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Characterization of Facial Trauma Associated with Standing Electric Scooter Injuries

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Since 2017, standing electric scooters (e-scooters) have been deploying rapidly in metropolitan areas worldwide, with an increasing number of injuries being reported.^{1–4} Based on current literature, understanding facial trauma in the context of e-scooter use remains understudied. Most prior studies have grouped facial fractures in aggregate without specifying exact patterns. Moreover, none have examined ophthalmologic sequelae.

To study this further, we retrospectively reviewed patients demonstrating facial injuries associated with e-scooter use between June 2018 and May 2019 at 2 emergency departments at the University of California, San Diego. The study protocol was submitted to the University of California, San Diego, Institutional Review Board, which granted waiver of informed consent. The study adhered to all tenets of the Declaration of Helsinki.

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HUMAN SUBJECTS: Human subjects were included in this study. The University of California, San Diego, IRB/ethics committee deemed this study IRB-exempt. All research adhered to the tenets of the Declaration of Helsinki. The institutional review board granted a waiver of informed consent.

No animal subjects were included in this study.

Encounters related to facial trauma associated with the terms *scooter*, *bird*, or *lime* (the latter 2 describing e-scooter brands in the region) in the intake triage field were identified. For each patient, data recorded included: demographics, use of drugs and alcohol at presentation, helmet use, mechanism of trauma, type of facial injury, presence of associated comorbidities, need for hospitalization, and need for surgical intervention. Descriptive statistics were maintained using Microsoft Excel (Microsoft, Redmond, WA).

During the study period, 34 patients demonstrated facial injuries associated with e-scooter use. Twenty-five (74%) were men, with a mean age of 36.7 years (standard deviation, 15.3 years; Table 1). None of the patients wore a helmet. Approximately three quarters (n = 25 [74%]) were intoxicated or impaired because of alcohol or drug use based on self-reporting, physician observation, or formal toxicology testing. The mean blood alcohol level among intoxicated patients who underwent testing was 203.4 mg/dl (standard deviation, 4.3 mg/dl).

Nearly all patients (94%) showed 1 or more facial fractures (Table 1). Furthermore, most (79%) demonstrated complex facial fractures involving multiple anatomic subunits. Lateral orbital rim and orbital floor fractures were most common, each present in more than half of the patients. Orbital roof fractures and medial orbital wall fractures were each present in approximately one quarter of patients. Four patients (12%) showed bilateral fractures.

Ophthalmologic examination was performed in 26 of 34 patients (76%), including all patients with orbital fractures. Five patients (15%) showed eyelid lacerations, including 1 with a severe degloving injury (Fig S1, available at www.aojournal.org). One patient (3%) showed intraretinal hemorrhages without decreased acuity. All patients showed normal visual acuity except for 1 patient, who demonstrated no light perception visual acuity with elevated intraocular pressure of more than 50 mmHg secondary to retrobulbar hemorrhage. This patient required emergent lateral canthotomy and cantholysis to decrease intraocular pressure and to restore his vision to baseline. No patients showed extraocular muscle entrapment or globe rupture.

Most patients (n = 26 [76%]) were admitted to the hospital (Table 1). Surgical intervention was required for 8 patients (24%) in the acute inpatient setting. Approximately one fifth (21%) were found to have associated intracranial hemorrhage based on computed tomography imaging. Four patients (12%) showed impaired neurologic status requiring intubation for airway protection. Most patients with intracranial hemorrhages were monitored closely and without neurosurgical intervention. However, 1 patient sustained a cerebral contusion with extensive intracranial hemorrhage requiring craniotomy and prolonged hospitalization, ultimately leading to cognitive disability and skilled nursing facility rehabilitation.

In summary, this series details patients demonstrating facial injuries associated with e-scooter use from 2 academic emergency departments. We found a high percentage of complex facial fractures involving multiple anatomic subunits, which tend to be more severe and difficult to repair. This is likely a function of impact speed, the surface area of impact with diffuse impact force, lack of restraints, and coup–contrecoup forces. Additionally, approximately one quarter had sustained orbital roof fractures, which are high risk given the

possibility of cerebrospinal fluid leak. One quarter of patients required surgical repair in the acute inpatient setting, also suggesting greater severity.

Detailed ophthalmologic sequelae of e-scooter injuries have not been reported previously. Although nearly all patients showed normal visual acuity and intraocular pressures after the e-scooter facial injuries, notably 1 patient demonstrated a massive retrobulbar hemorrhage causing no light perception vision until emergent cantholysis was performed. Another patient experienced retinal hemorrhages, and several patients showed eyelid lacerations, with 1 patient sustaining a severe and disfiguring degloving injury. With the high proportion of orbital fractures, we expected to note a higher frequency of eyelid lacerations; however, the mechanism for laceration typically is avulsion or direct penetrating injury, and not blunt impact seen as the main mechanism of injury in this study. With the relatively recent deployment of e-scooters, it is difficult to ascertain whether the incidence of ocular complications from facial trauma secondary to e-scooter use differs significantly from other mechanisms (e.g., motor vehicle accidents). Nevertheless, the presence of these sequelae in this series at least demonstrates the potential for substantial ocular morbidity related to e-scooter use.

Whereas well-delineated regulations and legal consequences exist for driving motorized vehicles while intoxicated, current laws ignore the substantial usage of nonmotorized road vehicles, including e-scooters.⁵ Our data show that 74% of patients with facial trauma were intoxicated or impaired as a result of alcohol or drug use, with mean blood alcohol levels exceeding 3 times the legal limit. Prior studies also report high intoxication rates among e-scooter riders with a broader range of injuries.^{1,3} The lack of regulation in this area is an important public health issue, especially given the severity of associated injuries.

Lack of helmet use likely contributed to head injury being reported as the most common type of injury after e-scooter accidents in other reports.² Our series also demonstrated an alarming rate of serious head injury, with 21% of patients sustaining intracranial hemorrhage. Currently, e-scooter companies have supported limiting regulations mandating the use of protective gear. For example, a bill recently passed in the California State Legislature that permits adults to ride e-scooters without helmets, reversing a prior law requiring helmets regardless of age.⁶

In conclusion, patients with facial injuries associated with e-scooter use demonstrate complex and high-risk facial fractures resulting in surprisingly high rates of hospitalization, intracranial hemorrhage, decreased neurologic status, and need for acute inpatient surgical intervention. The severity of injuries documented herein provides additional support for public policy development around this emerging mode of transportation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.**Characteristics of Patients Demonstrating Facial Injuries Associated with Electric Scooter Use**

Characteristic	Data (n = 34 Patients)
Mean (SD) age, yrs	36.7 (15.3)
Male gender, no. (%)	25 (74)
Self-reported race, no. (%)	
White	23 (68)
Hispanic	6 (18)
Asian	3 (9)
Other	2 (6)
Positive alcohol screen results, no. (%)	21 (62)
Mean blood alcohol level (SD), mg/dl	203.4 (4.3)
Positive urine toxicology results, no. (%)	6 (18)
Benzodiazepines	1 (3)
Opioids	1 (3)
Methamphetamine	2 (6)
THC	3 (9)*
Helmet use, no. (%)	0 (0)
Mechanism of injury	
Collision with object	15 (44)
Mechanical fall	9 (26)
Hit by moving vehicle	3 (9)
No recall	6 (18)
Scooter malfunction	1 (3)
Required inpatient admission, no. (%)	26 (76)
Required inpatient surgery, no. (%)	8 (24)
Required intubation, no. (%)	4 (12)
Facial fractures, no. (%)	32 (94)
Lateral orbital wall	18 (56)
Orbital floor	17 (53)
Orbital roof	9 (28)
Medial orbital wall	8 (25)
Nasal bone	3 (9)
Maxillary bone	3 (9)
Mandibular bone	2 (6)
Intracranial hemorrhage, no. (%)	7 (21)
Intraretinal hemorrhage, no. (%)	1 (3)
Retrobulbar hemorrhage, no. (%)	1 (3)
Lid laceration, no. (%)	5 (15)

SD = standard deviation; THC = tetrahydrocannabinol.

* One patient showed positive results for both THC and methamphetamines.