CRANIOFACIAL INJURIES RESULTING FROM MOTORCYCLE ACCIDENTS: AN INTEGRATIVE REVIEW

Lesões craniofaciais decorrentes de acidentes por motocicleta: uma revisão integrativa

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ABSTRACT

Traffic accidents have been a public health problem in the fastest growing in Brazil and the world, especially motorcycles. In addition to the high mortality rates, also include injuries and sequelae caused the crash survivors. The face injuries are common in this type of accident causing aesthetic and functional deformities in the face, requiring rehabilitation. A search of the literature was performed to map the lesions in the craniofacial region resulting from traffic accidents per motorcycle, also seeking their possible implications for Human Communication. The Pubmed, Lilacs and SciELO data were accessed by selecting the articles by title, then by abstract, to the end select the articles for reading in full. After this process, 10 studies were selected for review. In the facial region, the most frequent were fractures in the bones of the jaw, and Nasal Zygomatic, being the most prominent in the region. Stood out as the Cranial Trauma injuries more severe, since they can lead to death. Despite the breakdown of injuries, sequelae and data on the rehabilitation of the victims of accidents caused by motorcycles were rare in the literature.

KEYWORDS: Accidents, Traffic; Motorcycles; Wounds and Injuries; Facial Injuries

INTRODUCTION

Traffic accidents (TAs) have been representing an epidemic for current societies and enter in the public health agenda with the morbidity and mortality by external causes[1]. In 2010, of all deaths from external causes recorded in Brazil, agressions (homicides) occupied the leading cause of death for the total population, followed by deaths from TAs. Between 2006 and 2010, the deaths from Tas corresponded to an increase of 20%[2].

Data become more alarming when we observe the TA indexes for motorcycles. In Brazil, motorcyclists stand out among traffic accidents victims, corresponding to na increase of almost 51% between 2006 and 2010, while the other types of accidents, such as pedestrians and cars, for example, decreased or remained with the same indexes[2]. Men are the victims in 89% of the occurrences, of which 65% of them are aged between 20 and 39 years old[3].

Among the damages caused to patients who survive the motorcycle accidents, the motor and psychological sequelae and mutilation stand out. According to World Health Organization (WHO) data, between 20 and 50 million traffic accident victims survive with traumas and wounds[4].

As to the gravity, the injury in the head is the isolated injury more frequently found in severe and faltal cases[5]. In the face, which is usually affected in all types of traffic accident occurrences, the following injuries stand out: nose and tooth fracture, jaw fracture, cornea laceration, optic nerve laceration and Lefort fracture II[5].

Nascimento and Gimeniz-Paschoal[6] highlight that such injuries in the head and also in the face can result in direct and indirect disorders of human communication. These articulatory changes happen

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Conflict of interest: non-existent

when the structure and function of hard and soft tissues suffer some kind of injury in this part of the body[6].

The authors also claim that the lesions in this region tend to be more complex due to the diversity and peculiarities of existing anatomical structures in these locations, such as central nervous system, bones, muscles, cartilages, joints and complex vascularization. Depending on the location of the contusion and the degree of involvement, the victims clinical picture will be softened through speech rehabilitation and other health care specialties[6].

Considering the high rate of motorcycle accidents and the magnitude and seriousness of the injuries in the head and the neck, this study will provide better knowledge of the more incident injuries in this part of the body, intending the early care of speech sequels.

Thus, a search in the literature took place, in order to identify the injuries in the craniofacial region arising from traffic accidents by motorcycle and its possible implications for human communication.

METHODS

This is an integrative review, survey that aims to synthesize knowledge of a given area from the formulation of a question, recognition, choice and critical evaluation of surveys[7].

A literature research on the two central issues involving the following question was performed: What are the more incident injuries in the head and the neck in victims of traffic accidents by motorcycle?

The choice of articles included research in scientific data bases. The bases in which the reasearch happened were Lilacs (Latin-American Literature in Health Sciences), Comprehensive Medline (Medical Literature end Retrieval System on Line) via Pubmed and Scielo. In Medline base, the keyword was used in English, while in the other bases, the keywords were used in Portuguese, Spanish and English. There was no restriction on the year of publishing. For the search of articles, standardized descriptors by the Medical Subject Heading (Mesh) and Descriptors in Health Sciences (Decs) were used, according to Figure 1. In every combination, the Boolean operator And was used.

Figure 1

The articles were initially selected by the titles, refined by summaries. After reading the abstracts, studies that seemed to match the purpose of this review were wholly read, and once they met the inclusion criteria, they were selected to take part in this survey.

Inclusion criteria for selecting articles were: studies describing the injuries arising from traffic accidents by motorcycles in greater detail in the skull and face areas. As for the exclusion criteria of the studies, the only epidemiological studies of motorcycle accidents and case studies were not considered.

The articles selected for this review were characterized by type of study performed, sample size, the venue of the survey, the year of publication, the institutional origin of the authors, the methodology and the results.

The variables to characterize the injuries were: lesion location, severity, sequels, whether or not the use of the helmet and rehabilitation.

English	Spanish	Portuguese
Accidents, Traffic (Mesh) and Motorcycles (Mesh)	Acidentes de Tránsito (Decs) and Motocicletas (Decs)	Acidentes de Trânsito (Decs) and Motocicletas (Decs);
Motorcycles (Mesh) and Wounds and Injuries (Mesh)	Motocicletas (Decs) and Heridas y Tramatismos (Decs)	Motocicletas (Decs) and Ferimentos e Lesões (Decs)
Motorcycles (Mesh) and Sequelae (Termo Livre)	Motocicletas (Decs) and Complicatión (Termo livre	Motocicletas (Decs) and Sequelas (Termo livre);
Motorcycles (Mesh) and Craniocerebral Trauma (Mesh)	Motocicletas (Decs) and Traumatismos Craneocerebrales (Decs)	Motocicletas (Decs) and Traumatismos Craniocerebrais (Decs)
Motorcycles (Mesh) and Rehabilitation (termo livre)	Motocicletas (Decs) and Rehabilitación (term livre)	Motocicletas (Decs) and Reabilitação (termo livre)
Motorcycles (Mesh) and Facial Injuries (Mesh)	Motocicletas (Decs) and Traumatismos Faciales (Decs)	Motocicletas (Decs) and Traumatismos Faciais(Decs)

Figure 1 – Combination of the terms used for search strategy

LITERATURE REVIEW

As the results, a total of 3306 articles was found in the data bases, in the selected languages, of which 2332 articles were excluded in the title reading. Among the 974 articles that remained, 901 were excluded in abstracts reading. Finally, 73 articles were available to be wholly read, of which, 63 were excluded by the text or repetition. See flowchart:

To compose this review, the selected studies after reading in full are highlighted in Figure 3, according to the variables for injuries characterization.

The studies analyzed showed that the interest in mapping the injuries in the head and the neck, arising from motorcycle accidents, have been going through the 80s and 90s, 2000s to 2012. In visualizing works carried out at different times, it should be considered that these accidents and their consequences have aroused greater concern for surveys, as it has been observed the increasing number of accidents involving this type of vehicle. This increase can be explained by the acceptance and approval of the population for being an agile, economic and low cost vehicle[8].

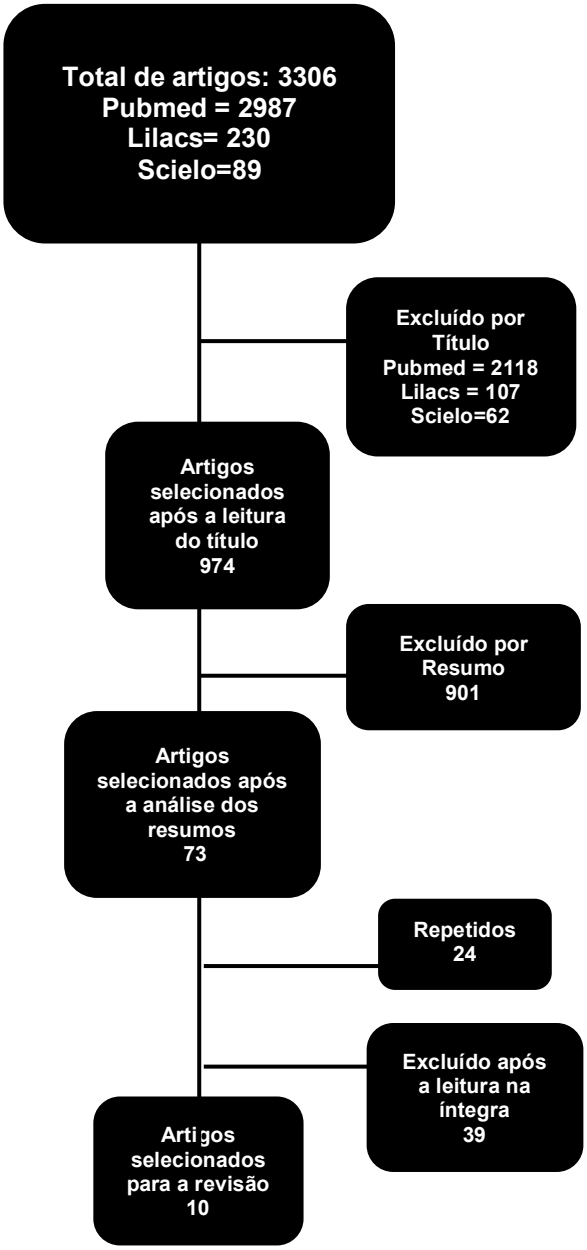

Figure 2 – Flowchart of articles selection

As for the origin of the selected studies, there is na heterogeneity of countries located in different continents (Taiwan, Germany, Turkey, Nigeria, USA, Brazil). This variation confirms the contents pointed by the World Health Organization, which showed a scene of "pandemic". Only in 2009, there were 1.3 million deaths from traffic accidents in 178 countries worldwide. It is estimated that these figures will reach 1.9 million traffic deaths in 2020 and 2.4 million in 2030[4].

The highlight for motorcycle accidents can be observed in the studies of Lee et al[9]. Oginni et al.[10], asian and african countries, due to the large fleet as the main mean of transport commonly used. In the study Ramli et al.[11], it is cited that 49% of registered vehicles in Malaysia are motorcycles.

In Brazil, the growth trend of motorcycle accidents was also highlighted [12,13], once, tragically, mortality from motorcycles increased 244% from 2000 to 2010, period of data collection in these surveys[4]. In this sense, it may be said that motorcycle accidents are already configured as a major threat to Brazilian health and also to global health.

As for the quality of the studies samples, there is also heterogeneity in ages, but the studies are unanimous in pointing out men as the most affected victims. In general, they observed that the age range between 19 and 29 was the most affected by accidents and injuries, with highlight Taiwan and Brazil's study[9,12], which highlighted an age group above this average (31 years). The explanation lies in the indexes given by WHO, which show that traffic accidents are the major cause of death among this age group (15-29 years), the 3rd cause of death in the range of 30-44 years and the 2nd in the range of 5-14 years[4].

As for the selected data collection method of the studies, most consisted in thoroughly detailing the injuries in head and neck area, collected directly through clinical examination, of each sample individual participant[8-11,14]. Others searched for data on hospital records[11,12] and databases from hospital information systems[13].

One explanation for the divergence in the types of collection can be related to the choices of researchers. By opting for direct collection, the

Author/year	Country	Sample	Collection Method	Injuries found	Helmet use	Sequelae	Rehabilitation
Cannell, H. et al./1982	England Eng.	N= 56 individuals, with average age of 25 years old, no detailed gender. Data collection period: 4 months between 1978-1979.	Direct collection.	Head trauma attempted 49%, forehead and face soft tissues attempted 38% of the victims, and face bones and teeth 11%.	All the individuals of the sample used the helmet.	Of the 56 total individuals, 11 passed away.	Not detailed.
Maw-Chang Lee et al. /1995	Taiwan Eng.	N=1.160 with craniofacial injuries 75% were male, average age at about 31 years old.	Direct collection, in the period from June of 1990 to June of 1993. The areas of head and face were divided in regions (22 head and 12 face). The severity of injuries was measured by Glasgow scale.	Among all the 1.160 cases, 783 (68 %) had facial injuries, 785 (68%) had head injuries, e 408 (35%) were attempted by both facial and head injuries. Of total N, 220 had fractures, 94 had just skull fractures, 118 had just face fractures, and 8 cases had both. Skull fractures were distributed as it follows: 46 frontal; 41 temporal; 8 parietal; 10 occipital, and two skull fractures bases. Among the facial fractures there were: 37 zygomatic; 38 nasal bone; 43 mandibular; 4 maxillar; 7 orbital fractures.	In the study, no individual of the sample used the helmet (inclusion criteria).	92% of the victims recovered,1 victim remained in persistent vegetative state, four passed away, and in 6,2% the results were unknown.	Not detailed.
Gopalakrishna, G. et al. /1998	U.S.A. Eng.	N=5.790, of which 89,7% were male. Data were collected between 1991-1993.	Collection through hospital reports. The injuries were coded by AIS (Abbreviated Injury Scale).	Of 5.790 injured motocyclists, 1410 (24,3%) were attempted by facial injuries. As for the nature of injuries, there were: Sotf tissues injuries: 68,3% Facial fractures: 11,6% Soft tissues and facial fractures: 18,7% Facial organ fracture:1,7% Facial fractures are 30% of bone fractures, distributed: Alveolar: 1,5% Orbital: 27,2% Zygomatic: 25% Maxilla: 37,5% Nasal: 27% Mandible: 23,2% Not specified:9% Multiple injuries:18,7%	Of the victims with facial injury, 36,8% used a helmet, 56,8% did not use a helmet.	Not detailed.	Not detailed.

Author/year	Country	Sample	Collection Method	Injuries found	Helmet use	Sequelae	Rehabilitation
Richter, M. et al./2001	Germany Eng.	N=226, of which 88,5% were male, with average age of 28,9 years old.	Direct collection, through medical exam, in the period from July 1996 to July 1998. Head injuries were mapped in individuals who presented the Abbreviated Injury Scale (AIS) score of 2 or higher.	81 motocyclists were scored AIS +2, 409 head injuries were mapped. Of them, 84 attempted head bones (calvarial; canial base; frontal sinus; Le Fort; Mandibular; Orbital; Maxillar; Dental; Nasal e Upper cervical spine dislocation).	In the study, all the individuals of the sample used a helmet (inclusion criteria)	37% of the sample subjects passed away, of which 88% had the head injury as the cause of death.	Not detailed.
Kraus, J.F.; et at/ 2003	U.S.A. Eng.	Cohort study with injured motocyclists treated in located hospitals. Victims of accidents that happened between January 1, 1991 and December, 31, 1993. The study population was 5.790 motocyclists. The average age of injured riders was 28,7 years old, of which aproximately 90% of the injured riders were men.	Database.	Facial injuries, including fractures and damage in soft tissues, were diagnosed in 1410 (24,4%) of 5.790 injured motocyclists. The facial bones more frequently injured were maxilla (23,3%) and mandible (22,0%). The zygomatic boné was the less fractured (15,6%). The chances of a traumatic brain injury combined with a facual injury of any type were 3,52 times higher than those without facial injury. Among the riders with only one facial fracture, the greatest chances of traumatic brain injury (OR 5,93 , IC 95% 2,64-13,61) are for those with orbital bone fracture.	Facial fracture associated with brain injury varied according to the helmet use. The study found the use of the helmet as a potential protective effect.	Not detailed.	Not detailed.
Oginni, F.O.; et al./2006	Nigeria Eng.	Period of 18 months. Prospective study. 107 patients (83 male and 24 female) with average age of 25,4 years old.	Direct collection.	Most soft tissues injuries (70,6%) were lacerations. Of 107 patients, 52 (48,6 %) suffered from isolated injuries, while 55 (51,4 %) had several combinations of injuries. Mandible registered the highest incidence of fractures (63,3%), followed by zygomatic bone (22,7%). In the study, the middle third of the face had 22 injuries that were Le Fort I or II, midpalatal, and nasal bones fractures. These were registered in more severe cases.	Not detailed.	Complications occurred in 13 patients, of which 5 suffered from soft tissues infection, 4 suffered from blunt head trauma, 1 case of ruptured eyeball, paresthesia of the inferior alveolar nerve, severe trismus and otorrhea.	Not detailed.

Author/year	Country	Sample	Collection Method	Injuries found	Helmet use	Sequelae	Rehabilitation
Ramli, R. ; et al/ 2008	Malaysia Eng.	All patients victims of motorcycle accidents with oral and maxilofacial trauma were recruited (total of 133), collected in a period of 2 years. Of them,106 were male. The average age was 25,8 years old.	Direct collection.	The study showed that most parto f the injuries (46,9% , N = 53) were in maxillofacial area, in lower third of the. The most common fracture was in the mandible. Then, injuries happened in middle third of the face, involving the zygomatic boné. The third highest incidence of facial injury is in the upper third of the face, accounting only 2 cases with frontal boné fracture. The study also found that the fractures in the head and the face are generally noted in riders who had suffered frontal collisions. Frontal collisions are, however, 4 times liable to cause death and severe injuries.	It was showed that 2,7% (N= 3) did not use a the helmet, 5,3% (N = 6) did not use a helmet properly, and 38% (N = 43) did not know about the helmet use in the moment of the accident.	Not detailed..	Not detailed.
Alicioglu, B. et al. /2008	Turkey Eng.	N= 212 patients (204 male, 8 female, aged ± 26 years old)	Retrospective study, with medical records analysis.	Skull and maxillofacial injuries were present in 66,5% of the injured by motorcycles. They were divided as follows: Maxillofacial injury 17,9% Trauma to the skull 29,7% Intracranial injury 50,5%	Not detailed.	4,3% of the patients investigated passed away.	Not detailed.
Cavalcante, J.R et al./2012	Brazil Eng.	N=272 patients, aged between 21 and 40 years old. Male gender was predominant (94,5%).Data were collected in a period of 1 year (March of 2009 to March of 2010).	Direct collection.	The main facial fractures found were: 51,8% in mandibular bones; 18,8% in zygomatic; 9,2% in nasal bones.	In this population, 54 used helmets and 218 did not use helmets.	Not specified.	Not detailed.
Junior, S.L.M. et al/2012	Brazil Eng.	367 motorcycle accidents victims, on which 299 were men and 68 were women, with average age of 26,1 years old. Data were collected in a period from April 1, 1999 to July 31, 2009.	Database.	Of the 367 cases of motorcycle accidents, there were 221 patients (60%) with 338 facial fractures, in a proportion of 1,5 fractures per patient. Mandibular fractures were the most common, representing 47% of all fractures. The second most frequent fracture was in the zygomatic complex, present in 31% of the patients. Motorcycle accidents caused multiple facial fractures in 40% of the patients. As for the tissues injuries, the study found this distribution: Soft tissues 27% Soft tissues and bones 51% Soft tissues and dental 13% Bones and dental 2% Soft tissues, bones and dental 7%.	Two hundred seventy nine motocyclists (76%) were using a helmet in the momento f the accident. The study showed that 64% of this group had facial fractures. The use of protective equipments did not statistically decreased the number of facial fractures.	Not detailed.	Not detailed.

Figure 3 – Studies selected after searches in Scielo, Medline e Lilacs bases.

risk of wrong data due to poor filling of hospital records, or associated with underreporting of information on information systems is reduced, as it is showed in Ferreira's study[15]. The low quality of medical information and record data in information systems complicates a lot the compatibility of the databases[15].

The percentage of injuries and fractures varied according to the service center where such victims were received. For example, in Lee et al.[9], Cavalcante et al.[12] and Alicioglu et al.[16] studies, injuries and fractures in the face has affected 68%, 60% and 66.5% respectively, victims of motorcycle accidents, because they are reference centers in oral and maxillofacial area. In other studies, Richter et al.[17], Gopalakrishna et al.[18] and Cannell et al.[8], these rates approached, corresponding 24.3%, 24.4% and 38%, respectively.

Regarding to injuries mapped by the studies, there were disagreements and agreements. The studies confirm to point out the jaw region, as the most commonly present in facial injuries and fractures resulting from motorcycle accidents[9,13-17]. The zygomatic bone oscillated in the "rankings" of facial injuries/fractures, being placed between 2nd[13-16] and 3rd[9] most affected bones, and the nasal bone, which was positioned between 2nd[9,12] and 3rd[13] position. The remaining face bones are cited when fractured, however they are showed up less frequent when compared to other facial bones. In Gopalakrishna et al.[18] and Kraus et al.[14] study, the jaw bone was the most affected one between the facial bones, diverging from the other studies. According to Oginni et al.[10] study, these bones (mandibular, zygomatic and nasal) are prominent, therefore they are more frequently affected by collisions, when they hit the face region.

As for the severity of injuries and fractures in this area, Richter et al.[17], Kraus et al.[14] and Oginni et al.[10] studies highlight an association between facial injuries and cranial traumas in the most severe victims. Lefort I and II injuries were associated with more severe TBI in Richter et al.[17] and Oginni et al.[10] studies, as well as orbicular bone fractures were present in victims with TBI in Kraus et al.[14] study.

In the selected studies, the incidence and severity of facial and head injuries also varied according to the collision position (front, side, etc.)[11], the use or not of protective equipment (helmet), among others. According to Ramli et al.[11] study, these types of injuries and fractures are more common in drivers who collide in front position. The study also highlighted that this type of collision (frontal) is, generally, the most dangerous, in other words, it makes the victim more susceptible to death.

The helmet use was highlighted in Richter et al[17], Lee et al.[9] and Cannell et al.[8] studies, as a sample inclusion criteria. In Gopalakrishna et al.[18], Cavalcante et al.[12], Junior et al.[13], Kraus et al.[14] and Ramli et al.[11] studies, there was a comparison of the injuries found according to the use or not of the helmet. However, there was a great disagreement between Junior et al.[13] and Kraus et al.[14] studies, since the study performed in Brazil did not notice that the use of the protective equipment decreased statistically the number of facial fractures. Kraus et al.[14] study also found an association between facial fracture and brain injury. According to the authors, the helmet has the power to prevent fractures and brain injuries[14].

These data corroborate Liberatti et al.[19] study, which showed the helmet use as a device capable of acting in injury prevention, as well as it helps to reduce morbidity and mortality by traffic accidents.

As for the rehabilitation data, the selected studies did not detail the need to treat the surviving victims of motorcycle accidents, in order to restore the functions related to the stomatognathic system, system affected by trauma in head and neck region. To Bianchini et. al[20], fractures in this region have been typifying a speech therapy concern field, once they often interfere this system functions performance and, thereafter, in the victims quality of life.

In the study by Bianchini et al.[20], which evaluated patients suffering from face trauma arising from multiple causes (accidents, falls, assaults), it was found that changes in stomatognathic functions resulting from trauma were present in 100% of cases. Those changes such as: deviations and/or changes in the course of mandibular movements, facial edema, palpation pain, muscle disorders from fracture, joint noises, changes scarring (keloid or restrictive scar)[20].

The same study could also confirm that speech therapy was effective since all patients treated in the sessions showed significant improvements related to the changed aspects, which led to a better organization and functioning of the stomatognathic system[20].

After this extensive review, accordant and discordant points were raised about the universe of injuries and fractures present in motorcycle accidents victims. It is evidenced that the literature, national and international, have solid knowledge about the detailed description of the injuries suffered by the victims. However, what can be seen is the lack of studies that describe the complications and sequelae left[21]. Lee et al[9], Richter et al.[17], Alicioglu et al.[16] and Cannell et al[8] studies highlight, in general, the deaths as a consequence of injuries and fractures in the face and the head. The Nigerian

study by Oginni et al.[10] deepens more on complications caused by injuries, detailing on the location and severity, but does not address the need for rehabilitation or possible treatment mechanisms to mitigate them.

Worldwide, injuries and facial fractures continue to generate discussion among researchers due to functional and esthetic deformities affecting individuals, as quoted by Ramli et al.[11]. Although there is knowledge about the prevalence of injuries, it is important to point out that these can be attenuated through speech therapy, which proves to be effective for the treatment of patients with fractures in this region, enabling the disposal of the main complaints, minimizing the resulting consequences from trauma and thus promoting the myofunctional rehabilitation.

CONCLUSION

In the several studies selected for this review, it can be seen that traffic accidents by motorcycle, can cause esthetic deformities and functional changes in the face. In addition to these damages, there are the most serious injuries, such as head trauma, present in most fatal victims. The most commonly affected population is of men aged between 19-29 years, working age, who due to the accident, remain with often irreversible consequences, and in more severe cases, the lifetime is briefed when the accident leads to death.

Although the studies conducted in Brazil and other countries have pointed out in detail the head and face structures most commonly affected by this type of event, data about the resulting consequences after these injuries were scarce. It is emphasized that the injuries in the face and the head are associated with more severe cases of motorcycle accidents and possibly implicate the health of human communication. It is reinforced that the events and mortality involving motorcyclists are presenting significant increase and therefore studies that may indicate the most prevalent consequences and ways to mitigate them should be encouraged.

RESUMO

Os acidentes de trânsito têm constituído um problema de saúde pública que mais cresce no Brasil e no mundo, com destaque para as motocicletas. Além dos altos índices de mortalidade, destacam-se também as lesões e sequelas causadas aos sobreviventes ao acidente. As lesões de face são comuns neste tipo de acidente, causando deformidades estéticas e funcionais no rosto, necessitando de reabilitação. Foi realizada uma busca na literatura para mapear as lesões na região craniofacial decorrentes de acidentes de trânsito por motocicleta, buscando também suas possíveis implicações para a Comunicação Humana. As bases de dados Pubmed, Lilacs e Scielo foram acessadas, selecionando os artigos pelos títulos, em seguida pelos resumos, para ao final selecionar os artigos para leitura na íntegra. Após este processo, foram selecionados 10 estudos para a revisão. Na região facial, as fraturas mais frequentes foram nos ossos da Mandíbula, Zigomático e Nasal, por serem os mais proeminentes na região. Destacaram-se os Traumas Cranianos como os tipos de lesões com maior gravidade, uma vez que podem levar ao óbito. Apesar do detalhamento das lesões, as sequelas e dados sobre a reabilitação dessas vítimas de acidentes por motocicletas foram raros na literatura.

DESCRITORES: Acidentes de Trânsito; Motocicletas; Ferimentos e Lesões; Traumatismos Faciais

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Received on: February 05, 2015
Accepted on: April 22, 2015

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