



Research

A Neurosurgical Perspective on Electric Scooter Accidents

Elektrikli Scooter Kazalarına Nöroşirürjikal Bakış: Klinik Tecrübemiz

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ABSTRACT

Objective: Electric scooters (e-scooters) have become the preferred personal vehicles in the world because of their easy accessibility, fast and even environmentally friendly features. E-scooters started to be used in İstanbul for the first time in Türkiye in 2019 and became popular in other metropolitans over time. We started encountering injuries associated with the growing use of e-scooters at our clinic.

Methods: This retrospective study evaluated 242 patients who were admitted to the Emergency Department of University of Health Sciences Türkiye, Haydarpaşa Numune Training and Research Hospital due to electric scooter accidents between January 2020 and May 2023 for neurosurgical pathologies.

Results: Among the 12 patients included in the study, 8 were male and 4 were female. The mean age was 26.6 years (14-50). It was determined that none of the participants used protective equipment (helmet, knee pad, etc.). According to the retrospective evaluation, two patients were followed up for mild head trauma, seven for moderate head trauma, and one for severe head trauma. One patient with severe head trauma required long hospital stay and repeated surgical intervention. One patient underwent conservative follow-up, and the other required surgery.

Conclusion: E-scooters are environmentally friendly and can accelerate transportation; however, using them without complying with protective equipment and traffic rules can cause severe trauma. Despite our limited number of patients, we monitored one patient with trauma progressing to severe morbidity. We believe that injuries related to e-scooters will be more frequent in neurosurgery emergency practice.

Keywords: Accident, brain surgery, neurotrauma, trauma

ÖZ

Amaç: Elektrikli scooter (e-scooter), şehir içi ulaşımında kolay ulaşılabilir, hızlı, ucuz ve hatta çevre dostu yapılarıyla dünyada ve Türkiye’de tercih edilen bir kişisel ulaşım aracı olarak karşımıza çıkmaktadır. Türkiye’de ilk defa 2019 yılında İstanbul’da kullanılmaya başlanan e-scooterlar, zaman içinde diğer büyük şehirlerde de kullanıma girdi. E-scooter’ların artan kullanımıyla birlikte ilişkili yaralanmalar da nöroşirürji klinik pratiğimizde karşımıza çıkmaya başladı.

Yöntem: Bu çalışmada Ocak 2020-Mayıs 2023 tarihleri arasında Sağlık Bilimleri Üniversitesi Haydarpaşa Numune Eğitim ve Araştırma Hastanesi Acil Servisine e-scooter kazası nedeniyle başvuran 242 olgu, nöroşirürjikal patolojiler için retrospektif olarak değerlendirildi.

Bulgular: Çalışmaya dahil edilen 12 olgunun 8’i erkek, 4’ü kadın idi. Ortalama yaş 26,6 yıl (14-50). Hiçbirinin koruyucu ekipman (kask, dizlik vb.) kullanmadığı öğrenildi. Retrospektif değerlendirmede 2 olgu hafif, 7 olgu orta, 1 olgu ağır kafa travması nedeni ile takip edildiği belirlendi. Ağır kafa travmalı 1 olgunun uzun hastane yatışı ve tekrarlayan cerrahi girişim ihtiyacı mevcuttu. Olguların 1’i konservatif izlemle takip edilirken, 1’inde cerrahi girişim ihtiyacı oldu.

Sonuç: Ulaşımı hızlandıran ve aynı zamanda çevre dostu e-scooter’ın koruyucu ekipman ve trafik kurallarına uymaksızın kullanımının ciddi travmalara neden olduğu görülmektedir. Biz de sınırlı sayıdaki olgularımıza rağmen bir olgunun ciddi morbidite ile giden travma ile takibini yaptık. Zaman içinde e-scooter ilişkili yaralanmaların nöroşirürji acil servis pratiğinde sıklığının artacağını düşünmekteyiz.

Anahtar Kelimeler: Kaza, beyin ameliyatı, nörotravma, travma

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INTRODUCTION

The world's growing population, especially in metropolitan areas and the resulting traffic jams have increased the need for faster vehicles for transportation. Shared electric scooters (e-scooters) have rapidly spread in many urban centers around the world since their first use in Santa Monica, California in 2017 (1). E-scooters, which started to be used as a better alternative to other means of urban transportation, have recently emerged as fast, easy, and cheap vehicles that are also respectful to nature (1,2).

E-scooters, which were first used in İstanbul in 2019 for the first time in our country, have spread to other metropolitan areas in recent years. They have become a practical, fast, and cheap means of transportation available through applications downloaded to mobile phones. Fees are determined according to the duration of use, and the distance and destination can be selected by the driver. Following their introduction in Türkiye in 2019, the speed limit for e-scooters was 25 km/h and the legal age limit was 15, per the regulation published in the related law for the first time in 2021. The same speed limit and age limit apply as of 2024. Driver's licenses and protective equipment are not compulsory, according to the regulation. They are particularly popular among the young population, especially during rush hours when traffic is heavy and public transportation is crowded.

The increase in the daily use of e-scooters has led neurosurgeons to encounter relevant injuries at emergency and trauma clinics with increasing frequency over the years. Head traumas ranging from mild to severe and pathologies related to the spine are observed with considerable frequency. In our study, we aimed to evaluate patients who presented to our emergency department because of e-scooter injuries and were consulted by a neurosurgeon between 2020 and 2023 for neurosurgical traumatic pathologies based on their demographic and clinical characteristics.

METHODS

Approval for this study was obtained from the University of Health Sciences Türkiye, Haydarpaşa Numune Training and Research Hospital at a meeting (date: 29.11.2022, number: E-62977267-771). Among the 242 patients admitted to the Emergency Department of University of Health Sciences Türkiye, Haydarpaşa Numune Training and Research Hospital between January 2020 and May 2023 due to e-scooter injuries, patients hospitalized and followed up

in the neurosurgery clinic were retrospectively evaluated based on the medical records. Treatment consent forms were obtained for all patients and are available in the patient files.

All patients included in the study underwent cranial computed tomography (CT) and full spinal CT imaging after presenting to the emergency department. Among the 242 patients evaluated, 12 patients with pathology detected on radiological imaging due to neurosurgical injury who were followed up as inpatients in our clinic were included in the study. No exclusion criteria were applied for patients.

Statistical Analysis

Statistical analyses of the study were performed using the arithmetic mean. During the study, patient information, including age, sex, use of protective equipment, neurosurgical pathologies, neurological examination results, need for surgery after admission, intensive care hospitalization, and neurological status at discharge, was evaluated retrospectively based on the patient files.

RESULTS

Among the 242 patients admitted to the emergency department of our hospital due to e-scooter-related accidents, 172 (71.07%) patients with suspected cranial and/or spinal trauma underwent cranial and whole spinal CT examinations per the trauma protocol, and 98 (56.9%) of these patients with suspected radiologic or clinical findings were consulted to neurosurgery. Twelve (12.2%) of the consulted patients were treated as inpatients at the neurosurgery clinic. Ten patients were followed up due to head trauma and 2 due to spinal injury. One patient with severe head trauma was operated on urgently after admission and was followed up in the intensive care unit for a long period after the surgery. The remaining patients were followed up at our clinic.

Among the 12 patients in the study, 8 were male, and 4 were female. The mean age was 26.6 years (14-50). All patients were users of e-scooters. None of the patients used protective equipment (helmet, knee pad, elbow pad, etc.). No use of alcohol or sedatives was detected in any patient. (Table 1).

Based on the retrospective evaluation, 10 patients were found to have head trauma. Two patients were followed up for mild, seven for moderate, and one for severe head trauma. Among the patients hospitalized in our clinic, only one had concomitant orthopaedic traumatic pathologies. The patient was treated by an orthopaedic and

traumatology physician. Plastic and reconstructive surgery was performed for four patients with maxillofacial traumatic pathologies. The remaining patients had isolated cranial or spinal trauma.

One patient with severe head trauma required long hospital stay and repeated surgical intervention. The patient whose hematoma was discharged by decompressive craniectomy due to acute subdural hemorrhage was transferred to our clinic after follow-up in the intensive care unit (Figure 1). The patient was transferred to the clinic for rehabilitation based on the stable course of his general condition. Non-obstructive hydrocephalus was detected in the examinations performed due to sleepiness and regression in neurological score. The patient was referred to our clinic and underwent ventriculoperitoneal shunt procedure (Figure 2). The patient was re-transferred to the rehabilitation department with the same neurological condition as before the development of hydrocephalus, Glasgow Coma Scale (GCS) 9, quadriplegia, and no verbal response.

Th 12 vertebrae corpus fracture was detected in a 27 year-old male patient who was followed up for spinal trauma (Figure 3). Following the thoracolumbar magnetic resonance imaging, the thoracolumbar injury classification system (TLICS) score of the patient was calculated as 1, and a decision was made on conservative follow-up. A 14 year-old female patient with spinal trauma developed L1 burst fracture, posterior spinal element fracture, and ligament injury during advanced examination. The TLICS score of the patient was 4, and surgery was decided in the early posttraumatic period with posterior segmental instrumentation. Both patients were discharged without neurological impairment.

All nine patients hospitalized for mild and moderate head trauma were observed to have GCS: 15, without any neuromotor deficit. Only two patients were diagnosed with mild head trauma due to cephalic hematoma alone. Patients without radiological progression on follow-up imaging were discharged uneventfully.

Table 1. Neurological status and epidemiological features of the cases

	Sex	Age	Trauma type	Pathology-neurological status
Case 1	M	26	Moderate	Right frontal sinus fracture, anterior skull base fracture-GCS: 15
Case 2	M	28	Moderate	Left temporal bone fracture+epidural Hematomaz-GCS:15
Case 3	M	32	Moderate	Pneumocephalus+nasal ve bilateral orbital fracture-GCS:15
Case 4	F	50	Moderate	SAH-GCS:15
Case 5	M	30	Moderate	Maxillofacial ve frontal sinus fracture-GCS:15
Case 6	F	18	Moderate	Left frontal bone fracture-GCS: 15
Case 7	M	24	Spinal	Th-12 Corpus fracture, anterior column-normal exam. - TLICS: 1
Case 8	M	23	Severe	Subdural hematoma+left temporal bone fracture- intubated, GCS: 5
Case 9	M	29	Mild	Cephalohematoma-GCS: 15
Case 10	M	23	Moderate	Left frontal sinus fracture-GCS: 15
Case 11	F	23	Mild	Cephalohematoma-GCS:15
Case 12	F	14	Spinal	L1 compression fracture-normal exam.-TLICS: 4

GCS: Glasgow coma scale, TLICS: Thoracolumbar injury Classification and severity scale, Th-12: Th 12 vertebrae, SAH: Subarachnoid hemorrhage

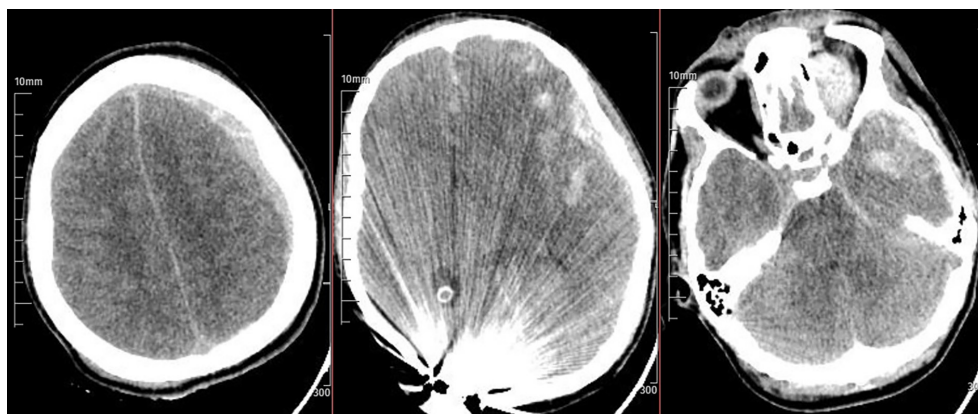


Figure 1. Severe head trauma patients preoperative CT images
CT: Computed tomography

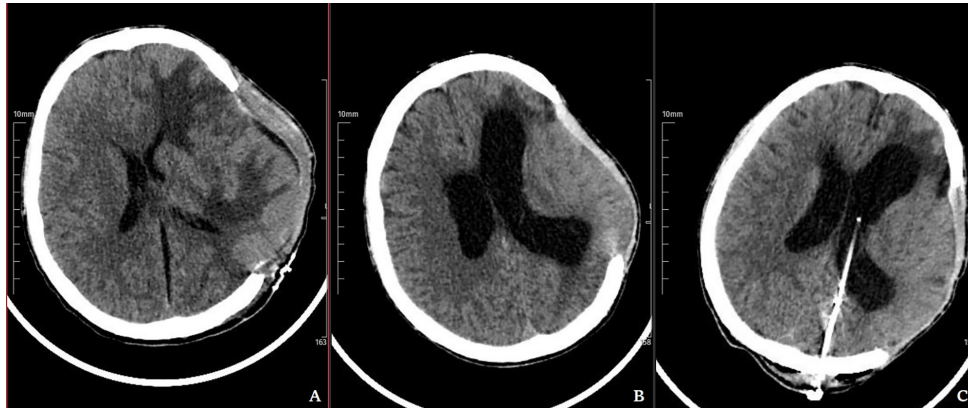


Figure 2. Severe head trauma patient A. Treatment of the subdural hematoma with decompressive craniectomy, postoperative B. Hydrocephalus in follow-up. C. After VP shunt surgery
VP: Ventriculoperitoneal

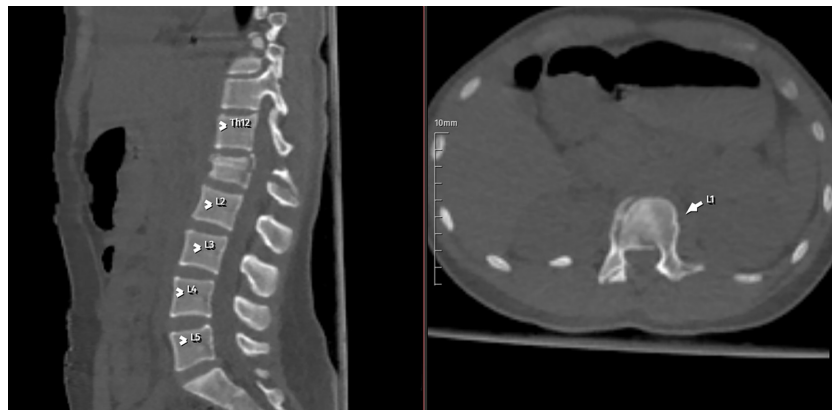


Figure 3. CT imaging of patient with L1 spine fracture after e-scooter injury
CT: Computed tomography, Th-12: Th 12 vertebrae

Seven patients were diagnosed with moderate head trauma due to bone and intracranial pathologies observed on cranial radiological imaging. One patient presented with traumatic subarachnoid hemorrhage, but no clinical symptoms. No worsening was observed during the clinical and radiological follow-up of the patient. Two patients had non-depressed fracture lines and thin epidural hemorrhage in the calvarium.

Signs of maxillofacial trauma accompanied by pneumocephalus were detected in four patients. All patients were referred by a plastic and reconstructive surgeon during hospitalization. Patients were referred to the polygenic risk scores outpatient clinic for elective treatment.

All patients with mild and moderate head trauma were discharged without neurological deficiency after clinical and radiological follow-up.

DISCUSSION

E-scooters are fast, easy, inexpensive, and environmentally friendly means of transportation where users can determine the destination and duration of their journey. It has become increasingly popular in Türkiye and around the world because of these reasons. The increasing frequency of this therapy brings with it the risk of serious morbidity and even mortality associated with high-speed trauma. Several studies have reported these risks, with rates of 115-250 injuries/million rides and 19 deaths/million rides (3-5). The most common e-scooter injuries were injuries to the upper extremity (54%), lower extremity (47%), head and neck (43%) (4).

Several studies in the literature reported that the frequency of young adult males in e-scooter accidents was significantly higher than that of females (4,6,7). Most patients present with mild head trauma. Long hospitalization periods, severe morbidity, and mortality were noted in patients with severe head trauma. The high proportion of male patients is noteworthy, especially among patients with severe trauma.

In the study of Kobayashi et al. (8) and Trivedi et al. (7), the use of alcohol and other drugs at varying frequencies was mentioned among the patients (2). In our study, the number of male patients was also significantly higher than the female patients. Despite the age and gender ratios being consistent with the literature, no alcohol or drug use was detected in any of our patients.

In the literature, extremity injuries are mentioned in most cases associated with e-scooters (4). In addition, other injuries causing long hospitalization periods, recurrent surgeries, and severe morbidity, such as severe head trauma, were also reported (9). Accordingly, using protective equipment becomes essential to reduce the risk of high-speed trauma injury associated with e-scooters. Many studies in the literature have mentioned the poor use of protective equipment when using e-scooters (7,8). E-scooter mobile applications contain expressions such as the use of protective equipment is recommended; however, this equipment cannot be supplied with the vehicle. This leads to the neglect of the use of protective equipment for e-scooters, which are alternatives to other means of transportation. None of our patients used protective equipment.

Spinal trauma associated with e-scooters were rarely mentioned in the literature. Injuries were mostly reported in relation to extremities or the head and neck region (9). A case report of Glynn et al. (5) presented a patient with cervical artery dissection who wore protective equipment. The clinical results were evaluated on the 5th day following the trauma. The patient who had no symptoms in the early posttraumatic period was significant in terms of the problems that may arise in the long term after the accident (5). Contrary to the common findings in the literature, a relatively high rate (16.6%) of patients with spinal trauma were detected in our series. One of these patients underwent surgery due to the need for surgical treatment. The findings suggested the importance of multidisciplinary and detailed evaluation of all patient systems after e-scooter accidents.

In Türkiye, membership is available to e-scooter applications used on cell phones with identity information and the condition of being over 15 years of age. Nevertheless, the fact that the 14 year-old patient who underwent surgery due to spinal trauma was using an e-scooter revealed insufficient supervision, suggesting that parents lacked sufficient awareness regarding this issue. The literature also mentions negligence regarding age, speed limits, and the use of protective equipment when using e-scooters.

We observed in our study that e-scooters, which are environmentally friendly, inexpensive, and fast vehicles, may cause mild or severe morbid outcomes without proper use. It was reported in the literature that using e-scooters without protective equipment and complying with traffic rules particularly caused severe trauma and even mortality (2). Despite our limited number of patients, we monitored one patient with trauma progressing to severe morbidity. The publications in the literature reported moderate head traumas caused by e-scooters in compliance with our series. We believe that patients should also be examined for spinal trauma. Proper regulations will enable safer use of e-scooters.

CONCLUSION

The fast and practical use of e-scooters in urban transportation and their environmentally friendly properties make them a prominent choice for transportation preferences. It should be noted that injuries resulting from neurosurgery can cause severe morbidity and even mortality. The injuries were associated with a significant deficiency correlated with the use of protective equipment. The importance of protective equipment, compliance with speed limits, and following traffic signs should be considered in terms of safety. Determining legal speed limits with traffic signs when using scooters, making it mandatory to have fixed protective equipment on shared scooters and building special roads for these vehicles may be a good way to protect against possible injuries.

ETHICS

Ethics Committee Approval: Approval for this study was obtained from the University of Health Sciences Türkiye, Haydarpaşa Numune Training and Research Hospital at a meeting (dated 29.11.2022, number: E-62977267-771).

Informed Consent: Treatment consent forms were obtained for all patients and are available in the patient files.

FOOTNOTES

Authorship Contributions

Surgical and Medical Practices: E.B.K.Ö., A.T.Ç., Concept: E.B.K.Ö., A.T.Ç., Design: A.T.Ç., Data Collection or Processing: E.T.M., K.D., Analysis or Interpretation: E.B.K.Ö., E.T.M., A.T.Ç., Literature Search: E.B.K.Ö., E.T.M., Writing: E.B.K.Ö.

Conflict of Interest: No conflict of interest was declared by the authors.

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