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Common Causes of Eye Removal Surgery in Turkish Patients: A Review of 226 Cases

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Abstract

Purpose: To evaluate the etiological factors that cause end-stage eye disease or phthisis bulbi requiring enucleation or evisceration and our surgical results.

Material and Methods: Medical records of 226 patients, who underwent eye removal surgery, were analyzed retrospectively. Demographic information, clinical history, surgical procedure and histopathological data were all collected. Evisceration surgery was performed under general anesthesia in all patients except tumor cases and one patient with rhino-orbital mucormycosis. The patients were followed for an average of 16.46 ± 10.78 months and checked for the possible complications, cosmetic and functional results.

Results: A 144 men, and 82 women, with a mean age of 41.78 ± 22.6 years, were underwent nucleation (n=15) or evisceration (n=211) due to traumatic (n=169) and non-traumatic (n=57) causes. In the traumatic group, 79.8% of 169 patients were injured by penetrating and 14.2% by blunt trauma. A 3.6% of the patients were injured in a traffic accident, and 2.4% of them were injured by explosives. In the non-traumatic group, 40% of 25 patients had post-traumatic endophalmitis, 32% had endophthalmitis due to corneal ulceration and melting, 24% had endophthalmitis after cataract surgery. One patient had panophthalmitis due to rhino-orbital mucormycosis. Another cause in the non-traumatic group was glaucoma, of which 92.3% had neovascular glaucoma and 8.7% had congenital glaucoma. Of the patients who were enucleated for tumor, 35.7% had retinoblastoma, 14.3% had medulloepithelioma, 42.9% had uveal melanoma and 7.1% had metastastatic tumor from paranasal sinuses. The most common complaint in the follow-up period was discharge, seen in all prosthesis wearing patients. 13.3% of the patients had itching due to ocular prosthesis. 4.4% of the patients were complaining about deep superior sulcus. 4.4% had pyogenic granuloma and 17.8% had implant exposure.

Conclusion: Etiological factors should be carefully evaluated and precautions should take in order to reduce devastating effect of the physical loss of the eye.

Keywords: *Enucleation; Evisceration; Ocular injury; Etiology; Frequency*

Introduction

Depending on the clinical diagnosis and severity of the disease, evisceration/enucleation is an end-stage treatment of various eye diseases, such as unresponsive endophthalmitis, painful blind eye, intraocular malignancy, severe eye trauma, phthisis bulbi, congenital anophthalmia or microphthalmia [1-4]. Ocular trauma is the most prevalent cause of eye enucleation mentioned in several published literatures [5]. Fireworks injuries, traffic and work accidents, penetrating injuries due to sharp objects are the most frequently reported causes of trauma [5]. Studies from various geographic regions have reported that work-related injuries are more common in men [5]. Another reason for eye removal is endophthalmitis, a serious eye infection of exogenous or endogenous origin that can cause permanent vision loss in the affected eye. Most cases are of exogenous origin as a complication of cataract surgery, intravitreal injection, or penetrating ocular trauma [6]. Neovascular glaucoma due to retinal vascular diseases, diabetes mellitus or ocular ischemic syndrome and angle-closure glaucoma are also the most common

causes of eye removal surgery [7,8]. In studies, it was reported that 42.55% of patients operated for glaucoma had neovascular glaucoma, 38.8% traumatic glaucoma, 45% infection / inflammatory glaucoma, and 11% neoplasm-related glaucoma [9,10]. The surgery is decided according to the severity, spread and course of the disease [11]. Although the indication may differ between countries, evisceration surgery is preferred for blind painful eye, endophthalmitis, phthisis bulbi, glaucoma and severe traumatic injuries, while enucleation is preferred for end-stage eye diseases and intraocular malignancies that do not respond to medical treatments [12-17]. Evisceration surgery is preferred to enucleation because it is not only technically easy but also provides more functional and cosmetic results [18]. In a review study involving a total of 24,444 enucleated patients, it was stated that 40.9% of cases were caused by trauma and 24.2% by tumors while in another study, endophthalmitis is the main factor in 45.5% of the patients, phthisis bulbi and trauma together only accounts 39.5% of these patients [19]. Men, especially 0-10 years old, undergo evisceration surgery due to ocular trauma [20]. In another study including 1129 cases, it was stated that trauma was the responsible factor in 67% of the cases [21]. On the other hand, the risk of developing endophthalmitis following open globe trauma is reported as 3.1% and 11%, and studies have shown that 14.3% of these cases result in evisceration [22,23]. The rate of post-enucleation or evisceration complications depends on many factors, including implanted material, surgical techniques, and previous surgery. The most common complications are discharge, implant exposure, implant migration or infection, conjunctival detachment, and pyogenic granuloma [24]. In this retrospective study, we aimed to investigate etiological risk factors that cause eye amputation and our surgical results.

Material and Methods

This retrospective study included 226 eyes that underwent enucleation or evisceration surgery between 2009 and 2019 years. The study protocol adhered to the tenets of Declaration of Helsinki and was approved by the ethics committee. Fully informed written concert form from patients were taken. Patient consent to publish identiable photograph archival was taken from all patients. The patients' demographic information, clinical history, visual acuity, indication for surgery, duration of follow up, complications encountered during the follow-up period and histopathological findings were all noted. Patients were divided into two groups as traumatic and non-traumatic according to the factors causing eye loss. In the traumatic group, 135(79.8%) of 169 eyes had perforating injury with sharp objects and 24(14.2%) had blunt trauma due to ball, door handle, fall, fireworks, plastic bottle cap. There were 6 (3.6%) patients injured in traffic accident and 4 (2.4%) patients injured with explosive substance. There were 57 patients in the non-traumatic group. Of these, 25(11.1%) were operated for endophthalmitis, 14(6.1%) for tumors, 13 (5.8%) for glaucoma, 2(0.9%) for anterior staphyloma, 2 (0.9%) for retinal detachment and 1 (0.4%) for microcornea. Evisceration surgery was performed under general anesthesia in all patients except tumor cases in the non-traumatic group and one patient with panophthalmitis due to rhino-orbital type fungal infection 'mucormycosis'. Histopathological examination of the specimens was reported as fibrotic, osseous metaplasia and hyalinization or chronic inflammatory changes or tumoral changes. Orbital implants with different materials (synthetic hidroxyapatite, bioceramic-Alumina, porous polyethylene-Medpor, or acrylic implants) were used to compensate the volume loss in eye removel surgery. After the socket volume was determined with orbital sizer, the implant was placed in the scleral cavity either by radial sclerotomy technique as in 76 patients or by posterior sclerotomy as in the remaining 150 patients. The spherical size of the implant, mostly preffered was between 18-22 mm. The patients were evaluated for the cosmetic and functional results of the ocular prosthesis. In cases where the implant was extruded with a large conjunctival defect (> 10mm) with scleral melting, we used dermis-fat graft, taken from the lateral upper quadrant of gluteal region, for anophthalmic socket reconstruction, because of its advantage of no foreign-body reaction and disease transmission. The patients were followed up for an average of 16.46 ± 10.78 months (range, from 8 to 60 months) and evaluated in terms of possible complications, cosmetic and functional results.

Statistical Analysis

NCSS (Number Cruncher Statistical System) Statistical Software (Utah, USA) program was used for statistical analysis. While evaluating the study data, in addition to descriptive statistical methods (mean, standart deviation, median, frequency, and ratio), ShapiroWilk test and box plot graphics were used for the conformity of variables to normal distribution. Kruskal Wallis test was used for intergroup comparisons of parameters that did not show normal distribution, and Dunn test was used to identify the group that caused the difference. Pearson's chi-square test was used to compare qualitative data. Significance was evaluated at the $p<0.05$ level.

Results

A total of 226 eyes of 226 patients, 144 (63.7%) men and 82 (36.3%) women, underwent eye removal surgery between 2009 and 2019 years. The median age of men was 44.3 ± 24.11 years (range: 1- 94 years) and women was 37.2 ± 19.12 years (range: 1-72 years). The patients were divided into two groups in terms of etiological factors as traumatic (n=169) and no

Traumatic (n =57). Of the 169 patients in the traumatic group, 62 were women. The most common causes were perforating injuries with glass, pencil, scissors, fork, wood or piece of iron in 135(79.8%) eyes, and blunt trauma due to ball, door handle, fall, fireworks, and plastic bottle cap in 24 (14.2%) eyes. There were 6 (3.6%) patients injuried in traffic accident and 4 (2.4%) patients injuried with explosive substance. The patients in this group underwent cosmetically evisceration surgery to correct their unpleasant facial appearance due to phthisis bulbi (Figure 1).

Figure 1*: Patient with phthisis bulbi in the left eye due to penetrating trauma.*

Figure 2*: Panophthalmitis with the infection spreading to the sclera and the Tenon's capsule, severe conjunctival hyperemia, chemosis in left eye of rhino-orbital mucormycosis patient.*

There were 25 eyes with endophthalmitis, of which only 6 were female. The most common causes of exogenous endophthalmitis were following cataract surgery in 6 (24%) eyes, perforated corneal ulcer in 8(32%) eyes, post-traumatic endophthalmitis in 10 (40%) eyes., which were mostly occured from hitting the branches of a tree, getting sand or soil into the eye, hitting the cow's tail especially seen in farmers and work-related foreign body injuries with metal or wood mostly in men. And we had also 1 (4%) patient with panophthalmitis due to rhino-orbital mucormycosis (Figure 2). A 157 Microbiologic assessment of the endophthalmitis patients were reported as; Pseudomonas aeruginosa, gram-negative rods (n=4), and Bacillus cereus, gram-positive rods (n=5) in 10 (36%) of post-traumatic endophthalmitis cases, fungal infections with Aspergillus (n=4) and Fusarium (n=2) were in 8(75%) of corneal ulcus and melting cases, Mucormycosis (n=1) with fungal infection in 1 patient with panophthalmitis, Staphylococcus epidermidis (n=1) and Streptococcus viridans (n=1) and unisolated culture (n=7). There were 14 (6.1%) eyes, 5 of which were female, who underwent enucleation due to ocular tumor. Of these, 5(35.7%) were retinoblastoma, 2(14.3%) were medulloepithelioma, 6(42.9%) were uveal melanoma and 1 (7.1%) was metastatic tumor originating from the paranasal sinus.

Figure 3: *Anterior staphyloma after an eye injury with sparkler.*

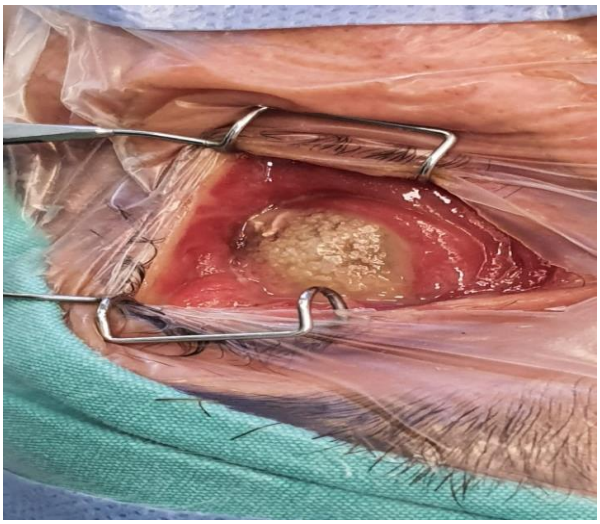


Figure 4: *Synthetic porous polyethylene implant exposure with large conjunctival and scleral melting.*

There were 13 (5.8%) eyes, 7 of which were female, operated for glaucoma of these 12(5.8%) had blind, painfull eye due to neovascular glaucoma, Secondary to retinal vein occlusion and diabetic neovascularization and 1(7.7%) had congenital glaucoma with histopathological diagnosis of medulloepithelioma. In addition, there were 2(0.9%) patients with anterior staphyloma (Figure 3), 2(%0.9) patients with retinal detachment and 1(0.4%) patient with microcornea underwent evisceration surgery. Patient demographics were presented in (Table 1). Patients distribution according to gender was presented in Graphic 1 and according to etiologic factors was presented in Graphic 2. When the responsible etiological factors in patients who underwent evisceration or enucleation surgery was evaluated statistically according to age and gender, a significant difference was found between age distributions according to etiology ($p<0.01$); when the significance was examined with the Bonferroni corrected Dunn test; the ages of trauma cases were found to be significantly lower than those of glaucoma and endophthalmitis ($p=0.0001$; $p=00001$; $p<0.01$ respectively); the ages of the tumor patients were also found to be significantly lower than the endophthalmitis and glaucoma cases ($p=0.011$; $p=0.029$; $p<0.05$ respectively).

Figure 5: *Acrylic implant exposure.*

Figure 6: *Secondary repair of socket with Dermis-fat grafting.*

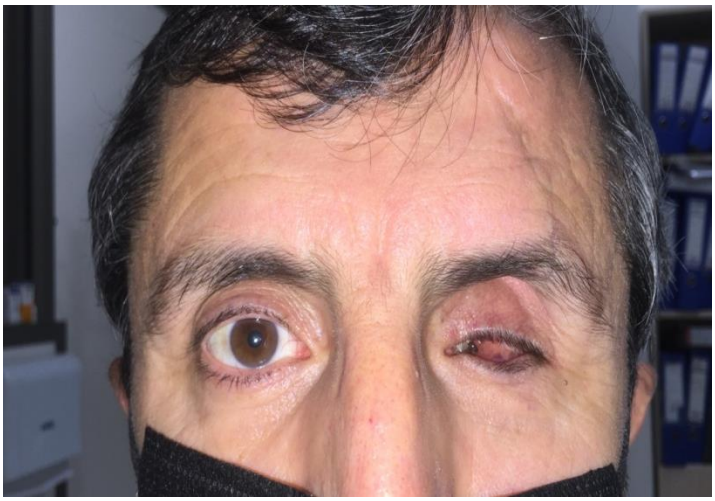


Figure 7: *Deep superior sulcus seen in patient's left eye.*

Figure 8: *Typical mosaic like pattern papillary conjunctivitis seen in chronic irritation from ocular prosthesis.*

There was no significant difference between the ages of endophthalmitis and glaucoma cases and trauma and tumor cases ($p>0.05$). No statistically significant difference was found between gender distributions according to etiologies ($p>0.05$) (Table 2). Perforating injuries were mostly due to work-related injuries in men between the ages of 21-55 and home accidents in women. Children under the age of 20 were mostly injured by toys, stones and sticks while playing. Patients over 50 years of age had injuries as a result of falling or cutting wood. Endophthalmitis due to corneal ulcer and melting and post-cataract endophthalmitis was seen in almost equal numbers in men and women aged 56 years and over. Endophthalmitis due to penetrating injury was seen in patients aged 21-84 years. Neovascular glaucoma was most common in patients aged 56 years and older, and congenital glaucoma was seen at the age of 5 years. The other responsible factors for eye removal according to age range were; retinoblastoma was seen at the age of 1, medulloepithelioma between the ages of 5-15, uveal melanoma 60-88, and metastatic tumor was seen at the age of 80. To

compensate the volume loss in eye removal surgery, 95 of 226 eyes were implanted with synthetic hydroxyapatite orbital implant, 35 with porous polyethylene-Medpor, 46 with bioceramic-Alumina implants, and 50 with acrylic implants. Implant exposure was seen as a late complication in 40(17.7%) of the cases. Of these, 10(20%) had acrylic and 30(31.8%) had synthetic implants. Fornices schrinkage was observed in 10(4.4%) patients (Figures 4-5). Socket reconstruction with dermis-fat graft was performed in 40 patients with large implant exposure (Figure 6) other postoperative complications seen in patients were; 5(2.2%) had ptosis, 10(4.4%) had superior sulcus syndrome, 10(4.4%) had pyogenic granuloma. Discharge was the major complaint seen in all prosthesis wearing patients. Allergic reactions due to ocular prosthesis wearing and papillary formation in the upper lid tarsal conjunctiva was observed in 30(13.3%) patients and treated with antiallergic agents (Figure 7-8). Most of the patients were satisfied and wear their prosthesis with 30 degrees of horizontal and 15 degrees of vertical mobility.

Table 1: *Demographic information of the patients.*

	Min-Max	**Mean ± SD**
Age(year)	1-94	41.78 ± 22.6
Gender	**n**	**%**
Female	82	36,3%
Male	144	63,7%
Etiology		
Tumor	14	6,1%
Uveal Melanoma	6	
Metastatic tumor	1	
Retinoblastoma	5	
Medulloepithelioma	2	
Glaucoma	13	5,8%
Neovascular	12	
Congenital	1	
Endophthalmitis	25	11,1%
Post-cataract related	6	
Perforated corneal ulcus Post-traumatic Rhino-orbital mucormycosis	8 10 1	
Trauma	169	74,8%
Perforating	135	
Blunt	24	
Traffic accident	6	
Explosive	4	
Retinal detachment	2	0,9%
Microcornea	1	0,4%
Anterior staphyloma	2	0,9%

Discussion

Eye removal surgery (evisceration/ enucleation) is performed for cosmetic purposes after a serious injury, intraocular malignancy, endophthalmitis, panophthalmitis unresponsive to medical treatment and painful blind eye [25]. The choice between the two surgical procedures varies according to countries, depending on the severity, spread, prognosis of the disease and the desire to

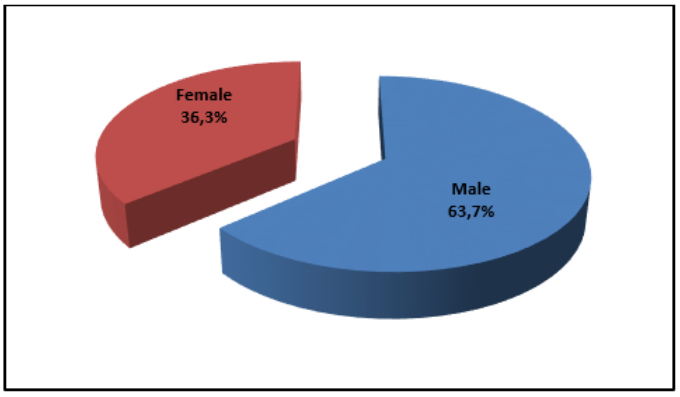
obtain the best possible support for a future prosthesis [26,27]. It has been stated that in developed countries tumor is the main indication factor, while in undeveloped countries trauma is the main factor for enucleation [28]. However, recent studies show that the incidence of enucleation is gradually decreasing and the indication for evisceration is increasing [29,30]. This is because evisceration surgery produces less inflammation and scarring, resulting in better implant motility and cosmetic results than enucleation surgery. While the evisceration indication rate was initially reported as 10.7%-28%, this rate increased up to 72% [18,24].

Table 2: *Evaluation of the factors that cause eye removal according to age and gender.*

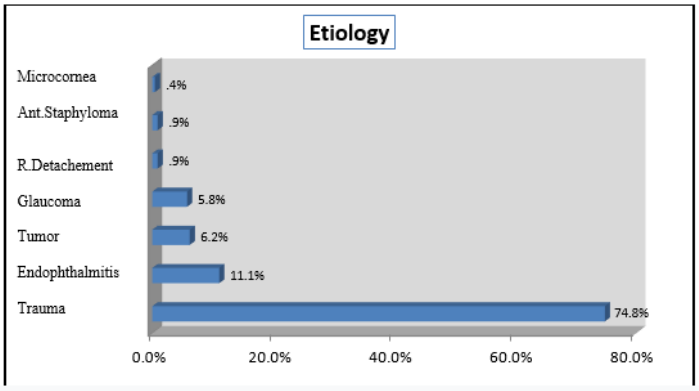
	N	Age			Gender	
		Mean ± SD	**Median**	**Min- Max**	**Male (n,%)**	**Female (n,%)**
Endophthalmitis	25	68,9 ± 16,0	72,0	37-94	20 (80)	5 (20)
Glaucoma	13	64,2 ± 18,6	70,0	5-78	6 (46,2)	7 (53,8)
Trauma	169	36,6 ± 18,0	31,0	8-94	106 (62,7)	63 (37,3)
Tumor	14	44,8 ± 35,4	65,5	1-88	9 (64,3)	5 (35,7)
† R.detachment	2	57,0 ± 2,8	57,0	55-59	1 (50)	1 (50)
†Microcornea	1	18,0	18,0	18	1 (100)	0
† Ant. staphyloma	2	55,0 ± 4,2	55,0	52-58	1 (50)	1 (50)
p		***[a]0,001****			***[b]0,197***	

*[a]Kruskal Wallis test, [b]Pearson Ki kare test,† Due to small number of cases, they were excluded from assessment, **p<0,01*

Graphic 1: *Distribution of patients according to gender.*



Graphic 2: *Distribution of patients according to etiology.*



In our study, except for tumor cases, and one case with panophthalmitis due to rhino-orbital mucorrnycosis, we preferred evisceration surgery to 212(93.8%) of 226 patients, which was technically easy to perform in a short time and had good cosmetic results. Ocular trauma is the most prevalent cause of eye enucleation mentioned in several published literatures [10]. In a study, it was reported that enucleation was mostly performed due to trauma (36%), followed by malignant tumor (20.7%), glaucoma (19.6%), phthysis bulbi (9%) and endophthalmitis (8.1%) [10,21]. It is well known that the type and severity of the eye injury affect the rate of development and progression of phthisis bulbi [4]. In our study, evisceration surgery was performed in 169(74.8%) eyes with post-traumatic phthisis, 25 (11.1%) eyes due to endophthalmitis, and 13(5.8%) eyes due to glaucoma. Enucleation surgery was performed in 14 (6.1%) eyes due to tumor, and 1 eye with panophthalmitis. In addition, evisceration surgery was performed for cosmetic purpose in 2 patients who developed phthisis bulbi after retinal detachment surgery, 1 patient with microcornea, and 2 patients who developed anterior staphyloma due to fireworks injury in childhood. Fireworks injuries, traffic and work accidents, penetrating injuries due to sharp objects are the most frequently reported causes of trauma [10]. Studies from various geographic regions reported that job-related injuries has been more common in men [10]. In our study, in which we evaluated traumatic injuries according to age groups and the type of occurrence, 130 (77%) of the cases had perforating injuries due to sharp objects

with glass, pencil, scissors, fork,wood piece, stone, and 29(17.2%) had blunt injuries with ball, door handle, fall, explosive object, fireworks, plastic bottle cap, especially between 9 to 68 years of age. These were mostly caused by work-related injuries in men, games with sparklers or sharp objects in children, housework accidents in women, and falls in elderly. Endophthalmitis, one of the most devastating infections of the eye, can cause irreversible blindness in the infected eye hours or days after the onset of symptoms.8 In a study of 791 cases, it was stated that 58% of the cases were due to microbial keratitis, and 14-15% were due to post-traumatic and post-cataract endophthalmitis [6,8]. The commonest isolated organisms were reported as gram positive organism with a rate of 17.52% was Streptococcus pneumonia, gram-negative organisms with a rate of 54.65% was Pseudomonas aeruginosa, and the most common isolated fungus was Aspergilluss spp. with a rate of 42.33%, all had poor prognosis, which may result in evisceration even with prompt and appropriate treatment [6]. Bacillus cereus, gram-positive rods, is one of the most common cause of post-traumatic endophthalmitis 6(%), causing fulminant endophthalmitis with a very poor visual prognosis [8]. Postoperative endophthalmitis mostly occured in older ages [9]. In the literature, enucleation or evisceration has been reported at high rates in cases of endophthalmitis due to corneal ulceration, mostly caused by Pseudomonas aeruginosa [13,17,19,22]. Late diagnosis and treatment of microbial keratitis, topical steroid use, trauma, contact lens use, corneal surface disease and previous ocular surgery have been reported as risk factors responsible for the progression of keratitis to endophthalmitis [19]. In our study, 25(11.2%) eyes underwent evisceration surgery for endophthalmitis. 10 (40%) had post-traumatic endophthalmitis, 8(32%) had endophthalmitis due to corneal ulcer and melting, and 6(24%) had post-cataract endophthalmitis. Although most cases were reported as culture negative, Pseudomonas aeruginosa, and Bacillus cereus were the most common isolated organisms in post-traumatic endophthalmitis, Aspergillus and Fusarium were the most common isolated fungi in fungal keratitis with melting. Endogenous endophthalmitis usually associated with a number of systemic disease, including liver abscess, pneumonia, endocarditis, urinary tract infection, meningeal infection, diabetes mellitus, immunosuppression, and some has a history of recent hospitalization or recent surgery [19]. In one of the study, the reported rates of eye removal was 27.3% in eyes with endogenous endophthalmitis [19]. In our study, patients with endophthalmitis whose inflammation could not be controlled with intravitreal antibiotics, vitrectomy or therapetic keratoplasty were gone to evisceration surgery. For whom we had evisceration surgery were diabetic immunosuppressive, and those. The probable reasons for the progression in spite of prompt and appropriate management due to relatively virulent organisms with possible high antibiotic resistance pattern, and the widespread use of corticosteroid in ophthalmology. Enucleation was performed to one patient with panophthalmitis due to rhino-orbital mucormiyocis who was hospitalized in the intensive care unit due to COVID-19 and had widespread of disaese to brain. Retinoblastoma is the most common intraocular tumor of childhood that requires enucleation, presents with leukoria and strabismus, 90% of which are diagnosed before the age of five [7]. Medulloepithelioma, is a rare embriyonel neuroepithelial intraocular tumor arising from primitive medulloepithelium and diagnosed in the first decade of life [3]. Poor vision and pain are the most common symptoms, but the patients are treated for secondary complications such as cataract or glaucoma before the underlying mass is discovered [3,14,23]. Of the cases that underwent enucleation due to tumor, 37-49% were reported as retinoblastoma and 34-42% as uveal melanoma [10,15]. In our study, 14 eyes (6.1%) were enucleated due to tumor. Of these, 5(35.7%) were at 1 years of age, underwent enucleation surgery due to leucocori, and pathologically diagnosed as retinoblastoma, 2(14.3%) patients (14.3%) aged 5-15 years with medulloepithelioma had blind painful eye finally diagnosed as medulloepithelioma, 6(42.9%) patients had uveal melanoma between 60-88 years, 1(7.1%) patient 80 years old with metastatic tumor from the paranasal tumor. Patients who underwent evisceration or enucleation with the diagnosis of glaucoma were mostly reported as neovascular glaucoma 42.55% or traumatic glaucoma 38.8% [20]. In our study glaucoma was seen in 13 patients. A 12 of them were between ages 59-78 years with neovacular glaucoma, and 1 was a 15-year-old patient who had been treated for congenital glaucoma for many years and had a pathological diagnosis of medulloepithelioma. It was stated that, there is a decreased in the frequency of globe removal due to ocular complications of failed retinal detachment surgery due to improvements in retinal detachment surgery [24]. In our study, evisceration surgery was performed on 2 phthisic eyes with retinal detachment due to penetrating trauma. The prevalence of anterior staphyloma develops especially due to childhood trauma [26,27]. In our study evisceration surgery was performed in 2 patients who were injuired by fireworks in childhood, and developed anterior staphyloma in the upper quadrant with corneal opacity. The incidence of postoperative ptosis, implant displacement, implant exposure, socket contracture, and deep superior sulcus syndrome is lower in evisceration surgery than enucleation [2]. The most common procedure-related complications were major eye discharge (39.6%) [28]. In studies investigating the effect of material and design of the implant on implant exposure, it has been stated that non-porous implants have a high migration rate and integrated porous implants have a high exposure rate, but in another study it was stated that, the material did not play a role in the extrusion of the implant [11]. In our study we used synthetic

hydroxyapatite, porous polyethylene, bioceramic and acrylic implants. Implant extrusion was observed in 17.8% of our patients as a late complication, and its occurrence in the cases we performed with radial sclerotomy suggested that it may be the factor responsible for the extrusion. The most common complaint was discharge (100%), and itching due to allergic reaction of ocular prosthesis was observed in 13.3% of the patients using prosthesis.

Conclusion

Losing the eye, which is an important organ in facial aesthetics, is a very disturbing situation for both the patient and their relatives. Trauma was the leading cause of eye loss in our study, and we think that it may be possible to reduce the rate of eye removal by taking necessary precautions against the factors that cause trauma.

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Conflicts of Interest

There is no conflicts of interest.

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