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Orthopaedic injuries among electric bicycle users

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ABSTRACT

Introduction: The use of electric bicycles (E-bike) has dramatically increased. E-bikes offer convenient, environmental-friendly, and less expensive alternative to other forms of transport. However, E-bikes provide a new public health challenge in terms of safety and injury prevention.
This study is the first to specifically investigate the E-bike related orthopaedic injuries, based on a national trauma registry.
Methods: Data from a National Trauma Registry were reviewed for patients hospitalized following E-bike related injuries. Between Jan 2014 to Dec 2015, a total of 549 patients were reviewed. Data were analyzed according to demography, type of orthopaedic injury, associated injuries and severity, injury mechanism and treatment in the operating room.
Results: A total of 360 (65%) patients sustained orthopaedic injuries, out of them 230 (63.8%) sustained limb/pelvis/spine fractures. Lower extremity fractures were more prevalent than upper extremity fractures ($p < 0.001$). The tibia was the most fractured bone (19.2%). Patients over the age of 50 years were at the highest risk for spine (20. 5%, $p = 0.0001$), pelvis (15.9%, $p = 0.0001$) and femoral neck (15.9%, $p = 0.0172$) fractures relative to other age groups. Approximately 42% of patients sustained associated injuries, with head/neck/face injuries being the most prevalent (30.3%). followed by chest (11.9%) and abdominal injury (13.3%). A collision between E-bike and a motorized vehicle was the mechanism of injury in 35% of cases. In this mechanism of injury, patients had 1.7 times the risk for associated injuries ($p < 0.0001$) and the risk for major trauma (ISS score ≥ 16) was more than the double ($p = 0.03$).
One third of patients with orthopaedic injuries required treatment in the operating room.
Treatment varied depending on the type of fracture.
Conclusions: This study provides unique information on epidemiological characteristics of orthpaedic injuries caused be E-bikes, pertinent both to medical care providers, as well as to health policy-makers allocating resources and formulating prevention strategies.

Introduction

The use of electrically assisted bicycle or E-bike is increasingly popular worldwide, and growing dramatically on a global scale. It is estimated that 466 million E-bikes will have hit the road by 2016 [1].

The advantages offered by this mean of transportation are many. E-bikes provide convenient, environmental friendly, and less expensive alternative to other forms of personal transport such as cars, motorbikes, public transportation etc [2–5].

Research on E-bike was conducted mainly on analyzing its growing popularity[5,6] and physical and health related effects [7–10]. Unfortunately, their growing popularity has brought also a

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public health challenge in terms of safety. Several studies have reported a rise in both fatal and non-fatal E-bike related injuries in the last years [3,11–13]. Only scarce data are available on the injury patterns and characteristics of E-bike related road traffic accidents [1,13,14]. This study was undertaken to investigate specifically the epidemiology of E-bike related orthopaedic injuries, based on a national trauma registry.

Materials and methods

Data were obtained from the Israeli National Trauma Registry (ITR), maintained by Israel's National Center for Trauma and Emergency Medicine Research at the Gertner Institute for Epidemiology and Health Policy Research. Database was reviewed for orthopaedic injuries, defined as limb and/or spine and/or pelvis injuries, in patients using E-bike, Between Jan 2014 to Dec 2015. Only patients who were riding an E-Bike and hospitalized were included, where as a pedestrian for example, whom an E-bike hit was not included in this cohort. Injuries were separated to fractures, and injuries other than fracture such as contusion, abrasion, laceration etc.

The ITR does not collect data on individuals who were dead at the scene or upon arrival at the emergency department, nor does it include patients that were discharged home from the emergency department. Trained medical registrars at each hospital record data and electronic files are transferred to the ITR. During this period, the ITR included trauma patients admitted to all six level I trauma centers and 14 other regional trauma centers in Israel.

Medical diagnosis classifications were based on the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD9) and the Abbreviated Injury Scale {AIS} coding. Associated injuries were documented for each of the 9 body regions coded by the Abbreviated Injury Scale. Face was included with head and neck.

Data included age, injury type, associated injuries and severity, injury mechanism and treatment in the operating room.

Patients were stratified by gender and by 4 different age groups. Severity was based on injury severity score (ISS) of which ISS >= 16 was the cutoff for defining an injury as a major trauma.

Fracture treatment analysis was performed according to three anatomic regions of each of the extremities. The lower extremity regions were divided to the femur bone, the leg bones group (tibia/fibula including the ankle) and the bones of the foot (tarsal, metatarsal and phalanx). The upper extremity regions were divided to the humerus bone, the arm bones group (radius/ulna) and the bones of the hand (carpal, metacarpal and phalanx). Mechanism of injury was analyzed according to whether the collision was between an E-bike and a motorized vehicle (i.e. car or motorcycle) or a non-motorized mechanism such as a fall or collision with an object.

Fracture treatment strategies were divided into four categories: closed reduction with no internal fixation (CRNOIF), closed reduction with internal fixation (CRIF), open reduction with no internal fixation (ORNOIF) and open reduction with internal fixation (ORIF).

Statistical analysis was performed using SAS statistical software version 9.4 (SAS, Cary, NC). Statistical tests performed included $\chi 2$ test and binomial proportions test. P value smaller than 0.05 was considered statistically significant.

Results

A. Overview

Between Jan 2014-Dec 2015 a total of 549 patients, who were hospitalized due to E-bike related injuries (as riders) according to ITR records, were included in the study.

A total of 360 (65.5%) patients sustained an orthopaedic injury, out of them 230 (63.8%) sustained limb/pelvis/spine fractures.

Table 1 reviews the overall orthopaedic injury distribution.

Of 360 patients, 85.3% (307) were males and 14.7% (53) were females. Patients were stratified to 4 groups according to their age. Data showed that 11.9% (43) of patients were younger than 12 years, 38.3% (138) were 13–17 years old, 37.5% (135) were 18–49 years old, and 12.2% (44) were 50 years and older.

B. Injury analysis and distribution

Detailed analysis of fracture type distribution in upper and lower extremities is summarized in Table 2.

Overall lower extremity fractures were more prevalent than upper extremity fractures (34.7% n = 125 compared with 25% n = 90, $p < 0.0001$).

The tibia was the most fractured bone (19.2%, $p < 0.0001$), followed by the forearm fractures (radius 8.9%, ulna 7.5%). Overall, 16.9% (61 out of 360) patients sustained multiple fractures.

When analyzing upper extremity injuries (both fractures and other injuries) no significant differences in prevalence were found across the age groups. However, for lower limb fractures, significant differences were found ($p = 0.0003$). When analyzing prevalence of lower extremity fractures according to age groups, the highest prevalence was found for the 18–49 years age group (45.9%) and 50+ years (43.2%).

For spine fractures, the highest prevalence was in the 50 years and older age group (20.5%, 9 of all 21 of all spine fractures, $p = 0.0007$). Also, in this age group of patients 50 years and older, there was the highest prevalence of pelvis fractures (15.9%, 7 of all 13 pelvis fractures, $p < 0.0001$) and the highest prevalence of femur neck fractures (15.9%, 7 of all 16 femur neck fractures, $p = 0.0285$).

C. Associated injuries and severity

Out of 360 patients with orthopaedic injury, 151 (41.9%) sustained an additional injury.

Head/neck/face injuries were found in 109 (30.3%) patients, chest injuries in 43 (11.9%) patients and abdominal injuries in 48 (13.3%) patients.

Overall 23 (6.4%) patients had injury severity score (ISS) equal or greater than 16, which is the cutoff for defining an injury as major trauma.

Table 1
Injury distribution among hospitalized patients following e-bike related injuries.

Location of injury	Upper Extremity		Lower Extremity		Spine	Pelvis
Type of injury	Fractures	Injury other than fractures	Fractures	Injury other than fractures	Fractures	Fracture
Total number of patients n, (%)[a]	90 (25.0%)	74 (20.5%)	125 (34.7%)	113 (31.4%)	21 (5.8%)	13 (3.6%)

[a] % from the total number of e-bike related orthopedic injured patients (n = 360).

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