

E-scooters and the City – Head to Toe Injuries

Justyna Kowalczevska

Department of Neurosurgery and Neurotraumatology,
Poznan University of Medical Sciences, Poland

 <https://orcid.org/0000-0001-9382-9798>

Szymon Rzepczyk

Department of Forensic Medicine, Poznan
University of Medical Sciences, Poland

 <https://orcid.org/0000-0001-6330-1511>

Corresponding author: szymon.rzepczyk@interia.eu

Czesław Żaba

Department of Forensic Medicine, Poznan
University of Medical Sciences, Poland

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ABSTRACT

In the recent years, electric scooters have become much more common. With an increasing number of drivers, the number of accidents and injuries involving e-scooters also was on the rise. The most common are head and neck injuries, including open wounds of soft tissues, traumatic brain injuries (TBIs), cranial bones fractures, and intracerebral hemorrhages (ICH). The second most frequent injuries involve both upper and lower extremities. Fractures of the spine and injuries to the thorax and the abdominal cavity are less common. Many injuries could be avoided by using helmets, not driving e-scooters under the influence of intoxicating substances, and systematizing the rules of e-scooters use among other road traffic users.

Introduction

The market has been overrun by companies offering rental of electric scooters, which caused a change in the urban micromobility. Accessibility, simplicity, affordable price and environmental friendliness have significantly contributed to the popularization of this mode of transport [1]. In Poland, the first e-scooter rental system via a smartphone application was introduced in Warsaw in autumn 2018, and subsequently also in other cities [1]. Nevertheless, as the number of users increases, so does the number of accidents and injuries involving these vehicles [1–3]. Research shows that since the introduction of e-scooter rental systems, the incidence of inju-

ries resulting from accidents involving them has more than doubled; furthermore, the frequency of hospitalization in such cases has increased over threefold [4].

Risk factors

There is a number factors affecting the likelihood of an accident and injury related to the use of an e-scooter. The type of accident plays an important role, and the most dangerous are the least frequent ones, that is collisions with another vehicle, followed by hitting objects and falls, which are most common [5]. Usually, young men are the casualties of such accidents [6, 7]. The

most prevalent time for e-scooter related injuries is at weekends in the evening during the summer months [7, 8]. Another significant factors are risky activities, such as using the phone while driving as well as using the vehicle under the influence of alcohol, or intoxicants, such as cannabinoids [2, 9]. No requirement to wear protective helmets presents another vital aspect regarding the head injury risk. The percentage of e-scooter drivers using helmets rarely exceeds 5% [5]. Additional risk factors include high speed (the maximum permitted speed of e-scooters in Poland is 20 kilometers per hour; however, the engines used in these vehicles allows them to reach twice the maximum speed), tandem driving and driving on the sidewalk [1, 10].

Injury pattern

Head and neck injuries constitute the most common e-scooter related trauma [11, 12]. They occur in approximately 30–50% of all accidents involving e-scooters [11, 13, 14], which may be the result of the low percentage (about 4%) of users wearing protective helmets [14]. Many craniofacial traumas stem from inertly hitting the ground as a result of an unsuccessful attempt to prevent the fall. Moreover, high center of gravity of the scooter rider predisposes them to sustain head injuries [2]. In most cases, head injuries are minor, however, in approximately 25–30% of patients, open wounds of soft tissues require surgical intervention, around 15% develop TBI (Traumatic Brain Injury), about 10% have tooth fractures, and approximately 6% develop symptoms of concussion. About 2% of patients also sustain ICH (Intracerebral Hemorrhage) [2, 11, 12, 15]. The most frequently damaged areas of the soft tissues of the head include the forehead, scalp and chin. Soft tissue injuries, most often manifested in the form of lacerations and abrasions, can leave permanent esthetic defects on the skin of the face, despite being treated quickly and accurately. The midface (nasal bone, maxillary sinus, lateral wall of the orbit, zygomatic bone) is the most commonly damaged area in terms of the cranial bone fractures. Additionally, patients with fractures of the skull base might sustain cerebrospinal fluid leakage [2]. Patients, who have had a scooter accident often undergo

imaging examinations of the head – about 20% of them show intracranial lesions, such as brain contusion, traumatic subdural hemorrhage, traumatic subarachnoid hemorrhage, diffuse TBI, epidural hemorrhage [2, 12, 15, 16]. Furthermore, a small percentage of patients require neurosurgical intervention, but many of them require outpatient observation. The individuals may need hematoma evacuation or intracranial pressure monitoring. The vast majority of the patients with head trauma were under the influence of alcohol during the accident, indicating alcohol consumption as a particular risk factor for head injury while riding an e-scooter [16]. There is a five-fold higher risk of TBI in patients who were under the influence of intoxicants during an e-scooter accident, and the risk of their hospitalization increased two-fold [17]. Most head traumas do not require extensive medical intervention, however, the long-term effects of the injuries cannot be assessed directly following the accident, in the emergency room. As a result of a short-term consciousness impairment, 40% of the patients will experience chronic headaches and fatigue [11, 14, 18]. TBI and ICH may also be associated with the occurrence of post-traumatic epileptic seizures of various nature which may take place at different times after the accident [19]. It is also vital to bear in mind the rarer cases of compression fractures of the spine and the occurrence of central cord syndrome [15, 16]. Nevertheless, head injuries, half of which are TBIs, are the most common cause of hospital admissions resulting from e-scooter accidents [20]. TBIs are also the leading cause of death among the young [21].

Except for the head injuries, limb injuries are the most common e-scooter related trauma [22, 23]. The very method of driving the vehicle contributes to this fact. The upright position and the higher center of gravity during sudden braking causes the user to be thrown over the handle bar, which results in limb injuries due to their protective positioning [2]. In the area of the upper extremities, injuries occur in 47–51% of cases, and the most common include lacerations, bruises and fractures in the distal parts of the wrist and the forearm [3, 5, 7, 23]. Injuries to the shoulder girdle e.g. ruptures of the ligaments and muscle attachments along with fractures of the scapula and clavicle, are also typical [24, 25]. In the area of the lower extremities, injuries occur in 36–48%

of cases, usually in the distal parts [3]. Fracture to the metatarsal bones and ankle sprains are frequent as a result of clumsy pushing, or sudden leg dropping from the vehicle [5, 7]. In the area of the lower extremities, fractures are most commonly found in the lower leg [23]. Additionally, fractures of the femoral neck, as a result of a fall, have also been reported [24]. Significant therapeutic problems, frequently requiring surgery, are injuries of the knee joint, damage to the bones forming the joint and the ligamentous apparatus [24]. Overall fractures occur in 18–31% of cases, and lower limb fractures more often require surgical treatment [5, 26]. Chest and abdominal injuries are relatively rare, however, there have been reports of rib fractures, pneumothorax, and damage to the structure of the lungs or liver [5, 7, 25]. Approximately 5% of patients require hospitalization, and 1% require intensive medical care [5]. Fatal accidents are rarely reported, although some studies indicate a significant underestimation in this regard [5, 6].

Conclusions

It is crucial that physicians working in trauma centers are educated regarding the typical injuries that e-scooters users may report. Furthermore, it is vital to develop detailed diagnostic protocols following the abovementioned accidents. It is essential to record events involving e-scooters and thoroughly research the frequency and characteristics of e-scooter related trauma in individual regions. The collection of this data will allow for a better understanding of injuries typical for users of such vehicles, which will result in the development of a diagnostic protocol after such accidents, as well as methods protecting against the consequences of road incidents for users of e-scooters. For the sake of safety, it is necessary to adapt the legal regulations related to the use of e-scooters and to create a road-friendly infrastructure to accommodate them. In addition, it is essential to raise awareness regarding the potential benefits of using helmets, with the emphasis on the danger of not using them, which could prevent numerous future injuries. It is also advisable to introduce appropriate rules for the use of scooters on pavements, in order to prevent potential accidents involving pedestrians.

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Conflict of interest statement

The authors declare no conflict of interest.

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