

# E-scooter-related facial injuries: a one-year review following implementation of a citywide trial

Rajeevan Sritharan,<sup>\*1</sup> Christopher Blore,<sup>2</sup> Richa Arya<sup>3</sup> and Kevin McMillan<sup>4</sup>

## Key points

The use of e-scooters can result in facial injuries, some significant, requiring operative intervention to the riders as well as road users.

Poor awareness of, and compliance with, safety regulations can increase the number of facial injuries sustained.

Our study highlights that further attention is needed to regulate e-scooter devices to ensure safety for riders and other road users.

## Abstract

**Objective** Birmingham City Council commenced electric scooter (e-scooter) trials in September 2020 as part of the wider UK effort to introduce e-scooters as an alternative method of transport. We aimed to review and evaluate maxillofacial injuries in the initial trial period of one year and comment on the safety implications.

**Method** The Queen Elizabeth Hospital is a Level 1 Major Trauma Centre and the hub for maxillofacial services in Birmingham, UK. A single-centre retrospective study captured patients who sustained e-scooter-related facial injuries in the Birmingham e-scooter trial period from September 2020 to September 2021.

**Results** A total of 29 patients were identified as having facial injuries. Of those patients: 59% (n = 17) were men and aged under 30; 43% (n = 18) of all injuries recorded involved hard tissue; and 41% (n = 12) were recorded to be under the influence of alcohol or cannabis. The non-use of helmets was recorded in 34% (n = 10) of patients. Additionally, 20 patients were managed operatively and 100% of patients (n = 12) that were under the influence of drugs or alcohol required operative management.

**Conclusion** With the introduction of these trials, it is shown that facial injuries represent a sizeable proportion of all injuries. E-scooters have significant safety issues. Our study may influence legislation to account for improvements in users' compliance with safety measures and enforcement of those using e-scooters illegally. Legislation regarding the future of e-scooters is expected in the coming year as outlined in the 2022 Queen's Speech.

## Introduction

The promotion of electric scooters (e-scooters) as means of transportation in large UK cities has become more prevalent in recent years. They are classified as a form of micro-mobility

transportation or battery-powered personal transportation device. E-scooter technology has evolved and now represents a thriving market, with a predicted market value of over £20 billion by 2025.<sup>1</sup> The popularity of e-scooters as an alternate mode of affordable and environmentally friendly transport has increased dramatically worldwide. The UK Government has identified carbon neutrality as a principal reason for the implementation of e-scooters as an alternate means of transportation.<sup>2</sup> Many cities across the world have implemented ride-sharing e-scooter services.<sup>3</sup> The UK has recently commenced e-scooter ride-sharing schemes as part of green initiatives, which began with an initial pilot scheme in Teesside, Middlesbrough.<sup>4</sup> Local authorities have partnered with ride-sharing companies and subsequent trials have rapidly spread, with the Department of Transport (DoT) reporting that trials have commenced in 32 regions in England.<sup>5</sup> Before the amendment of the law on 4 July

2020, the use of e-scooters had been illegal on public roads.<sup>5</sup>

The UK trials were initially granted a trial period of 12 months but the end date of any ongoing trials were extended to March 2022.<sup>6</sup> All UK local authorities can commission an e-scooter trial provided they meet the DoT requirements. Birmingham is the second largest city by population in the UK. Voi, a Swedish-based micro-mobility company, commenced trials starting in September 2020 for one year as the exclusive provider for the West Midlands region. Initially limited to the vicinity around Birmingham City Centre, this has since expanded to the north and south west regions of the city. Statistics reported by Birmingham City Council show that over 550,000 rides have occurred on 1,200 e-scooters, covering an area of 36 km<sup>2</sup> since the start of the trial.<sup>6</sup> Users can access the devices via an app which uses geofencing and global positioning system technology to locate and track the movements of e-scooters.

<sup>1</sup>Junior Specialist Dentist in Oral and Maxillofacial Surgery, Department of Oral and Maxillofacial Surgery, Queen Elizabeth Hospital, Mindelsohn Way, Birmingham, B15 2GW, UK; <sup>2</sup>Speciality Registrar in Oral and Maxillofacial Surgery, Department of Oral and Maxillofacial Surgery, Queen Elizabeth Hospital, Mindelsohn Way, Birmingham, B15 2GW, UK; <sup>3</sup>Dental Core Trainee in Oral and Maxillofacial Surgery, Department of Oral and Maxillofacial Surgery, Queen Elizabeth Hospital, Mindelsohn Way, Birmingham, B15 2GW, UK; <sup>4</sup>Consultant in Oral and Maxillofacial Surgery, Department of Oral and Maxillofacial Surgery, Queen Elizabeth Hospital, Mindelsohn Way, Birmingham, B15 2GW, UK.  
<sup>\*</sup>Correspondence to: Rajeevan Sritharan  
Email address: rajeevan309@gmail.com

### Refereed Paper.

Submitted 15 June 2022

Revised 12 September 2022

Accepted 26 September 2022

<https://doi.org/10.1038/s41415-023-5459-8>

**Table 1 Mechanism of injuries as a result of the use of e-scooters**

Mechanism	Number
Fall	21
E-scooter vs car	4
Pedestrian vs e-scooter	3
Collision	1

**Table 2 Type of injury and subsequent management**

Type of injury	Total	Operative management	Conservative management
Mandible fracture	2	2	0
Orbital fracture	2	0	2
Zygomatic fracture	3	1	2
Maxillary fracture (Le Fort)	1	1	
Frontal bone fracture	2	1	1
Nasal fracture	3	1	2
Soft tissue	24	19	5
Dental/dentoalveolar	5	2	3
<b>Total</b>	<b>42</b>	<b>26</b>	<b>14</b>

Since the introduction of these trials, several concerns have been raised. Poor enforcement of users may be an issue, as reports have suggested that users are often intoxicated when riding e-scooters. E-scooter users also pose a risk to pedestrians and injuries have been reported involving the collision of riders and pedestrians.<sup>7</sup> There has been a sustained increase in the prevalence of injuries associated with e-scooters, including serious injuries across emergency departments in the UK.<sup>8</sup>

Facial injuries associated with e-scooters are poorly understood due to minimal research on the topic. As such, we aimed to investigate facial injuries associated with e-scooter use in the initial trial period in Birmingham. The secondary aim was to explore the wider safety implications of imminent legislation related to these devices. The context of this study was that the initial trial in Birmingham, originally conducted from September 2020 to September 2021, had been extended until at least March 2022 by Birmingham City Council.<sup>6</sup>

## Method

### Settings

The oral and maxillofacial department based at the University Hospital Birmingham Trust, Queen Elizabeth Hospital Birmingham (QEHB) operates a hub and spoke model to

several peripheral hospitals. QEHB is a Level 1 Major Trauma Centre, receiving tertiary referrals. Peripheral hospitals, along with the hub hospital, cover all geographical areas that the Birmingham e-scooter trial extended to and refer all oral and maxillofacial conditions for adults to the QEHB for specialist assessment and treatment.

### Search methodology and data analysis

A retrospective cohort study was conducted from the period between September 2020 (trial commencement) to the end of September 2021 (planned trial end). Data were collected in collaboration with Health Informatics via keyword search of the following phrases: 'electric', 'e-scooter' and 'scooter'. The search was carried out on an in-house database: the Prescribing Information and Clinical System. The data returned were sifted through manually to identify suitable patients. The data reviewed included emergency department consultations, oral and maxillofacial consultations and theatre procedures. All patients aged 16 and above with facial injuries were included in the study. Data collected included: demographics (age, sex); mechanism of injuries, such as collision or fall; type of facial injury; treatment conducted; whether the patient had other non-oral and maxillofacial injuries or head

injuries; whether the patient wore a helmet; or if the patient was intoxicated. Patients were classified as riders or non-riders to distinguish between those who had been passengers or pedestrians. Patients that had injuries sustained outside Birmingham but attended for follow-up were not included, as the injury occurred outside the trial zone. Data were collated in Microsoft Excel and stored via tables. Statistical analysis was performed using the same software.

The project was registered with Clinical Audit and Research Management System and an ID was generated which allowed for data collection. All patient data are anonymised and non-identifiable. Formal ethical approval was not required as this was a retrospective cohort study.

## Results

A total of 29 patients were identified who sustained oral and maxillofacial injuries between September 2020 and September 2021. The median age of the patients was 25 and the average age was 31 (SD = 15). A total of 83% (n = 24) of patients were men and 59% (n = 17) of patients identified were men aged 30 and under.

The mechanism of injuries is highlighted in Table 1, the majority of which were falls. Two injuries were a result of users sharing one e-scooter. Patients sustained several maxillofacial and non-maxillofacial injuries. The non-maxillofacial injuries sustained were as follows: traumatic brain injury; two iliac bone fractures; abdominal laceration; pneumothorax; forearm injury; two patients with multiple rib fractures; acetabulum fracture; volar fracture; humeral head dislocation; bilateral wrist fracture; hand injury; skull base fracture; and splenic and liver lacerations. Moreover, 34% (n = 10) of our cohort in addition sustained non-maxillofacial injuries, with one resultant fatality. These injuries required input from emergency physicians, orthopedic surgeons and intensivists.

Maxillofacial injuries and their management are shown in Table 2. Two injuries were not treated due to patient death before definitive management. Patients with soft tissue abrasions or contusions to the maxillofacial region were recorded as soft tissue injuries managed conservatively. The most common injuries were soft tissue lacerations (n = 24), followed by mid-face

**Table 3 Patients who were recorded as being under the influence and recorded use of helmets among patients who sustained e-scooter injuries**

Category	Number	Percentage
<b>Substance under the influence</b>		
Alcohol	9	31%
Cannabis	2	7%
Not recorded	17	59%
Alcohol and cannabis	1	3%
<b>Total under the influence</b>	<b>12</b>	<b>41%</b>
<b>Use of helmet</b>		
No helmet recorded	10	34%
Not recorded	19	66%
<b>No helmet and under the influence</b>		
	5	17%

fractures, which include nasal, zygoma, maxillary and orbital fractures (n = 9). In total, 69% of patients identified (n = 20) were managed operatively for their maxillofacial injuries and 100% of patients (n = 12) that were recorded as having consumed alcohol or cannabis required operative management. Substance use and helmet compliance are demonstrated in Table 3.

## Discussion

UK legislation on e-scooters during the trial period mandated that the user must be 18 years or older and have a valid driver's licence with category Q entitlement. The speed is limited to a maximum of 15.5 mph and in certain areas, it can be further limited to 8 mph. The use of a mobile phone or users being under the influence of alcohol or illicit substances is illegal and can lead to prosecution. The carrying of passengers on an e-scooter is prohibited; however, the use of a helmet is not mandatory but recommended.<sup>5</sup>

Our results highlight the significant impact that e-scooter injuries can have on the head and neck region. Facial injuries represent a sizeable cohort of patients injured while using e-scooters.<sup>9</sup> In the current literature, the prevalence of facial injuries has been reported between 58–62.7%.<sup>10,11,12</sup> A study in Hamburg, Germany, found that 46% of injuries associated with e-scooters involved head/facial injuries.<sup>13</sup> A study in Indianapolis, USA, identified 89 patients that sustained facial injuries in six months.<sup>14</sup> One fatality was reported in our cohort. Given the

nature of high-impact trauma associated with e-scooters, it is not surprising that some patients sustain significant craniofacial injuries. Traumatic brain injuries accounted for 18% of scooter-related admission in a case series in San Diego, California.<sup>15</sup> Demographics of those injured have stark similarities to other studies in that most patients in our cohort were men and aged under 30.<sup>14,15,16</sup> The majority of patients in our cohort (72%) sustained injuries due to falls from e-scooters. Soft tissue injuries to the head and neck region represented the greatest number of injuries. However, bony injuries were a significant proportion of the total injuries and a portion of those patients required operative intervention.

There are, however, several safety issues identified, namely poor compliance. Our study demonstrated that 41% of patients were under the influence of alcohol or drugs and 34% of patients did not wear a helmet. The use of a helmet and being under the influence of alcohol or drugs represents a significant factor in the likelihood of a rider sustaining an injury as shown by other studies.<sup>10,14</sup> The non-use of a helmet in research carried out in Brisbane, Australia, showed that there was an associated risk of head injury.<sup>17</sup> It remains to be seen if the use of facial protections, such as shields, can reduce the incidence of facial trauma. Traumatic brain injury was also found to be associated with alcohol consumption.<sup>18</sup> Research carried out in the USA shows that alcohol consumption among users can be between 5.2–17.2%.<sup>15</sup> This is comparable to our study representing a large cohort. Our data

showed that pedestrians were also at risk from injury, with three patients having sustained facial injuries as non-riders. The silent nature of the devices presents other road users with no audible signals that an e-scooter rider is within the vicinity. This has been identified by the Royal National Institute of Blind People.<sup>19</sup> In response, some e-scooters are being fitted with audible warning systems.

The costs to the NHS in treating patients that have suffered injuries are likely to be substantial, as 69% of patients required operative management under local or general anaesthetic. Recently, it has been claimed that the cost to the health service is, on average, £1,000 per patient.<sup>20</sup> E-scooters can represent a significant personal injury burden to the user, as well as having the capacity and financial implications to the health service, which have been amplified in the COVID-19 pandemic. In a study conducted in New Zealand, the cost of treating facial injuries associated with e-scooters totalled \$201,023.51 USD.<sup>16</sup>

Limitations of the study include that the total facial injuries were not known during the study period and could not be compared to injuries sustained via e-scooters. The study period focused on the initial trial period by Birmingham City Council. The report published by the council states in the trial period there have been 11 serious injuries and 107 minor injuries.<sup>6</sup> This is likely to be an underestimate given the difficulty obtaining data from different health trusts and unfortunately, it was not possible to determine if injuries sustained were because of private or public e-scooter use, as this information was not recorded in patient notes. Comparison to push-bike injuries would be useful, as well as looking at injuries before the trial period.

## Conclusion

In conclusion, facial injuries have reconstructive challenges and represent a clinically significant proportion of all injuries sustained in e-scooter use. This study shows that, in particular, some users suffered facial injuries as a result of poor compliance with laws and regulations around e-scooters in the defined trial period. We successfully highlighted safety issues in the trial period and we hope that our results may influence legislation to account for improvements in users' compliance with safety measures and enforcement of those using e-scooters illegally. Robust review and long-term studies

are required to monitor users' behaviours with regard to the devices. Legislation regarding the future of e-scooters is expected in the coming year as outlined in the 2022 Queen's Speech.

#### Ethics declaration

The authors report there are no competing interests to declare and no funding to declare.

The project was registered with Clinical Audit and Research Management System and an ID was generated which allowed for data collection. All patient data is anonymised and non-identifiable. Formal ethical approval was not required as this was a retrospective cohort study.

#### Author contributions

Rajeevan Sritharan: conception of the idea, data collection and analysis. Christopher Blore: drafting of the article. Richa Arya: conception of the idea, drafting of the article, final approval. Kevin McMillan: analysis, critical revision, final approval and guarantor of the manuscript.

#### References

- NatWest. The rise of the e-scooter. 2020. Available at <https://natwestbusinesshub.com/articles/the-rise-of-the-e-scooter> (accessed November 2021).
- Transport for London. Electric scooters. 2020. Available at <https://tfl.gov.uk/modes/driving/electric-scooter-rental-trial> (accessed November 2021).
- Bozzi A D, Aguilera A. Shared E-Scooters: A Review of Uses, Health and Environmental Impacts, and Policy Implications of a New Micro-Mobility Service. *Sustainability* 2021; **13**: 8676.
- Tees Valley Combined Authority. UK's First Ever E-Scooter Trial Gets Rolling In The Tees Valley. 2020. Available at <https://teesvalley-ca.gov.uk/uks-first-ever-e-scooter-trial-gets-rolling-in-the-tees-valley/> (accessed November 2021).
- UK Parliament. Regulating electric scooters (e-scooters). 2021. Available at <https://commonslibrary.parliament.uk/research-briefings/cbp-8:958/> (accessed November 2021).
- Birmingham City Council. West Midlands E-scooter Trial Extension. 2021. Available at <https://birmingham.cmis.uk.com/Birmingham/Document.ashx?czJKcaeAi5tUFL1DTL2UE4zNRBcoShgo=jOeNm3JUICKrsSYwDg6BQ3jI9nW18s%2BIxBXwpVi007j4lm6pNBky3g%3D%3D&rUzwRPf%2BZ3zd4E7lkn8Lyw%3D%3D=pwRE6AGJFLDNlh225F5QMaQWctPHwdhUfCz%2FLUQzgA2uL5jNRG4jdQ%3D%3D&mtIbCub5FFxsDGW9IXnlG%3D%3D=hFflUdN3100%3D&kCx1AnS9%2FpWZQ40DXFvdEw%3D%3D=hFflUdN3100%3D&uJovDxwdjMPoYv%2BAJvYtyA%3D%3D=ctNJf55vVA%3D&FgPIIEJYlots%2BYGoBi5oIA%3D%3D=NHdURQburHA%3D&d9Qj0ag1Pd993jsyOJqFvmyB7X0CSQK=ctNJf55vVA%3D&WGewmoAfeNR9xqBux0r1Q8Za60lavYmz=ctNJf55vVA%3D&WGewmoAfeNR9xqBux0r1Q8Za60lavYmz=ctNJf55vVA%3D> (accessed November 2021).
- Sikka N, Vila C, Stratton M, Ghassemi M, Pourmand A. Sharing the sidewalk: A case of E-scooter related pedestrian injury. *Am J Emerg Med* 2019; **37**: 1807.
- Cruz N D, Morgan C, Morgan R V *et al.* Injury patterns of e-scooter-related orthopaedic trauma in central London: a multicentre study. *Ann R Coll Surg Engl* 2022; **104**: 187–194.
- Kappagantu A, Yaremchuk K, Tam S. Head and Neck Injuries and Electronic Scooter Use in the United States. *Laryngoscope* 2021; DOI: 10.1002/lary.29620.
- Wüster J, Voß J, Koerdt S *et al.* Impact of the Rising Number of Rentable E-scooter Accidents on Emergency Care in Berlin 6 Months After the Introduction: A Maxillofacial Perspective. *Craniomaxillofac Trauma Reconstr* 2020; **14**: 43–48.
- Trivedi B, Kesterke M, Bhattacharjee R, Weber W, Mynar K, Reddy L V. Craniofacial Injuries Seen With the Introduction of Bicycle-Share Electric Scooters in an Urban Setting. *J Oral Maxillofac Surg* 2019; **77**: 2292–2297.
- Harbrecht A, Hackl M, Leschinger T *et al.* What to expect? Injury patterns of Electric-Scooter accidents over a period of one year – A prospective monocentric study at a Level 1 Trauma Centre. *Eur J Orthop Surg Traumatol* 2022; **32**: 641–647.
- Kleinertz H, Ntalo D, Hennes F, Nüchtern J V, Frosch K-H, Thiesen D M. Accident Mechanisms and Injury Patterns in E-Scooter Users – A Retrospective Analysis and Comparison With Cyclists. *Dtsch Arztebl Int* 2021; **118**: 117–121.
- Alwani M, Jones A, Sandelski M *et al.* Facing Facts: Facial Injuries from Stand-up Electric Scooters. *Cureus* 2020; DOI: 10.7759/cureus.6663.
- Kim W C, Campbell A R. Common Injury Patterns from Standing Motorized Scooter Crashes. *Curr Surg Rep* 2021; **9**: 8.
- Smit R B, Graham D O, Erasmus J. E-scooter injuries referred to the oral and maxillofacial surgical service at Christchurch Hospital: a retrospective observational study and cost analysis of 17-months of data. *Br J Oral Maxillofac Surg* 2021; **59**: 439–444.
- Mitchell G, Tsao H, Randell T, Marks J, Mackay P. Impact of electric scooters to a tertiary emergency department: 8-week review after implementation of a scooter share scheme. *Emerg Med Australas* 2019; **31**: 930–934.
- Uluk D, Lindner T, Dahne M *et al.* E-scooter incidents in Berlin: an evaluation of risk factors and injury patterns. *Emerg Med J* 2022; **39**: 295–300.
- Royal National Institute of Blind People. Highlighting the e-scooter challenge to safety on our streets. 2020. Available at <https://www.rnib.org.uk/news/campaigning/e-scooter-challenge-streets-safety> (accessed November 2021).
- BBC News. Bristol: E-scooter injuries 'costing NHS £1k per patient'. *BBC News* (London) 2021 December 2.