Maxillofacial fractures associated with motor vehicle accidents: A review of the current literature

Mohammad Ruslin a, b, Jan Wolff b, Tymour Forouzanfar b, Paolo Boffano b, * a Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, University of Hasanuddin, Makassar, Indonesia
b Department of Oral and Maxillofacial Surgery/Oral Pathology, VU University Medical Center/Academic Centre for Dentistry Amsterdam (ACTA), Amsterdam, The Netherlands

A R T I C L E   I N F O

Article history:
Received 9 January 2015
Received in revised form 22 February 2015
Accepted 2 March 2015
Available online 30 March 2015

Keywords:
Motor vehicle accidents
Facial trauma
Etiology
Epidemiology
Traffic

A B S T R A C T

Objective: The aim of this article was to review and discuss papers that were published during the past 30 years regarding the distribution and characteristics of motor vehicle accidents-related facial injuries throughout the world.

Methods: We systematically reviewed all papers that were published in English between January 1980 and December 2013 using MEDLINE and the MeSH term “facial fractures” together with the term “motor vehicle”.

Results: The percentage of motor vehicle accidents as an etiological factor in epidemiological studies about maxillofacial injuries ranged between 11% and 85%. On the whole, a progressively decreasing trend was observed, particularly in North America, Brazil, and Europe.

Discussion: Motor vehicle accidents are still one of the most important etiological factors for maxillofacial injuries. A great difference in the incidence of this kind of fractures between developed countries and developing countries can be observed.

© 2015 Asian AOMS, ASOMP, JSOP, JSOMS, JSOM, and JAMI. Published by Elsevier Ltd. All rights reserved.

1. Introduction

Maxillofacial fractures can have various causes, such as traffic accidents, falls, assaults, sports injuries, and others, in isolation or in combination with other injuries [1–39]. The epidemiology of these fractures varies depending on the geographic area, socioeconomic status, and the period of investigation [1–10]. In many countries, traffic accidents are the most common cause of maxillofacial fractures [1–10].

Motor vehicle accidents (MVAs) are still among the most frequent causes of facial fractures all over the world, although assault
is becoming the most frequent cause in many developed countries [2,40–42].

Investigations of MVA-related maxillofacial injuries are crucial to clarify the mechanisms and socioeconomic costs of MVA injuries, in particular because patients with oral and maxillofacial injuries often acquire disabilities and require long-term treatment [1,2,6].

In the last 30 years, the implementation of laws that require seat belts and/or airbags in cars and helmets to be worn by motorcyclists has had an impact on the incidence of facial trauma in developed countries [1,2,6,7].

Furthermore, socioeconomic reasons such as poor roads and speed limits are a crucial factor that influences the incidence of MVA [6,7].

Preventing maxillofacial injuries is a valuable pursuit for improving the quality of life of the involved subjects and decreasing the socioeconomic costs of motor vehicle collision injuries [6–8].

Thorough knowledge and understanding of the etiology and epidemiology of MVA-related facial injuries are fundamental for the development of health services, and the adoption of new methods for preventing injuries.

The aim of this paper, therefore, was to review and discuss papers that were published during the past 30 years regarding the distribution and characteristics of MVA-related facial injuries throughout the world.

2. Methods

We systematically reviewed all papers that were published in English between January 1980 and December 2013 using MEDLINE and the MeSH term “facial fractures” together with the term “motor vehicle”. Fourteen papers in other languages were excluded. Papers that presented complete data about the etiology of motor vehicle accidents with appropriate information about car, motorcycle and pedestrian accidents were identified and included. Data were collected on etiology and characteristics of fractures and summarized in tables.

This article was exempt from IRB approval as it is a review of the literature. We followed Helsinki Declaration guidelines.

3. Results

A total of 27 studies met the inclusion criteria and were included in this review (Tables 1 and 2).

The percentage of MVA as an etiological factor in epidemiological studies about maxillofacial injuries ranged between 11% [30] and 85% [24]. On the whole, a progressively decreasing trend was observed, particularly in North America, Brazil, and Europe. Data regarding male:female ratio were extremely different too, with results between 2.2:1 and 20.9:1.

The percentages of the categories of MVAs (car, motorcycle and pedestrian) showed a progressive trend all over the world: the incidence of maxillofacial injuries due to car accidents is decreasing, whereas a continuous increase in motorcycle-related facial injuries has been observed in Asia (Japan, India) and Europe (The Netherlands, Greece). A further observed result was the progressive decrease of incidence of facial injuries suffered by pedestrians in the last 30 years (Fig. 1). Facial fractures mainly involved the lower third or the middle third in all the considered studies (Table 2 and Fig. 2).

4. Discussion

Motor vehicle accidents are still one of the most important etiological factors for maxillofacial injuries. Nowadays, their incidence widely varies, as various factors are involved in the prevention of such accidents. In particular, not only road conditions, speed limits, and safety equipment, but also the characteristics of used vehicles, socioeconomic conditions and regulations about alcohol drinking before driving are fundamental for the prevalence of such injuries.

In the recent literature, a great difference in the incidence of MVA-related facial fractures between developed countries (20% in Japan, 35.2% in the Netherlands, 11% in Ireland) and developing countries (72–85% in India, 46.7% in China) can be easily observed. Of course, those data cannot be really compared because of the aforementioned differences in regulations and their implementations.

The etiology of MVA gives us important information, in particular regarding the progressive decrease of pedestrians suffering from MVA-related injuries. This may be the first result of the establishment and enforcement of more severe laws and regulations with regard to alcohol drinking and speed limits.

Unfortunately, there are too many variables to draw any conclusion about car and motorcycle accidents.

However, for car accidents, detailed examinations for neck lesions are suggested for the patients involved in MVAs. The decrease of the severity or incidence of head, chest, and abdominal

Table 1

Etiology of MVA-related maxillofacial fractures: review of epidemiologic studies.

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of patients</th>
<th>Percentage of MVA</th>
<th>M:F ratio in MVA victims</th>
<th>Etiology of MVA</th>
<th>Author</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Car</td>
<td>Motorcycle</td>
<td>Pedestrian struck by MV</td>
</tr>
<tr>
<td>Nigeria</td>
<td>1447</td>
<td>72.7%</td>
<td>20.9:1</td>
<td>67.2%</td>
<td>31.3%</td>
<td>6.5%</td>
</tr>
<tr>
<td>Jordan</td>
<td>131</td>
<td>61.1%</td>
<td>–</td>
<td>50%</td>
<td>20%</td>
<td>30%</td>
</tr>
<tr>
<td>India</td>
<td>262</td>
<td>50%</td>
<td>–</td>
<td>41.2%</td>
<td>39.7%</td>
<td>19.1%</td>
</tr>
<tr>
<td>Nigeria</td>
<td>442</td>
<td>69.9%</td>
<td>3.6:1</td>
<td>68.2%</td>
<td>20.8%</td>
<td>11.4%</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>1324</td>
<td>36.6%</td>
<td>–</td>
<td>60.2%</td>
<td>33.4%</td>
<td>6.4%</td>
</tr>
<tr>
<td>Japan</td>
<td>1502</td>
<td>38.8%</td>
<td>–</td>
<td>33.6%</td>
<td>59.4%</td>
<td>7%</td>
</tr>
<tr>
<td>Nigeria</td>
<td>206</td>
<td>35%</td>
<td>–</td>
<td>60%</td>
<td>25.7%</td>
<td>14.3%</td>
</tr>
<tr>
<td>Iran</td>
<td>237</td>
<td>54%</td>
<td>–</td>
<td>57%</td>
<td>43%</td>
<td>0%</td>
</tr>
<tr>
<td>Brazil</td>
<td>1024</td>
<td>29.9%</td>
<td>–</td>
<td>46.7%</td>
<td>40.5%</td>
<td>12.8%</td>
</tr>
<tr>
<td>India</td>
<td>2748</td>
<td>85%</td>
<td>4.5:1</td>
<td>73.3%</td>
<td>26.7%</td>
<td>0%</td>
</tr>
<tr>
<td>Japan</td>
<td>674</td>
<td>20%</td>
<td>–</td>
<td>23.7%</td>
<td>65.9%</td>
<td>10.4%</td>
</tr>
<tr>
<td>India</td>
<td>111</td>
<td>74.7%</td>
<td>–</td>
<td>74.6%</td>
<td>25.4%</td>
<td>0%</td>
</tr>
<tr>
<td>India</td>
<td>503</td>
<td>80.3%</td>
<td>6.6:1</td>
<td>17%</td>
<td>76%</td>
<td>3%</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>579</td>
<td>35.2%</td>
<td>2.2:1</td>
<td>40%</td>
<td>53.3%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Greece</td>
<td>727</td>
<td>50.8%</td>
<td>5.8:1</td>
<td>36.6%</td>
<td>56.1%</td>
<td>7.3%</td>
</tr>
<tr>
<td>Ireland</td>
<td>82</td>
<td>11%</td>
<td>2.6:1</td>
<td>94%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>India</td>
<td>740</td>
<td>72%</td>
<td>–</td>
<td>5.3%</td>
<td>92.1%</td>
<td>2.6%</td>
</tr>
<tr>
<td>China</td>
<td>1131</td>
<td>46.7%</td>
<td>–</td>
<td>66.1%</td>
<td>33.9%</td>
<td>0%</td>
</tr>
</tbody>
</table>

RTA: road traffic accidents.
Bold character indicate the most frequent category for each author.
Table 2
Characteristics of fractures in MVA-related trauma patients: review of epidemiological studies.

<table>
<thead>
<tr>
<th>Fractures</th>
<th>Author</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower third (%)</td>
<td>Middle third (%)</td>
<td>Upper third (%)</td>
</tr>
<tr>
<td>54</td>
<td>32</td>
<td>–</td>
</tr>
<tr>
<td>41</td>
<td>56</td>
<td>3</td>
</tr>
<tr>
<td>22</td>
<td>70</td>
<td>8</td>
</tr>
<tr>
<td>50</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>41</td>
<td>59</td>
<td>–</td>
</tr>
<tr>
<td>72</td>
<td>22</td>
<td>–</td>
</tr>
<tr>
<td>50</td>
<td>47</td>
<td>3</td>
</tr>
<tr>
<td>38</td>
<td>48</td>
<td>–</td>
</tr>
<tr>
<td>69</td>
<td>31</td>
<td>–</td>
</tr>
<tr>
<td>29</td>
<td>63</td>
<td>8</td>
</tr>
</tbody>
</table>

Fig. 1. Trends of patients who are victims of motor vehicle accidents-related facial injuries in the last 30 years.

injuries of the vehicle occupants thanks to seat belt use is still controversial, whereas front seat passengers are likely to suffer from less severe head or neck injuries than drivers because of the absence of a steering wheel. Of course, it seems that although wearing a seat belt is effective for preventing fatalities and generally decreasing the severity of injuries to the head or neck and to the trunk, it cannot prevent all oral and maxillofacial injuries in motor vehicle occupants [1].

Anyway, some authors confirmed that wearing a seat belt prevents the free flight of drivers within the vehicle and contact with the interior of the vehicle (other than the steering wheel) [8,9]. Furthermore, airbags protect motor vehicle passengers by providing a cushioning barrier between them and the vehicle’s interior hard surfaces, thus making the benefits of an airbag in decreasing drivers’ fatality well recognized [8,9]. Occupants of motor vehicles should heed the ubiquitous message that proper seat belt use not only is a highly effective means to reduce the risk of injury in general but also specifically reduces the risk of facial injury [8,9].

As for motorcycle accidents, the crucial role of helmets has to be acknowledged. Three types of helmets can be used: fixed full-face, articulated full-face, and open-face. Not only people who do not wear helmets are 3–4 times more likely to sustain a head injury than those who do, but full-face helmets in particular seem to be mostly effective in protecting the face [7,10]. Studies on the wearing of helmets by motorcyclists in urban areas have highlighted two main points: the effectiveness of laws aimed at increasing their use and the protection provided against brain injuries and death [7,11].

Legislations making helmet use compulsory for all motorcyclists are crucial to reduce the incidence of facial injuries in this category. As aforementioned in previous articles, it is demonstrated that motorcycle accidents in 100% of the patients cause severe traumatic brain injury, followed by moped/scooter accidents (63.3%). This may be due to the high velocity achieved by motorcycles in conjunction with the inconvenience of wearing helmets, making them more vulnerable in traffic. Instead, car accidents account for only 50% of the patients in the severe traumatic brain injury cases and furthermore for only 16.7% of the patients in the mild cases. This is probably due to compulsory wearing of seat belts and aggressive enforcement of “drinking and driving” laws [12,13].

Finally, pedestrians are a peculiar category of patients involved in MVAs. Maxillofacial fractures are not frequently seen in pedes- trians injured in motor vehicle accidents. Injuries to the head, shoulder/clavicle, and chest/ribs are observed frequently [1]. Most pedestrians – patients – are children or old persons. This

Fig. 2. Characteristics of facial fractures and their involvement of the lower, middle and upper third in the recent literature.
epidemiology may be partly related to the fact that the ability of a pedestrian to avoid a collision with a motor vehicle, or not to be injured seriously even if involved in an accident, is quite different from age to age. The youngest patients may not pay attention to the dangers on the street, whereas older pedestrians might not have high motor ability or reflexes due to the physiological consequences of aging and the presence of systemic pathological conditions [1].

In view of the overall cost of care to the society, emphasis should be placed on prevention of road traffic accidents. The public should be adequately informed on the usage of seat belt and helmet, and laws concerning speed limit and alcohol drinking [6].

Alcohol initially leads to a reduction in attentiveness, a false perception of velocity, euphoria, and difficulty in spatially discerning different light intensities. At higher concentrations, it determines slow reaction times and sleepiness, a reduction in peripheral vision and poor performance n routine activities, thus making alcohol drinking before driving a serious danger. Therefore, in several countries the penalty for driving under the influence of alcohol has been increased, and drivers who operate motor vehicles with high blood alcohol levels are criminalized [14].

5. Conclusions

Improving our understanding of the mechanisms of facial injuries in motor vehicle accidents can be crucial for the adoption of new methods for preventing injuries, thus decreasing the associated socioeconomic costs of these individuals. However, although fully restrained vehicle occupants are less likely to sustain severe injuries, it may not be possible to entirely prevent maxillofacial injuries. Further multicenter studies with the assessment of the results of laws enforcement and implementation are needed to clarify their efficacy for maxillofacial injury prevention.

Ethical approval

This study was exempt from ethical approval as it is a review.

Conflict of interest

The authors report no conflict of interest.

References


