (75%) of 12 patients with ruptures were male and 3 (25%) were female. The groups were homogenous in terms of age and gender (p: 0.17 and p: 0.534). The mean duration of follow up for the patients with laceration was 29.3±10.6 months (12-60 months) and it was 29.8±7.4 months (15-39 months) for the patients with rupture (p: 0.75). The most common complications observed in our patient cohort were traumatic cataract (21.5%), retinal detachment (10.0%), and vitreous hemorrhage (5.7%).

Among the 52 patients with lacerations for whom there was an available BCVA data, 13 (25%) patients showed no change in BCVA, 32 (61.5%) showed an increase in BCVA, and 7 (13.5%) showed a decrease in BCVA. Among the 11 patients with ruptures for whom there was an available BCVA data, 2 (18.2%) patients showed no change in BCVA and 9 (81.8%) showed an increase in BCVA. A total of 7 patients were children without verbal communication or patients with mental retardation whose BCVA data were not available. When both groups were compared, no significant difference was detected in terms of increase, decrease or no change in BCVA (p: 0.328). The mean BCVA of the patients with laceration was 2.03±1.13 before the operation and changed to 1.33±1.3 after the follow-up. The mean BCVA of the patients with rupture was 2.17±1.06 before the operation and changed to 0.66±0.77 after the follow-up. No significant difference was observed between the groups in terms of the BCVA before the operation and final BCVA (p: 0.67 and p: 0.38, respectively). When the patients were compared according to the injury type in terms of the frequency of complications secondary to the perforation (traumatic cataract, retinal detachment, vitreous hemorrhage, posterior synechia, peripheral anterior synechia), complication was observed in 23 (44.2%) patients with laceration and 4 (33.3%) patients with rupture (p: 0.474).

When the patients were evaluated in terms of the anatomical location of the perforation 29 patients (41.4%) had Zone I injury, 19 patients (27.1%) had Zone II injury,

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and 22 patients (31.4%) had Zone III injury. Comparison of the patients according to the perforation location in terms of the change in BCVA is shown in Table 3. While the mean preoperative BCVA of the patients with Zone I injury was 1.82±0.97, it was 1.64±1.36 for those with Zone II injury, and 2.67±0.81 for those with Zone III injury (p: 0.01). Comparison of the groups with post hoc Mann Whitney U test resulted in a significant difference between Zone I-III and Zone II-III (p: 0.025 and p: 0.026, respectively).

While the mean final BCVA of the patients with Zone I injury was 1.07±1.13, it was 0.81±1.26 for those with Zone II injury, and 1.97±1.24 for those with Zone III injury (p: 0.021). Comparison of the groups with post hoc Mann Whitney U test resulted in a significant difference between the patients with Zone II and Zone III injuries (p: 0.028). However, when these groups were compared in terms of the complication rate, no significant difference was detected (p: 0.14) (Table 4).

Table 1. The relationship between the injury type and the change in best corrected visual acuity

	Best Corrected Visual Acuity			
Injury type	**No change**	**Increased**	**Decreased**	**Total**
Laceration	13	32	7	52
Rupture	2	9	0	11
Total	15	41	7	63

Table 2. Relationship between the injury type and the rate of complication

	Complication		
Injury type	**Absent**	**Present**	**Total**
Laceration	35	23	58
Rupture	8	4	12
Total	43	27	70

Table 3. The relationship between the zone of injury and the change in best corrected visual acuity

	Best Corrected Visual Acuity			
Zone of injury	**No change**	**Increased**	**Decreased**	**Total**
Zone I	3	19	4	26
Zone II	7	9	0	16
Zone III	5	13	3	21
Total	15	41	7	63

Table 4. Relationship between the zone of injury and the rate of complication

	Complication		
Zone of injury	**Absent**	**Present**	**Total**
Zone I	21	8	29
Zone II	12	7	19
Zone III	10	12	22
Total	43	27	70

Discussion

In this retrospective study, the patients were divided into two groups as lacerations due to penetrating injuries and ruptures due to blunt injuries. When the patients were compared according to the injury type of the perforation, no significant difference was detected between the groups in terms of the frequency of post-traumatic complications and change in BCVA. However, when the patients were compared in terms of the location of the injury, the patients with Zone III injury had lower final BCVA values.

Several studies investigated the risk factors affecting the final VA and various risk factors were determined. Age, preoperative VA, mechanism of injury, location and extent of damage (zone of injury), afferent pupillary defect, the time lapse between the injury and surgery, presence of complications such as traumatic cataract, severe intraocular hemorrhage, choroidal damage, etc. were among the reported risk factors (5,7–10).

Some studies reported rupture secondary to blunt trauma as a risk factor for a poor prognosis as well(7,13) and in the study by Schmidt et al., the authors showed that postoperative change in visual acuity was better in the patients with ruptures (11). Thus, the effect of the mechanism of injury on the final VA was evaluated in this study. However, no significant difference was detected between the laceration and rupture groups in terms of the final BCVA. This might be related to the similar complication rates between the groups.

The open globe injuries (OGIs) are observed more frequently in male patients. In our study, consistent with the previous studies (14, 15), 70% of the patients with penetrating injury and 75% of the patients with blunt trauma were male. Although Guven et al. reported 24.3% of bilateral OGIs (14), since no patient was injured due to terror-related reasons, no patient showed bilateral injury in our study.

The frequency of penetrating trauma was found to be higher in the previous studies as in our study. Consistent with 82.9% of penetrating trauma in our study, Agrawal et al. reported 71.4% of penetrating trauma in their study (8). Although penetrating trauma was observed more frequently and no difference was detected between the laceration and rupture groups, we observed interestingly that bottle cap was the etiological factor causing injury in 2 patients and their final VA was no light perception. Then, we hypothesized that the pressure and the proximity of the etiological factor might be related to the severity of the injury. However, further studies investigating the impact of these parameters on the prognosis are necessary.

Ocular Trauma Classification Group proposed a system for locating the OGIs to predict the prognosis of the patients. According to this system, zone III injuries were found to be related to a poor prognosis in many studies (14, 16). Consistent with the previous literature, the patients with Zone III injury showed lower final BCVA values in comparison to those with Zone II injuries. However, no difference was detected between the patients with Zone I and III injuries.

This difference can be linked to the relatively low number of patients, absence of an intraocular foreign body in our patients, and non-military etiology. In our study, change in visual acuity was evaluated with logMAR equivalent of BCVA, while in the other studies varying range of VA were used for the categorization (14). Furthermore, since corneal perforation scars on the optical axis can dramatically decrease the visual acuity in cases with Zone I injury, the classification of the location according to the zones can be an insufficient approach. Thus, a newer classification system with a special emphasis on the central or paracentral corneal location of the wound might be proposed.

After the open globe injury, the most commonly affected locations are the most vulnerable parts of the globe. For example, blunt trauma affects more commonly the sclera rather than cornea. Additionally, surgical wounds are another example of the vulnerable site of the globe during the injury. For example, in patients with a keratoplasty history, the most vulnerable site is expected to be the donor graft interface. However, in one of our patients with a history of keratoplasty, a blunt trauma interestingly caused scleral rupture. The presence of blue sclera or etiological factors such as connective tissue disorders that might cause a decreased scleral rigidity was investigated and no pathology was discovered (17). Thus, perforation through the surgical wound might not be a certain rule.

The most commonly observed complications after the open globe injury was traumatic cataract and retinal detachment in our study. Traumatic cataract was reported as the most common post-traumatic complication in most of the previous studies (18). However, contrary to the other studies (1, 18, 19), intraocular foreign body, and aphakia after initial trauma were not observed in our patients. Absence of these post-traumatic complications might also be linked to the indifference observed in our study between the patients with Zone I and Zone III injury in terms of the final BCVA.

The rate of endophthalmitis after open globe injuries has been reported between 0.9-6.7% (20–23). In our study, endophthalmitis was not observed in any of the patients. Risk factors related to an increased frequency of post-traumatic endophthalmitis have been reported as a delayed presentation (>24 hours), microbial keratitis, and lens capsule breach (21). In our study, all of the patients were operated earlier than 24 hours after the trauma and intraocular foreign body was not observed in any of the patients. Additionally, intracameral moxifloxacin was applied to all of the patients at the end of the surgery contrary to the study by Essex et al. where the authors did not apply any intracameral antibiotic to any of their patients (22). Absence of endophthalmitis in our patient cohort might be related to these differences.

Conclusion

In conclusion, our series of patients with relatively softer OGIs presenting to a tertiary referral center has shown no difference in terms of final BCVA and complication rate according to the injury type (laceration or rupture). Although the preoperative mean BCVA was lower in the patients with Zone III injury, final mean BCVA values showed no significant difference between patients with Zone I and III injuries.

No significant difference was observed in terms of the complication rates between the patients with different zone injuries. These differences might be attributed to the selection of a group of patients with relatively softer injuries. Limitations of the study were its retrospective design and the absence of the pupillary afferent defect data. Further studies are necessary to investigate more precise risk factors (especially central corneal location) for the prediction of the prognosis after open globe injuries.

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