

Incidence, aetiology and pattern of mandibular fractures in central Switzerland

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Summary

PURPOSE: The two major causative factors for mandibular fractures, as stated in the literature, are either interpersonal violence or motor vehicle accidents. The purpose of this study was to describe epidemiological trends of mandibular fractures in Switzerland. A special emphasis was directed towards the potential impact of socio-economic standards on the mechanism and pattern of mandible fractures.

PATIENTS AND METHODS: A database of patients aged over 16 years who had been diagnosed with a mandibular fracture between January 2000 and December 2007 at the University Hospital of Bern, Switzerland's largest Cranio-Maxillofacial-Surgery Centre, was retrospectively reviewed. Patients' data including gender, age, mechanism of accident, fracture site and associated injuries were analysed and compared with previously published data.

RESULTS: There were a total of 420 patients with 707 mandibular fractures. The two most common causes of injury were road traffic accidents (28%) and various types of sports injuries (21%). A total of 13% of the patients were under the influence of alcohol or drugs at admission. Fractures were predominantly situated in the condyle/subcondyle (43%) and in the symphysis/parasymphysis region (35%). Occurrences of fractures in the angle and in the body were low, at 12% and 7% respectively.

CONCLUSION: In contrast to other highly developed countries, sports- and leisure-related accidents outnumbered motor vehicle accidents and altercations. The data presented here supports the assumption of a correlation of trauma cause and fracture pattern.

Key words: trauma; epidemiology; mandibular fracture; Switzerland

Introduction

Mandibular fractures are the second, most-frequent facial injuries treated at a trauma centre. According to several studies, they account for 15.5% to 59% of all facial fractures [1–4]. The epidemiological data for facial and mandibular fractures varies among countries and changes

over time. The aetiology of cranio-maxillofacial injuries is multi-factorial, mostly depending on socio-economic, demographic, cultural, technological and environmental factors. Therefore, the main mechanism of injury for mandible fractures is inconsistent in the literature.

Interpersonal violence is the most common cause for mandibular fractures in North-American countries [5–8], North European countries [2, 9, 10], Australia [11, 12] and New Zealand [13, 14]. In newly industrialising and less developed countries such as Jordan [15] or Nigeria [16], motor vehicle accidents are the most common cause for mandibular fractures.

In 2005, the World Bank reported that Switzerland was the richest country in the world, with a per capita wealth of 648,241 USD [17]. The high socio-economic standard and the alpine surrounding (40% of the surface are mountains) may influence the aetiology of facial trauma in Switzerland. Up to now, no epidemiological data from Switzerland have been published. The aim of this study was to evaluate the epidemiology and fracture pattern of mandibular fractures in Switzerland and compare these data to previously published studies from other highly developed countries. Furthermore, the study tried to shed light on a possible correlation of trauma mechanism and fracture pattern.

Material and methods

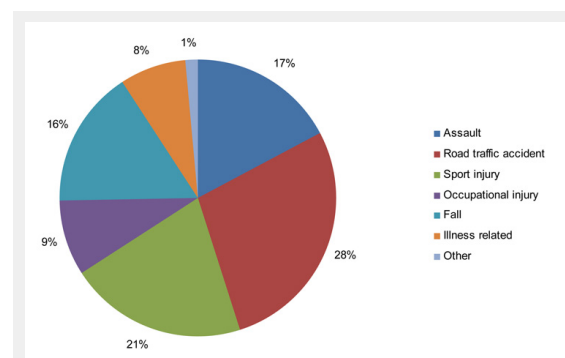


Figure 1
Trauma mechanism.

The Cranio and Maxillofacial Surgery Unit at the Inselspital in Bern is a level-one trauma centre, which provides maxillofacial trauma coverage for a mainly suburban and rural population of about 2.5 million. Since the introduction of a computer based databank in January 2000, all patient data are recorded at the time of admission to the emergency room. All emergency reports are written and saved as an electronic medical report with the Qualicare program as previously described in the literature [18]. This program permits a text or key word search and can immediately display complete patient notes and progress reports. The observation period for the study was from January 2000 until December 2007.

The search criteria included: lower jaw, mandible, mandibular fracture, condyle, condylar fracture, coronoid, angle fracture, symphysis fracture and parasymphysis fracture. Information obtained from the trauma database included the following: patient name, age, sex, trauma date, alcohol and drug abuse, sort of trauma, mechanism of injury, fracture localisation, additional injuries, investigation methods and initial therapy.

In addition to the trauma data bank search, a second text search of all electronic radiological reports from the department of neuro-radiology was performed with the previously mentioned key words. Next, all the medical files of the department of cranio-maxillofacial surgery were scanned in case of incomplete data.

Age was classified into 3 groups: 16 to 29 years old, 30 to 49 years old, and >50 years old. Patients under 16 years of age are also treated by our department, but could not be considered since the children's emergency room is not connected to the Qualicare database. We considered patients between 16-29 as young adults, who are often described as a risk population for mandibular fractures. The causes of the accidents were grouped into the following categories: road traffic accidents (RTA), interpersonal violence (IPV), sports, falls, occupational accidents, medical condition related accidents and other causes.

Based on the documented radiographic findings, the fracture sites were assigned to one of six anatomical subsites including symphysis/parasymphysis, body, angle, ramus, condyle and coronoid process.

Results

Over the period of 7 years, 420 patients with a total of 707 mandibular fractures were admitted and treated at the de-

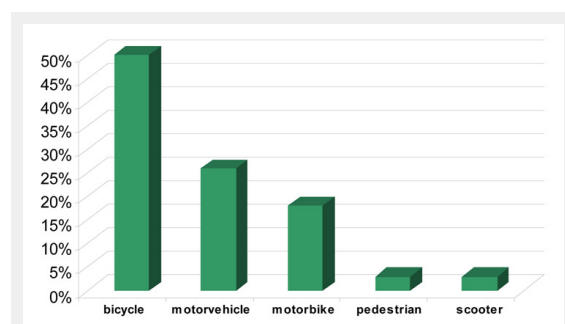


Figure 2

Road traffic accidents.

partment of cranio-maxillofacial surgery. Thus, the mean number of fractures per patient was 1.7 and the incidence to sustain a mandibular fracture was 0.0024 p.a. The mean age was 37 years with a wide range from 16 to 97 years. With 307 patients being male and 113 female, the male-female ratio was 2.7 to 1.

With 28% of all cases, the leading trauma causes were road traffic accidents (117 patients), which could be subdivided into three main categories: bicycle accidents (59 patients), motor vehicle accidents (31 patients) and motorbike accidents (21 patients) (fig. 1 and 2).

Second in frequency, with 21% of all cases, were various types of sport accidents (88 patients). Ice hockey (28 patients) was the most common activity followed by skiing (23 patients) and contact sports (8 patients) (see fig. 3).

Interpersonal violence accounted for 17% of all cases (72 patients) and was third in frequency, closely followed by falls (16%, 68 patients). The assault-related injuries showed a slightly increasing trend with a peak in 2006 (fig. 4). A total of 13% of all patients were under the influence of drugs or alcohol.

The risk to sustain a fracture of the lower jaw declined with age. It was biggest in the age group between 16 and 29 years, and was lowest in the group over 50 years (table 1). A stratification of the trauma causes according to age is summarised in figure 5.

Of the 707 total fractures, 303 were located in the condylar/subcondylar region, followed by the symphyseal region (246), the angle (87), the body (53), the coronoid process (13) and the ramus (5) (fig. 6). Fractures of the mandibular angle were most often results of sports accidents and altercations (fig. 7). Road traffic accidents were most com-

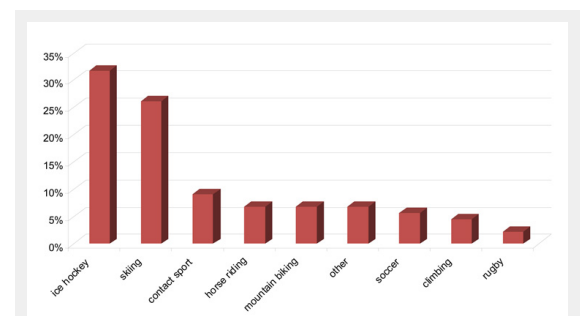


Figure 3

Sport related accidents.

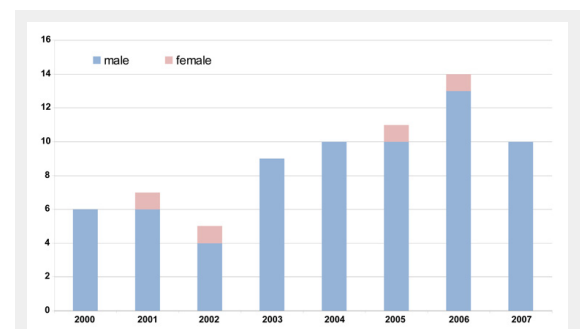


Figure 4

Interpersonal violence.

monly associated with condylar and parasymphseal fractures (table 2).

A total of 93 patients (22%) had associated maxillary and mid-facial fractures. Brain commotion was observed in 19%, but severe brain injuries were extremely rare.

Mandibular fractures were diagnosed using two discrete methods: 198 were diagnosed by using the currently recommended computed tomography and 222 were diagnosed with orthopantomograms and Clementschitsch (reversed Town's) view only.

Discussion

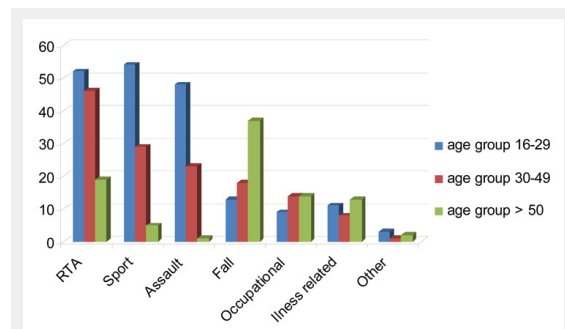


Figure 5
Stratification of the trauma causes according to age.

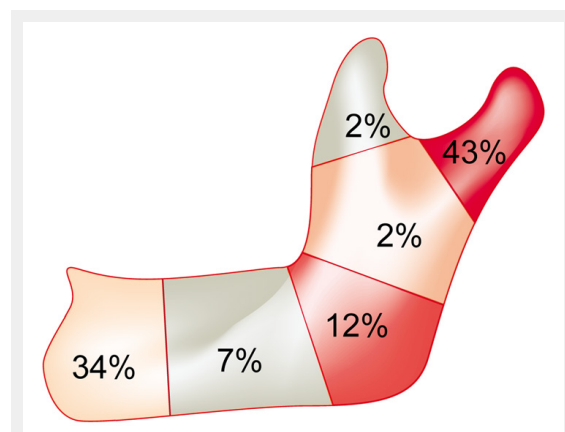


Figure 6
Anatomical sub-site distribution.

Throughout the scientific literature, there is uniform consent that the typical patient with a mandibular fracture is male and between 16 and 35 years of age [2, 5–10, 12, 14]. As outlined in the introduction, the aetiology varies significantly between countries. Almost all authors try to explain this variability by socioeconomic, cultural and environmental factors. When examining the question of whether a high socioeconomic standard has an impact on the aetiology and pattern of mandibular fractures, it becomes evident that the term “socioeconomic” is vaguely defined. For an individual, the variables “income”, “education”, “occupation” and “wealth” account for the socioeconomic status. In fact, it has been shown that these factors correlate with illnesses and accidents [19]. In the comparison of the socioeconomic status of populations of different countries, the factor “wealth” is probably the most important. However, “wealth” is equally difficult to define and therefore multiple indices exist to quantify wealth, including intangible assets. The Gross Domestic Product (GDP) per capita does not reflect the wealth distribution, the life expectancy, the standard of education, or the standard of living. Other indicators such as the Index of Sustainable Economic Welfare (ISEW) and Human Development Index (HDI) are more comprehensive than the GDP. Switzerland ranks highest, not only in the World Bank Report on “Where Is the Wealth of Nations?”, but also at least within the top ten of all other methods to quantify wealth including GDP per capita [17].

In fact, our study shows some inconsistencies with data previously published on the aetiology and fracture pattern of mandibular fractures of other countries. First of all, it

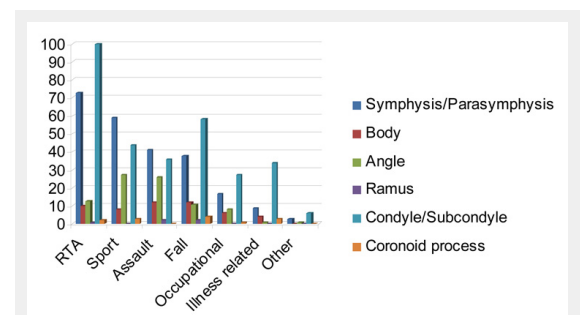


Figure 7
Correlation of trauma mechanism and fracture site.

Table 1: Age distribution and mechanism of injury.

	Total	RTA	Sport	Assault	Fall	Occupational	Illness related	Other
Age group 16–29	190	52	54	48	13	9	11	3
Age group 30–49	139	46	29	23	18	14	8	1
Age group >50	91	19	5	1	37	14	13	2

Table 2: Correlation of fracture site and trauma mechanism.

	Symphysis/Parasymphysis	Body	Angle	Ramus	Condyle/Subcondyle	Coronoid process
RTA	73	10	13	1	100	2
Sport	59	8	27	0	44	3
Assault	41	12	26	2	36	0
Fall	38	12	11	2	58	4
Occupational	17	6	8	0	27	1
Illness related	9	4	1	0	34	3
Other	3	0	1	0	6	0

is striking that the incidence to sustain a mandibular fracture in Switzerland is by far lower than in other countries; however, a comparison of those figures must be done with caution due to unreliable estimates on the served population. Compared to other countries such as Australia, Great Britain, Finland, Bulgaria or Kuwait, the incidence of mandibular fractures in Switzerland is markedly lower [2, 12, 20, 21] (table 3). It is noteworthy that in most publications concerning the aetiology of mandibular or facial fractures neither the number of incidences nor the number of treated patients is listed.

Secondly, the mechanism of trauma differs from previous reports in many aspects. Violence was not a major cause to sustain a mandibular fracture in Switzerland, although assault is known to be a significant predictor for isolated mandible fractures [22]. In contrast to several studies, which report very high rates of interpersonal violence with almost “epidemic proportions” [6, 7, 14, 21], only 17% of all fractures were a consequence of assault in our patient group. For example, a recent study from neighbouring Germany showed a rate of altercation of more than 38% [9]. Some of the explanations for a low violence rate are a low unemployment-rate of roughly 3%, a generous welfare system, and the introduction of a heroin supported therapy for drug addicts in 1994 financed by the health insurance and the city, which significantly reduced drug-related crime. Nevertheless, it should not be concealed that the rate of altercation also increased in our patient population during the observation period. The explanations for this phenomenon and the peak in 2006 can only be speculative. On the other hand, it must be pointed out that none of the cases involved a gunshot wound despite a very high percentage of privately owned small arms in Switzerland [24].

Another finding that contrasts with previous epidemiological studies is the high incidence of sports related fractures with 21% of all cases. The actual number was probably even higher than reported because many of the cycling accidents were probably falsely categorised under road traffic accidents, but were in fact sport related accidents. The predominance of certain sports activities varies from country to country, and depends mostly on cultural and environmental factors [25]. In New Zealand, for example, more than half of all sports related facial fractures are the result of playing rugby [25]. In our study, winter sports accounted for 58% of all sport related injuries with playing ice hockey as the leading cause. Based on the amount of winter sport accidents (93090 persons a year), the estimated incidence of mandibular fracture (0.01%) is however very low. These findings are consistent with the figures from the Swiss Counselling Centre for Accident Prevention (BFU). In 2007, the BFU documented that with regard to facial injuries, ice hockey was by far the most dangerous of all sports activities (BFU). In both ice hockey and skiing, the protection by helmets is insufficient in the prevention of mandibular fractures. Also in cycling, conventional helmets are incapable of preventing injuries to the lower face. In our study, cycling accidents accounted for half of all road traffic accidents and outnumbered motor vehicle accidents (MVAs) by far, which are the most common cause for mandibular fractures in many countries [8, 16, 26]. Compared to cyclists, the percentage of helmet use of motor-

bikers is close to one hundred percent in Switzerland (38% versus 99%, respectively (BFU)), and most of them use full-face helmets. This might explain why motorcyclists are less prone to suffer a fracture of the mandible than cyclists, despite their higher velocity.

Traffic law enforcement plays a critical role for traffic safety. In 2005, for example, 147 people per 1 million inhabitants died in the United States in road traffic accidents versus 55 in Switzerland (BFU). This is in part due to a strict enforcement of speed, safety and alcohol regulations. For instance, 86 out of 100 car drivers in Switzerland use their seat belt compared to countries like Turkey, where the compliance rate is only 18% [8]. Another explanation might be that most Swiss people can afford relatively new and expensive cars with advanced safety systems. Within the seven most commonly sold cars in Switzerland are high quality brands such as Mercedes, Audi, and BMW, and the average engine size is more than 2000 ccm, which is clearly above-average for all European countries [27]. It has been demonstrated that airbags and restraining devices significantly decrease the risk of sustaining a facial fracture in motor vehicle crashes [28, 29].

Regarding the relationship of trauma mechanism and fracture site, our study confirms previous findings of a correlation between aetiology and fracture pattern. The fracture classification was similar to those found in previous studies [2, 12, 22]. As previously shown by King et al., the prevalent fractures resulting from motor vehicle collisions are in the parasymphseal and condylar region, which is consistent with our results. The same applies to falls, which are most commonly associated with condylar fractures [6, 14]. An exception was the predominant fracture resulting from interpersonal violence, which in our study was in the parasymphseal and condylar region. Lee as well as King found angle fractures to be most often correlated with some sort of altercation [6, 14]. A possible explanation for our different findings could be a bias due to the small number of patients.

The principal finding that sports activities outnumbered MVAs and violence as the main cause, and the low incidence of fracture compared to international figures support the assumption of a causal relationship between a socioeconomic standard and the aetiology of mandibular fractures. Nevertheless, it must be kept in mind that the comparison of different studies is limited due to multiple variables, namely differences in date of publication and incomparability of the treated patient population.

Considering the comparable low number of traffic and occupational related injuries in our study, the safety measurements in these fields seem to have proven their effectiveness in the prevention of facial injuries. Hence in Switzerland, the future focus of preventive measurements should be on sports and leisure related activities. As the voluntary use of extensive facial protective gear such as full-face helmets is low, a mandatory use of helmets might be advisable, especially for ice hockey. Concerning cycling, further measurements must be found, such as optimising road conditions for cyclists.

Based on the relevant literature and our own results, we support the assumption of a correlation between trauma mechanism and fracture pattern. The practical application

of this is to optimise specific protective gear and to guide the treating physician towards a time and cost effective diagnostic workup.

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Table 3: Incidence to sustain a mandibular fracture in different countries.

Country	Incidence p.a. (%)	Study-Group
Australia	0.046	Schön R et al. 2001
Finland	0.009	Oikarinen et al. 2005
Great Britain (Scotland)	0.007	Ellis E et al. 1985
Bulgaria	0.006	Bakardjiev et al. 2007
Kuwait	0.004	Oikarinen et al. 2005
Switzerland	0.002	Zix et al. 2011