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Ophthalmic Trauma Malpractice in the Ophthalmic Mutual Insurance Company Database

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PURPOSE: To review ophthalmic trauma malpractice claims in the Ophthalmic Mutual Insurance Company (OMIC) database to determine the frequency and causes of litigation.

METHODS: A retrospective case series analysis of ophthalmic trauma claims from 2009 to 2019 was completed. Cases were selected only if the injury was secondary to trauma (e.g., fall, gunshot wound, paintball injury, etc.); iatrogenic traumatic surgical injuries were excluded.

RESULTS: 31 closed cases associated with 40 total claims related to ophthalmic trauma out of 2565 claims (1.56%) in the OMIC database were analysed. 13 of the 31 cases (41.9%) were decided for the plaintiff. In decisions for the plaintiff, the median settlement amount was $330,000 (range $125,000–$1,000,000). The most frequent initial diagnoses were corneal abrasion ($n = 10$), hyphema ($n = 5$) and open-globe injury ($n = 5$), and the most common final diagnoses were endophthalmitis ($n = 8$), intraocular foreign body ($n = 7$) and retinal detachment ($n = 7$). The most common causes of malpractice litigation were a delay in referral or follow-up ($n = 11$) and failure to get appropriate imaging ($n = 8$). In the 13 cases decided for the plaintiff, experts concluded nine did not meet standard of care.

CONCLUSIONS: Ophthalmic trauma malpractice claims are very uncommon in the United States, however, the payout is higher than non-trauma settlements, and approximately 40% of cases were decided for the plaintiff. Care could be improved with a careful history and complete ophthalmic examination (with dilated fundoscopy), imaging in appropriate patients, meticulous documentation, and early sub-specialist referral when the diagnosis or management plan was unclear.

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INTRODUCTION

From 2006–2011, there were 11,929,955 emergency department (ED) visits in the United States related to ophthalmic complaints [1]. In 2010, eye-related visits represented approximately 1.5% of all visits to the ED [2]. A recent *Eyenet* article reported that EDs across the country are struggling to maintain ophthalmology coverage [3]. Indeed, in rural regions of California in 2014, ophthalmology coverage in emergency departments was often less than 50% [4] and in Florida in 2020, only approximately 7% of rural hospitals had an ophthalmologist available on call [5]. It should not go unnoticed that in regions without ophthalmology coverage in the ED, there is a growing interest from the optometric community to expand their scope of practice by seeking hospital privileges in order to provide ED coverage for ocular injuries [6]. The increased use of ambulatory surgical centers, unfamiliar or poorly maintained ophthalmic equipment in the ED, and growth of sub-specialization in ophthalmology are frequently cited for the lack of ophthalmologists participating in ED call [3], however, poor reimbursement and liability concerns also contribute to this decreased interest in call coverage [7, 8].

Annually, roughly 7.5% of all physicians will face a malpractice lawsuit [9]. Ophthalmologists, historically, have had fewer claims than the average physician and lower rates of payments per claim [10, 11]. But even in low-risk specialties such as ophthalmology, approximately 5% of ophthalmologists will be named in a malpractice suit by age 45, and 19% by age 65 [9]. The Ophthalmic Mutual Insurance Company (OMIC) database contains all the professional liability claims brought against OMIC-insured physicians and was used in this study to evaluate the number, cause, and payments related to ophthalmic trauma malpractice cases [12, 13]. Until now, the OMIC database has not been evaluated for malpractice claims related to ophthalmic trauma. Our objective was to identify common diagnoses and provider practices that led to claims against OMIC-insured physicians. By educating ophthalmologists on the clinical patterns of ophthalmic trauma related to malpractice claims, this review of claims data aims to improve patient care and prevent future malpractice litigation, and to provide education on the actual frequency and risk of malpractice litigation in ophthalmic trauma in order to encourage trauma call coverage.

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METHODS

A retrospective analysis of closed trauma-related claims litigated against OMIC-insured ophthalmologists from 2009 to 2019 was completed. A claim is defined as a written notice or demand for money or services, including the institution of a lawsuit or arbitration proceeding; there may be multiple claims per case. Specific claims were identified by one author (A.M.M.) in March 2020 by searching the OMIC database for terms related to ophthalmic trauma: open globe, laceration (corneal, scleral), intraocular foreign body, rupture, penetrating, perforating, firework, chemical burn, thermal burn, abrasion, foreign body (peribulbar, intraorbital, corneal, conjunctival, orbital, periorbital, eyelid, lacrimal), hyphema, microhyphema, iridodialysis, cyclodialysis, laceration (eyelid, eyebrow, canalicular, nasolacrimal), fracture, retrobulbar hemorrhage, retrobulbar hematoma, commotio, choroidal rupture, sclopetaria, traumatic optic neuropathy, and shaken baby syndrome.

Cases were selected only if the injury was secondary to trauma; iatrogenic surgical injuries not related to a repair of an ophthalmic traumatic injury were excluded. The data also excluded open claims. All cases were reviewed independently by A.M.M. and at least two additional co-authors to ensure that the injury was secondary to trauma or repair of a traumatic injury. The claims data summary and litigation files of the defense attorneys for each case were reviewed. Individual patient medical records were not reviewed. The study complied with the Health Insurance Portability and Accountability Act and adhered to the tenets of the Declaration of Helsinki. Institutional review board was not required as data collection was approved through OMIC.

Data collected by the authors included: decision for defendant vs plaintiff, year of claim, plaintiff sex and age, state (location), adherence to the standard of care as assessed by OMIC board and committee members and/or outside defense experts, verdict, means of resolution, and settlement or judgment payment. Initial and final diagnosis in every case were identified; these were the critical diagnoses for the case determined by the co-authors. There could be multiple initial and final diagnoses for each case.

An additional analysis was completed to assess any errors in diagnosis or management, and these were evaluated by two co-authors and A.M.M for each case. Cases were assessed as either (1) correct diagnosis, correct management, (2) correct diagnosis, wrong management, and (3) wrong diagnosis, wrong management. Secondly, all cases were then separately assessed for cause of misdiagnosis or management. There were five categories: (1). Ophthalmologist accepted ED diagnosis and did not see the patient. (2). Proper imaging not ordered. (3). Delay in follow-up or referral. (4). Medical documentation issue. (5). Other. Certain cases were deemed non-applicable for this analysis if the authors felt that there was no diagnosis or management error. Disagreements were discussed and resolved as a group for all data collected.

RESULTS

Overall, there were 31 closed cases associated with 40 total claims related to ophthalmic trauma out of 2,565 claims (1.56%) in the OMIC database (Table 1; Supplemental Table 1). Baseline characteristics of patients were recorded (Supplemental Table 2). The median age at time of trauma was 41 years (range 1.5–72). Twenty-six (83.9%) patients were male. Florida ($n = 5$), Illinois ($n = 5$) and Massachusetts ($n = 3$) were the states with the greatest number of cases. The number of decisions for the plaintiff ($n = 13$) and defendant ($n = 18$) were analysed (Fig. 1A). All 13 decisions for the plaintiff were pre-trial settlements. The means of resolution for the defendant cases are presented in Fig. 1B. Of the 18 decisions in favor of the defendant, 12 were closed without payment and there were jury verdicts in four. In the two other cases, one was a motion of summary judgment (i.e., a motion was filed in court to have the case decided without a trial in favor of the defendant) and in the other case, an optometrist settled out of court and the OMIC insured ophthalmologist was found to be not liable. In decisions for the plaintiff, the median settlement amount was $330,000 (range $125,000–$1,000,000). The median settlement amount for all OMIC cases during the same time period was $137,500 (range $450–$3,375,000). No jury decisions resulted in a payment.

Case Information

All the cases decided for the plaintiff are summarized in Table 1 and for defendant in Supplemental Table 1. There were a wide variety of mechanisms of injury, but the most common causes of traumatic injury were fall ($n = 5$) and metal striking metal with intraocular foreign bodies (IOFB) ($n = 4$). The initial and final diagnoses of the cases were assessed (Fig. 2A, B). For patients initially diagnosed with corneal abrasions ($n = 10$), they were subsequently diagnosed with IOFB ($n = 4$), other open globe injuries ($n = 2$), endophthalmitis ($n = 4$), and ulcer ($n = 3$). Patients with a final diagnosis of endophthalmitis ($n = 8$) were initially diagnosed with open globe injury ($n = 2$), corneal abrasion ($n = 4$), vitreous hemorrhage ($n = 1$) and hyphema ($n = 1$). Further, in patients with a final diagnosis of IOFB ($n = 7$), six patients were initially misdiagnosed with either a corneal abrasion ($n = 4$) or open globe injury ($n = 2$). Of the injuries, 18 would need final management by a retina specialist, six by a corneal specialist, five by an oculoplastics specialist, and one by a glaucoma specialist.

Initial and final visual acuities were recorded. The initial visual acuity was not available for 12 patients because they were taken in the ED and were not available in the OMIC database. In the cases decided for the plaintiff ($n = 13$), only one patient had a final visual acuity better than 20/200. Five patients had no light perception (NLP) vision and of these, three underwent enucleation or evisceration. In the cases decided for the defendant ($n = 18$), nine eyes had a final vision better than 20/200. Of the nine eyes with vision worse than 20/200, five eyes were NLP, and three of these underwent enucleation.

Cause of Malpractice Claims

Upon review of the cases in the OMIC database, certain general trends in malpractice claims were identified and summarized in Table 2. In addition, to further classify the cause of a malpractice claim, an assessment of the diagnosis and management was completed (Fig. 3A). In the majority of cases decided for the defendant ($n = 13$) there was the correct diagnoses and correct management, while the majority of cases for the plaintiff involved a wrong diagnosis and wrong management ($n = 10$). The authors also studied the specific cause of the malpractice claim (Fig. 3B). Individual cases could have multiple causes, but the most common were a delay in referral or follow-up ($n = 11$) and failure to get appropriate imaging ($n = 8$). In the cases involving a delay in referral or follow-up, the most common subspecialities needing referral were retina ($n = 7$) and cornea ($n = 2$). “Other” cases were classified as other due to delay in starting antibiotics ($n = 2$), failure to order proper laboratory testing ($n = 2$), poor surgical technique ($n = 2$), failure to see patient prior to surgery ($n = 1$), and staff members turning a trauma patient away from clinic ($n = 1$).

Finally, the evaluations of whether the providers met the standard of care are presented in Fig. 3C. In one case, which was found in favor of the plaintiff, an OMIC expert evaluation was not obtained because the co-defendant was found liable. An expert evaluation was not obtained in approximately half of the cases found in favor of the defendant, because they were closed before expert assessment was obtained. One defendant case was classified as “other” because the expert felt that the insured ophthalmologist had met the standard of care, but the co-defendant optometrist working for the provider had not. Further, in three cases for the defendant and plaintiff each the standard of care decision was “mixed,” i.e., the expert reviewers had differing opinions on the liability.

DISCUSSION

Malpractice claims related to ophthalmic trauma are rare and in the OMIC database represent only 1.56% of claims. Previously reported rates of ophthalmic malpractice cases in the United

Table 1. Cases for the Plaintiff. For section cause of diagnostic/management error: 1.

Diagnosis/ Summary Statement	Mechanism of Injury	Initial Vision	Final Vision	Initial Diagnosis	Final Diagnosis	Diagnosis/ Management Error	Cause of Diagnostic/ Management Error	Standard of Care	Amount paid *all pre-trial settlements
IOFB, Endophthalmitis, Retinal detachment: Retained IOFB, endophthalmitis, and recurring retinal detachement after hammer hitting eye, resulting in "little to no vision" in 40 year old male	Hammer	20/30	Not recorded, "little to no vision"	Open globe injury	IOFB, endophthalmitis, recurrent retinal detachment	Wrong diagnosis, wrong management	2,4; should have ordered imaging on initial exam, no indirect ophthalmoscopic exam documented	Mixed	1,000,000
Open globe injury, Endophthalmitis: Ruptured globe and endophthalmitis after pen in eye, resulting in enucleation in 15 year old boy	Thrown pen	Not available	NLP, enucleation	Vitreous hemorrhage	Open globe injury, endophthalmitis	Wrong diagnosis, wrong management	3,5; failure to recognize occult open globe injury and delay in starting antibiotics by at least 24 h without any systemic antibiotics prescribed	Not done, although co-defendant found liable	959,000
Retinal Detachment: Undiagnosed RD and retina tear s/p fall, resulting in HM vision in a 57 year old male	Fall	Not available	HM	Cataract	Retinal detachment	Wrong diagnosis, wrong management	3, 4, 5; First ophthalmologist did not document dilated fundoscopic examination at any visit following trauma for over 3 months or prior to cataract surgery performed by second ophthalmologist; second ophthalmologist did not see patient until 3 days postoperatively when retinal detachment was diagnosed	Not met	475,000
Corneal abrasion, IOFB, Endophthalmitis: IOFB, vitreous hemorrhage, retinal detachment, and endophthalmitis after rock in eye resulting in enucleation in 18 year old male	Rock	CF @ 4 feet	NLP, enucleation	Corneal abrasion	IOFB, endophthalmitis	Wrong diagnosis, wrong management	1; ED provider missed the diagnosis, ophthalmologist did not examine or clarify mechanism of injury, phone advice only	Mixed	450,000

Table 1. continued

Diagnosis/ Summary Statement	Mechanism of Injury	Initial Vision	Final Vision	Initial Diagnosis	Final Diagnosis	Diagnosis/ Management Error	Cause of Diagnostic/ Management Error	Standard of Care	Amount paid *all pre-trial settlements
Hyphema, CRAO: CRAO s/p xylophone mallet hitting eye in setting of Sickle cell disease, resulting in NLP vision in 12 year old boy	Xylophone Mallet	LP	NLP	Hyphema	CRAO (sickle cell patient with IOP elevation secondary to hyphema)	Correct diagnosis, wrong management	1,5; ophthalmologist didn't see patient in ED, did not initially evaluate IOP or ask about history of sickle cell	Not met	380,000
Orbital Fracture: Orbital fracture and unknown cause of vision loss following second surgery after martial arts fight, resulting in NLP vision in 31 year old male	Mixed martial arts	Not available	NLP	Orbital Fracture	Injury during orbital fracture repair	Correct diagnosis, wrong management	5; Insured alleged that the MMA fighter was not resting as requested and initial implant moved secondary to this. Experts felt that patient should have used a titanium implant to reduce scarring and that he likely got lost in the eye with cautery causing damage to the optic nerve	Mixed	350,000
Corneal abrasion, IOFB: Siderosis and proliferative vitreoretinopathy s/p metal in eye, resulting in 20/200 vision in 41 year old male	Metal-on-metal	20/20	20/200	Corneal abrasion	IOFB, Siderosis, PVR, Traumatic Cataract	Wrong diagnosis, wrong management	1, 2, 3, 4: CT never completed, four days between ED and ophthalmologist appointment, missed transfer of medical documentation, failure to recognize early or late signs of siderosis	Not Met	110,000 OMIC. Total 330,000
Canalicular Laceration, Intraorbital foreign body: Canalicular laceration, retained IOrFB, retinal detachment, and proliferative vitreoretinopathy requiring orbitomies, second complicated by globe perforation and VH s/p palm tree frond in eye, resulting in CF @ 1	Palm tree frond	Not available	CF@ 1 FT	Canalicular laceration	Iatrogenic open globe, retained IOrFB bodies	Wrong diagnosis, wrong management	5; CT in ED did not show IOrFB, MRI showed abscess not IOrFB. Two surgeries, second complicated by globe rupture. Did not find IOrFB in either surgery so experts felt needed to explore more during surgery	Not met	300,000

Table 1. continued

Diagnosis/ Summary Statement	Mechanism of Injury	Initial Vision	Final Vision	Initial Diagnosis	Final Diagnosis	Diagnosis/ Management Error	Cause of Diagnostic/ Management Error	Standard of Care	Amount paid *all pre-trial settlements
foot vision in 71 year old male									
Corneal abrasion, Open Globe Injury, Endophthalmitis: Endophthalmitis and traumatic cataract s/p board with nail penetrating eye, resulting in 20/400 vision in 47 year old male	Nail studded board	Not available	20/200	Corneal abrasion	Open Globe injury, Endophthalmitis	Wrong diagnosis, wrong management	3,4,5: This case was a delay in diagnosis of endophthalmitis due to either the patient not showing for his appointment, or the office staff turning away the patient and not returning multiple phone calls. Also, very poor physician documentation, should have documented a telephone call	Not met	275,000
Corneal abrasion, IOFB, Retinal Detachment: Retained metallic IOFB, retinal detachmen, and siderosis s/p pulling wood with crowbar, resulting in LP vision in 24 year old male	Pulling wood deck, felt something in eye	20/20	LP	Corneal abrasion	IOFB, retinal detachment, siderosis	Wrong diagnosis, wrong management	2,3; failure to perform dilated fundoscopic examination or obtain imaging resulting in a delay in referral to retinal specialist	Not met	250,000
IOFB: IOFB and siderosis s/p hammering on metal, resulting in 20/100 PH 20/70 vision in 38 year old male	Metal-on-metal (+ eye protection)	20/25	20/70	Open globe injury	IOFB, Siderosis	Wrong diagnosis, wrong management	2; dispute about mechanism of injury: penetrating vs blunt, so did not order imaging.	Not Met	200,000
OGI, Endophthalmitis: Open globe with late diagnosis of endophthalmitis s/p fork in eye, resulting in evisceration in 44 year old female	Fork	HM	NLP, evisceration	Open globe injury	Endophthalmitis	Correct diagnosis, wrong management	3,4,5; Comprehensive ophthalmologist did not prescribe systemic antibiotics. Also did not refer to retina before nor obtain adequate consent before evisceration.	Not met	165,000
Corneal Abrasion, Corneal Ulcer: Fungal corneal ulcer	Mowing lawn	20/20	20/400	Corneal abrasion	Corneal ulcer (fungal) requiring multiple	Wrong diagnosis, wrong management	3,5: Delay in diagnosis/referral as insured failed to	Not met	125,000

Table 1. continued

Diagnosis/ Summary Statement	Mechanism of Injury	Initial Vision	Final Vision	Initial Diagnosis	Final Diagnosis	Diagnosis/ Management Error	Cause of Diagnostic/ Management Error	Standard of Care	Amount paid *all pre-trial settlements
requiring two corneal transplants s/p grass in eye, resulting in 20/400 vision in 41 year old male					penetrating keratoplasties		suspect, culture and treat fungal keratitis earlier		

Ophthalmologist accepted ED diagnosis and did not see the patient. 2. Proper imaging not ordered. 3. Delay in follow-up or referral. 4. Medical documentation issue. 5. Other.

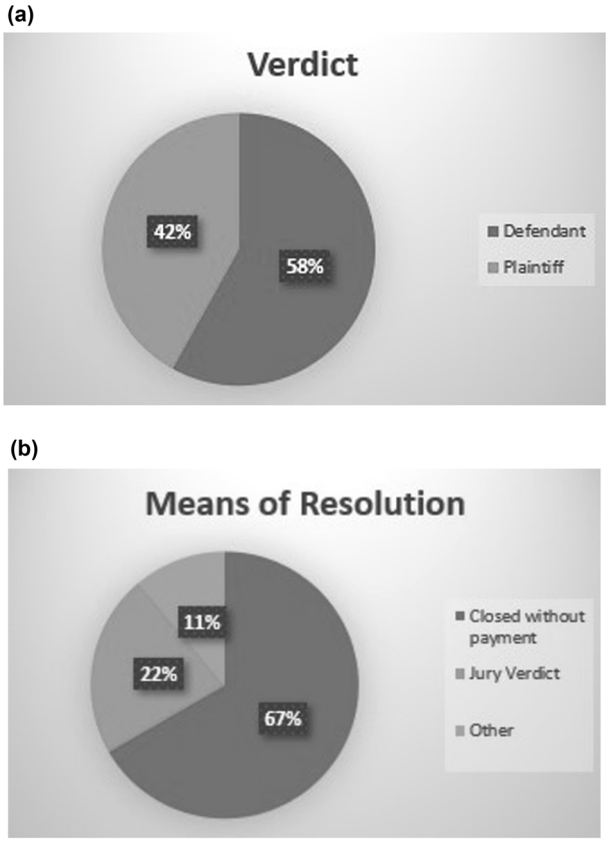

Fig. 1 Verdict decisions and means of resolution in decisions for the defendant. A: Verdict. B: Means of resolution in cases for the defendant.

States are about 4% [14], which is similar to that of about 3% in the UK [11]. In the OMIC database, the median settlement for ophthalmic trauma is roughly $200,000 higher than for other types of ophthalmic malpractice claims, but were similar to the mean compensation payment across multiple other medical specialities [10, 15]. The higher compensation rate is likely due to the frequent severe vision loss associated with ophthalmic trauma [16]. In the United States Eye Injury Registry (USEIR), approximately 25% of ophthalmic injuries result in a final visual acuity of less than 20/200 [17]. In our study, 12 of 13 cases that were ruled in favor of the plaintiff had a final visual outcome of 20/200 or worse and roughly 1/3 of the traumatized eyes had a final vision of NLP. Thus, although malpractice claims related to ophthalmic trauma are not common, the severity of visual loss associated with these injuries, especially if there was mismanagement, often results in larger settlement amounts.

One of the most notable observations of these OMIC trauma-related cases is the initial misdiagnosis of a penetrating eye injury as a corneal abrasion by either an ophthalmologist (6.5%) or a non-ophthalmologist (12.9%). It is important in corneal abrasion injuries to have a high suspicion for an occult open globe injury. Further, a diagnostic error such as this is sometimes compounded when the treating ophthalmologist who follows the patient thereafter does not perform a thorough and complete ophthalmic examination or order appropriate diagnostic imaging. In open globe and IOFB injuries, too often (25.8%) a dilated fundoscopic examination or adjunctive imaging such as B-scan ultrasonography by a trained ophthalmologist, plain film imaging if CT is not available, or computed tomography (CT) of the orbit was not done. When the eye examination is not suggestive of globe rupture, but the mechanism of injury involves metal striking metal

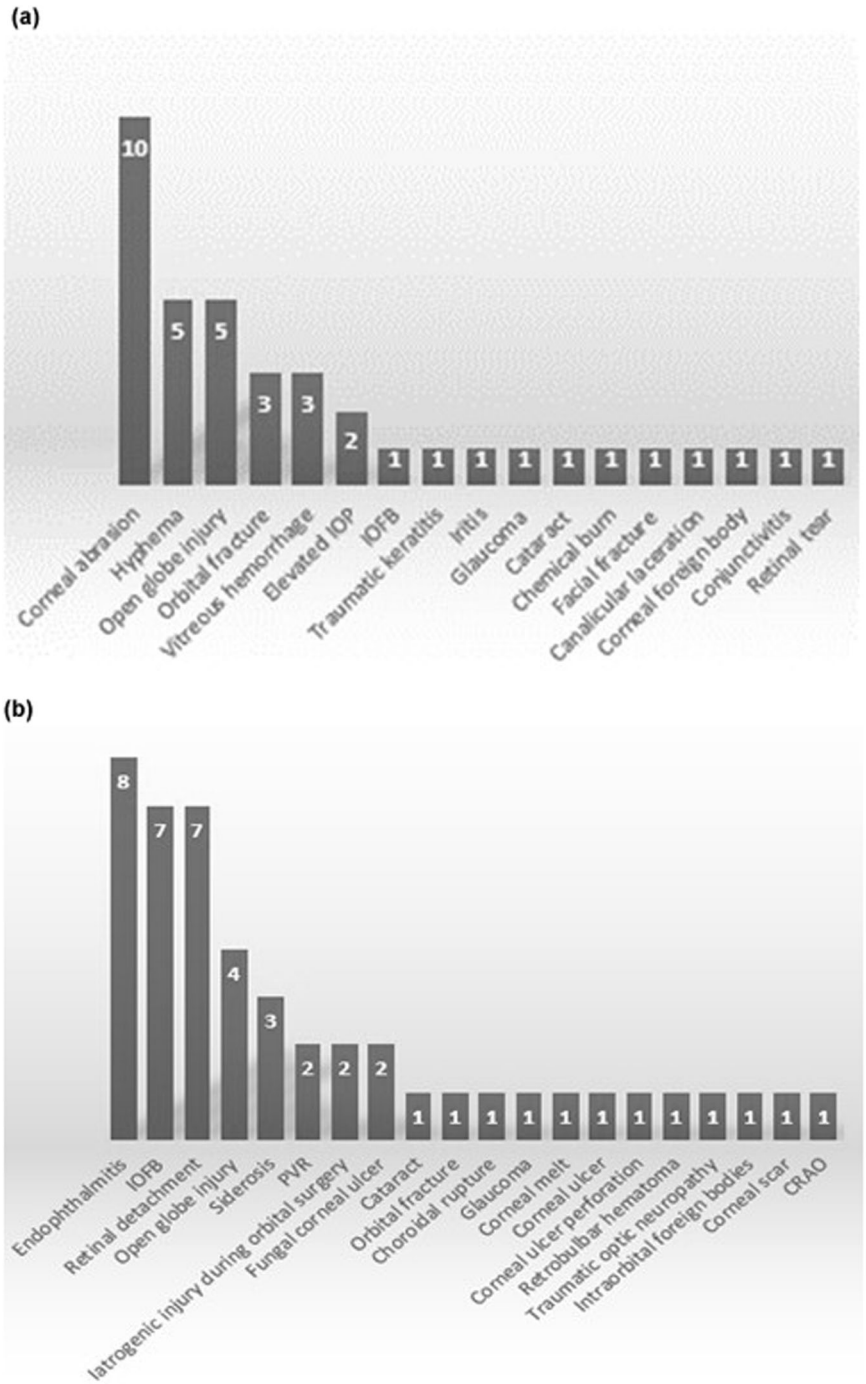

Fig. 2 Initial and final diagnoses. A: Initial diagnoses. B: Final diagnoses.

or a sharp object striking the globe, there should be strong suspicion for an occult open globe injury and possible IOFB. A previous study has shown that CT scan is the most reliable method for identifying suspected IOFBs when compared to B-scan ultrasonography or clinical eye examination [18]. If vegetable matter is suspected in the wound and a metallic IOFB has been excluded, MRI imaging may also be helpful [19]. CT imaging has a high specificity (approximately 75–100%) but low sensitivity (approximately 40–75%) for identifying open globe injuries. CT findings of changes in globe contour, volume loss, absence of lens, retinal detachment, and vitreous hemorrhage are the most predictive signs of an open globe injury [20–22]. However, CT imaging alone cannot be relied upon to diagnose an occult open globe and a comprehensive clinical examination including a dilated fundoscopic examination should be done [20, 21]. Treating ophthalmologists should have a low threshold for surgical evaluation under anesthesia if they are unable to rule out a ruptured globe by clinical examination and imaging [22]. This situation is not uncommon with ocular trauma in children [23].

Patients diagnosed with a traumatic corneal abrasion should be monitored for ulcer formation. In our study there was four cases of corneal ulcer formation (12.9%) and two fungal ulcers (6.5%). One of the fungal cases was mismanaged and resulted in a decision for the plaintiff. This case involved a delay in culturing the ulcer, treating the fungal keratitis, and referral to a corneal specialist. Although in the United States bacterial keratitis is most frequently

Table 2. Actionable steps.

Anterior Segment Injuries	
1	A corneal abrasion should always be evaluated at a slit lamp: monitor for corneal ulcer, endophthalmitis, open globe injury, and dilate to rule-out IOFB.
2	Traumatic corneal ulcers- consider fungal etiology, particularly for vegetable matter injuries
3	Hyphema- consider sickle cell disease, properly manage elevated intraocular pressure and if no posterior view is possible, get CT imaging or perform a B-scan ultrasound.
Open Globe Injuries	
4	Dilate both eyes of all trauma patients at initial visit unless concern for possible angle closure or obvious open globe injury (then dilate only the non-traumatized eye). In all cases, rule out IOFB, particularly those with metal on metal injuries. If the mechanism of injury (MOI) is concerning for an IOFB (essentially "something flew in eye" or any metal projectile), order CT imaging and monitor for signs of siderosis.
5	Start systemic antibiotics to prevent endophthalmitis.
Orbital Injuries	
6	Be careful of causing iatrogenic injuries to the optic nerve, extraocular muscles, or globe during orbital fracture repair.
7	Monitor for post-operative retrobulbar hematoma.
8	Consider MRI imaging in injuries involving plant/vegetable matter.
General Rules	
9	If there is a significant MOI (e.g., gun shot wound, motor vehicle accident, etc) or the providers' story doesn't make sense, especially in a pediatric patient, see the patient in the ED as soon as possible. Do not wait until the next day.
10	Educate your staff on the importance of follow-up in trauma patients. Alert the front desk staff of patients that were told to follow up from the ED.
11	If working with an optometrist, discuss all trauma cases with them
12	In complex cases when the diagnosis or management protocol is unclear, don't delay referral to subspecialists.
13	Carefully document ED examinations and telephone consultations.
14	Carefully document informed consent in traumatic cases.

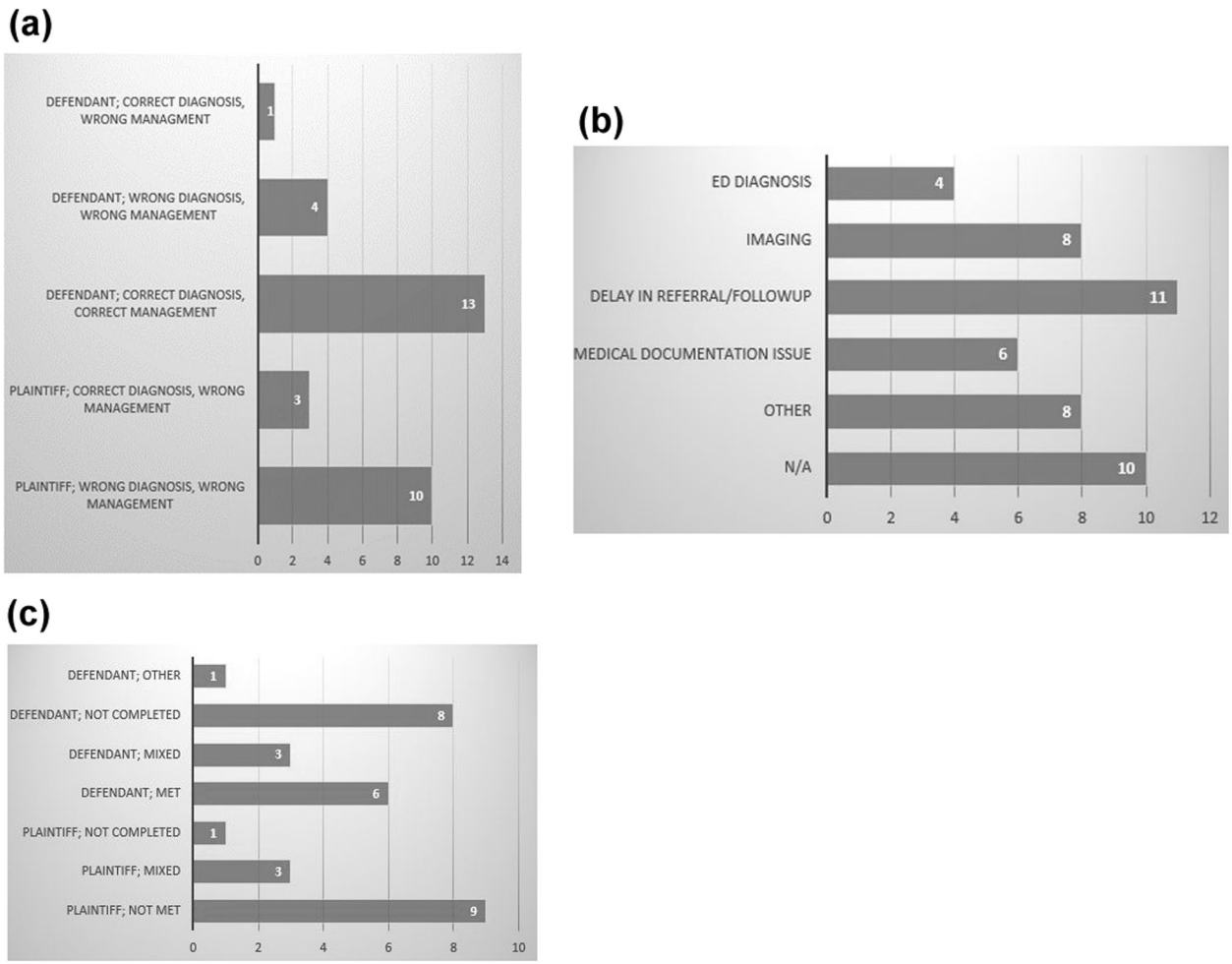

Fig. 3 Assessment of issues with diagnosis and management, specific causes of malpractice claims and evaluation of standard of care. A: Diagnosis and management assessment. B: Cause of malpractice claims. C: Standard of care.

associated with contact lens use, in South East Asia and South India, trauma is the largest risk factor for microbial keratitis [24–26]. In Florida, trauma has been found to be the most common cause of fungal keratitis [27, 28]. Initial daily follow-up and cultures of a corneal ulcer are typically indicated in patients with corneal trauma. Non-healing ulcers should raise concern for fungal infection and early referral to a corneal specialist should be considered [24, 27, 28].

Another striking observation was the frequency ($n = 5$; 16.1%) of undetected IOFBs resulting in endophthalmitis, siderosis, retinal detachment, and/or proliferative vitreoretinopathy all resulting in decisions for the plaintiff. Mismanagement of these cases resulted in delay of referral to a retinal specialist and removal of the IOFB. It is critical, in ophthalmic trauma, that patients are monitored for pigmentary retinopathy, iris heterochromia, pupillary mydriasis, and cataract development to rule out siderosis [29–31]. It should be noted that even when the electroretinogram (ERG) demonstrates decreased b-wave amplitudes in patients with an IOFB, visual acuity and other clinical signs may improve after IOFB removal [29, 31]. In addition, our series had multiple cases ($n = 6$, 19.4%) of open globe ($n = 4$) or IOFB-related ($n = 2$) trauma that developed endophthalmitis. Two cases were related to either failure or delay in prescribing systemic antibiotics. The incidence of endophthalmitis in patients treated with systemic antibiotics after open globe injury is approximately 1–3% [19, 32, 33]. Furthermultiple randomized controlled studies have not found a difference in rates of endophthalmitis between intravenous versus oral antibiotics [19, 32, 33]. Patients with an IOFB and delayed wound closure, contaminated wounds, or ruptured lens capsule should raise increased suspicion for endophthalmitis and the treating ophthalmologist should have a lower threshold for referral to a retina specialist [19].

A previous review of malpractice litigation related to oculoplastic surgery found that iatrogenic injury, legal blindness, and cranial nerve injury resulted in a higher likelihood of payment to the plaintiff ($p < 0.05$) [34]. The five orbital cases in this series represent a unique category of malpractice claims and were either related to injuries sustained during surgical repair of the initial traumatic injury, or due to poorly performed informed consent. Two of the orbital injury cases were decided for the plaintiff. One case involved an optic nerve injury which occurred during orbital fracture repair and the other involved exploration for an intraorbital foreign body resulting in an iatrogenic open globe. Both cases resulted in a final visual acuity less than 20/200. A third case due to retrobulbar hematoma after orbital fracture repair, which is known to occur after approximately 1% of orbital fracture repairs [35, 36] was decided for the defendant.

The two cases of poor informed consent involved oculoplastics cases. In the above mentioned retrobulbar hematoma after orbital fracture repair case, the written informed consent indicated that the patient should stop the use of aspirin for two weeks prior to surgery and the patient was not verbally advised of the increased risk of hemorrhage of patients on blood-thinning medications. The surgeon waited only three days off aspirin before performing the surgery. In another case involving evisceration for post-traumatic endophthalmitis, the surgeon obtained informed consent from a family member of the injured patient instead of waiting until the patient was able to give consent. These two cases demonstrate the importance of the informed consent process and the crucial role it plays in causing plaintiffs to initiate a claim [34, 37]. OMIC has numerous informed consent documents available on the company's website for many ophthalmic trauma surgical procedures [38–42].

Poor communication between an optometrist or ED physician and the treating ophthalmologist was another common cause ($n = 8$, 25.8%) of malpractice claim observed in this study. Half of these cases resulted in a plaintiff decision. With the rise in teleophthalmology for emergency department triage [4, 5], it is even more critical that the on-call ophthalmologist ask the referring provider appropriate questions to determine whether they have made the correct diagnosis, have completed an appropriate examination with suitable imaging, have a proper treatment plan, and have arranged follow-up. The on-call ophthalmologist should have a low threshold for evaluating the patient—in person—regardless of the time of day or night. For example, a pediatric case in this series involving decreased vision with hyphema resulted in NLP vision because the emergency department did not perform an intraocular pressure (IOP) check and the ophthalmologist did not ask whether the patient had a history of sickle cell disease [43, 44]. The patient's elevated IOP resulted in a secondary central retinal artery occlusion (CRAO) and blindness in the involved eye. It should be noted that depending on state laws, the provider can be held liable for any medical advice given over the phone, and careful documentation of telemedicine consults should be practiced as with all patient encounters [45]. The on-call ophthalmologist may wish to consider using a telemedicine consent in these sitations [46].

If an ophthalmic practice employs optometrists who treat ophthalmic trauma, it is important to observe and discuss trauma cases with them. In two cases, defendants were sued as their employed optometrists mismanaged trauma cases; both of these cases were dismissed for the defendant, but their optometrists settled out of court. Critically, ophthalmologists as supervisors with the highest credentials are at risk for legal action in mismanaged trauma cases by their employees. In addition, the on-call ophthalmologist should give feedback to ED providers if a case of ophthalmic trauma is misdiagnosed or mismanaged. Patients referred from the ED should have close follow-up and office staff should be notified of the patient's demographic information to track the patient in case they do not present for appointments. One case in this series involved office staff turning away an ED patient who had no insurance because the ophthalmologist had not alerted the staff that the patient was told to come in from the ED. Lastly, it is critical to refer to appropriate ophthalmic subspecialties in complex cases when the diagnosis or management protocol is unclear [45]. Delay in follow-up to the comprehensive ophthalmologist or referral to a subspecialist was an important factor in 11 cases in this study, of which retina was the most common subspecialty with delayed referral ($n = 7$).

There are limitations to this study. The OMIC database is restricted to claims brought against OMIC insureds which represent approximately 30% of privately insured US ophthalmologists. (There are approximately 18,000 active US ophthalmologists and OMIC insures about 5000, but approximately 8000 are self-insured by their hospital system or covered by federal tort laws as Veterans Affairs providers). Thus, malpractice claims of ophthalmologists with other insurance would not have been identified during this search [47]. Another limitation is that not all data was complete for every case and the authors did not have direct access to the individual patient medical records. Further, we did not look at the ophthalmic subspecialty distribution of different types of suits. Future studies should evaluate the practice patterns of the referring providers to see if subspecialists are more likely to have a case outside of their specialty area. Finally, the small sample size limited any statistical analysis.

Malpractice claims related to ophthalmic trauma are very uncommon in the United States, however, 42% of cases were found for the plaintiff and the settlement payments were higher than for non-trauma cases due to poor visual outcomes. But, if the on-call ophthalmologists had performed a careful history and complete ophthalmic examination (with dilated fundoscopy) and imaging in appropriate patients, the number of cases in this study might have been greatly reduced. Performance of a thorough informed consent, meticulous documentation, and early subspecialist referrals when the diagnosis or management plan is

unclear, are all critical factors in providing excellent patient care and also avoiding a malpractice claim. Finally, as the leaders in the care of ophthalmic trauma, it is critical that ophthalmologists maintain coverage of emergency departments throughout the United States.

Summary

What was known before:

- Decreasing call coverage- In the United States, there is a decrease in ophthalmologist coverage particularly in rural regions, and liability concerns have been found to be a contributing factor.
- Ophthalmology is a low-risk subspecialty for malpractice- Ophthalmologists face few claims and have lower payments, however approximately 20% of ophthalmologists will face a lawsuit by 65.

What this study adds:

- Larger settlement amounts for ophthalmic trauma malpractice- Overall malpractice claims are very low for ophthalmic trauma, but due to the severity of the vision loss in these injuries they result in larger settlement amounts than other ophthalmic fields.
- Corneal abrasion- corneal abrasion misdiagnosis was a frequent cause of litigation. Frequently, this was due to a missed open globe or intraocular foreign body with subsequent lack of imaging or referral to subspecialist for management.

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AUTHOR CONTRIBUTIONS

G.A.J. conceived the work. A.M.M. acquired the data. All authors played an important role in interpreting the results, drafting and revising the manuscript, approving the final version, and agree to be accountable for all aspects of the work.

COMPETING INTERESTS

Dr. Pelton is a Board member of Ophthalmic Mutual Insurance Company (OMIC). Dr. Rapuano is a Committee member of OMIC. Dr. Menke is an employee of OMIC. The other authors do not have any conflicts of interests.

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