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Motorcycle accident is the main cause of maxillofacial injuries in the Penang Mainland, Malaysia

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Abstract – *Background/Aim*: Maxillofacial injuries are among the commonest forms of body injuries. There are three divisions, namely, facial bone fractures, soft tissue injuries, and dentoalveolar injuries. Etiologies include motor vehicle accidents, assaults, falls, and sporting injuries. The aim of this study was to determine the profiles including the causes of maxillofacial injuries seen in an urban government hospital in the mainland of Penang State, Malaysia. *Materials and methods*: This was a cross-sectional study that recruited cases reported within a period of 1 year. The source population was maxillofacial injury patients presenting to the Oral and Maxillofacial Surgery Department of an urban hospital in the Penang Mainland, North Malaysia between May 2007 and May 2008. Cases of patients involved in accidents that occurred outside the reference vicinity were excluded. A case report form was developed and completed by the attending clinicians. Data were analyzed using SPSS version 12.0. *Results*: A total of 194 cases were studied, with the mean patient age being 27.8 (SD 15.20) years. The majority of patients were Malay men between 20 and 29 years of age. The main cause of injury was motorcycle accident (53.6%). The commonest injury (in isolation/combination with other injuries) involved the soft tissues (87.2%), dentoalveolar region (33.4%), and facial bones (23.9%). Laceration was the commonest soft tissue injury, and crown fracture was the most frequent dentoalveolar injury. The facial bone that was most highly involved in the injury was the zygoma. Subjects involved in motorcycle accidents had a significantly higher incidence of sustaining facial bone fractures. *Conclusions*: Motorcycle accidents were the commonest cause of maxillofacial injuries in the Penang Mainland, Malaysia. Most patients were young men. Hence, it is prudent to reinforce appropriate road safety and awareness interventions particularly focusing young male motorcyclists so as to reduce the risk of accidents.

Maxillofacial injuries are common injuries that occur due to motor vehicle accidents (MVA). It can occur in isolation or in combination with other concomitant injuries. In general, there are three broad divisions of maxillofacial injuries: facial bone fractures, soft tissue injuries, and dentoalveolar injuries. Mandible and mid-facial skeletal fractures are among the frequently reported facial bone fractures (1–3) while lacerations (4, 5) and tooth crown fractures (6, 7) are among the common soft tissue and dentoalveolar injuries respectively. Generally, more men are involved in such injuries than women with varying reported ratios. The highest occurrence seems to be in the range of second to fourth decades of life (4, 8).

The mechanisms are multifactorial, but commonly reported etiologies include MVA, assaults, falls, and sporting injuries. Interestingly, there seems to be a pattern in the major causative factors in developed and developing countries, with assault being the commonest cause in the former (9–11) and MVA in the latter (12–14). This may be attributed to the generally better attitude of road users and preventive measures including seatbelt and airbag use in the developed nations as compared to those in the developing countries.

Penang is a state in the north of the Malaysian Peninsula and consists of five districts including those in the Penang Island. The aim of this study is to determine the profiles, including the cause, of maxillofacial injuries seen in an urban government hospital in the Penang Mainland, Malaysia. This hospital serves as the referral centre for other district hospitals within its 30-km radius in the Penang Mainland as it is the only facility to offer tertiary care in oral and maxillofacial surgeries in this area. Ethical approvals were obtained from the Research Ethics Committee, Universiti Sains Malaysia (USMKK/PPK/KPPeM(190)) and the Ethics and Medical Research Committee, Ministry of Health, Malaysia (NMRR-09-100-3327).

Materials and methods

This was a cross-sectional study that recruited cases reported within a period of 1 year (May 2007 to May 2008). The sample size was calculated using sample size calculator for estimation program version 1.0.02 (15). The minimal sample size required was calculated to be the largest for subjects who had sustained soft tissue injuries. Using the confidence level of 95%, the expected prevalence of 29.0% (4), and precision of 7.0%, the minimum sample size required was 162 cases. However, the final size after an inflation of 20% for an anticipated non-response rate was 194.

The reference population included all maxillofacial injury patients in the Penang Mainland while the source population included maxillofacial injury patients presenting to the Oral and Maxillofacial Surgery Department of this hospital from May 2007 to May 2008. Cases of patients involved in accidents outside the reference vicinity were excluded.

Although a systematic random sampling method was initially planned, all cases fulfilling the criteria required for this study were included as the estimated number of cases and the minimum required sample size were almost similar.

A structured case report form based on previous literature and discussion with the oral and maxillofacial surgeons of this hospital was developed, and data were collected by the attending clinicians. The information collected included age, sex, and race of the patient; cause and type of maxillofacial injury; and presence of concomitant injuries.

Data were entered into the SPSS version 12.0 software (SPSS Inc., Chicago, IL, USA). The actual age (in numerical form) was represented as the mean and standard deviation (SD) while the categorical variables were represented as frequencies and percentages together with the 95% confidence intervals (exact binomial CI) wherever appropriate. The associations between maxillofacial injuries and motorcycle/non-motorcycle accident-related causes were analyzed using the Chi-square test for independence. All tests were two-tailed with a *P*-value of 0.05 or less considered statistically significant.

Results

A total of 194 patients were studied during the period of this study. The majority of the subjects were within the 20–29 years age group while the smallest group comprised subjects aged 50 years and above. The mean age of all subjects was 27.8 (SD 15.20) years. There were substantially more men than women (ratio, 4.5:1), and from the racial aspect, the subjects were mostly Malays. The age group, sex, and race distributions are as presented in Table 1. The majority of maxillofacial injuries were caused by motorcycle accidents (53.6%) while the rest were due to other types of MVA, falls, and others (Table 2).

With regard to the types of injuries, six cases were excluded from the analysis due to incomplete information. The injury types of the remaining 188 subjects were classified on the basis of the following broad categories: soft tissue injuries, dentoalveolar injuries, facial bone fractures, and a combination of any two or all three (Table 3). Almost half of the subjects sustained only soft tissue injuries, followed by a combination of dentoalveolar trauma and soft tissue injuries. Laceration was the commonest soft tissue injury, and crown fracture was the most frequent dentoalveolar trauma. The zygoma was the most highly involved facial bone. The presence of concomitant injuries is as presented in Table 4.

When the causes of injuries were categorized into either motorcycle accidents or others, further sub-analysis showed that those involved in motorcycle accidents had a significantly higher incidence of sustaining facial bone fractures than those who had maxillofacial injuries due to other causes ($P = 0.016$). However, there were no

Table 1. Descriptive statistics of study sample ($n = 194$)

Variable	No	% (95% CI)
Age groups		
0–9 years	20	10.3 (6.4, 15.5)
10–19 years	28	14.4 (9.8, 20.2)
20–29 years	84	43.3 (36.2, 50.6)
30–39 years	27	13.9 (9.4, 19.6)
40–49 years	18	9.3 (5.6, 14.3)
50 years and above	17	8.8 (5.2, 13.6)
Sex		
Male	159	82.0 (75.8, 87.1)
Female	35	18.0 (12.9, 24.2)
Race		
Malay	116	59.8 (52.5, 66.7)
Chinese	30	15.5 (10.7, 21.3)
Indian	31	15.9 (11.1, 21.9)
Others	17	8.8 (5.2, 13.7)

Table 2. Causes of maxillofacial injuries among study sample ($n = 194$)

Variable	No	% (95% CI)
Motorcycle accidents	104	53.6 (46.3, 60.8)
Other motor vehicle accidents	16	8.2 (4.8, 13.0)
Falls	38	19.6 (14.2, 25.9)
Others	36	18.6 (13.3, 24.8)
Total	194	100.0

Table 3. Types of maxillofacial injuries among study sample ($n = 188$)

Type of injury	No	% (95% CI)
Soft tissue injury only	85	45.2 (38.0, 52.6)
Dentoalveolar trauma only	13	6.9 (3.7, 11.5)
Facial bone fracture only	10	5.3 (2.6, 9.6)
Soft tissue injury + dentoalveolar trauma	45	23.9 (18.0, 30.7)
Soft tissue injury + facial bone fracture	30	16.0 (11.0, 22.0)
Dentoalveolar trauma + facial bone fracture	1	0.5 (0.0, 2.9)
All three	4	2.1 (0.6, 5.4)
Total	188	100.0

Total soft tissue injury: 87.2%, total dentoalveolar trauma: 33.4%, total facial bone fracture: 23.9%. Three commonest soft tissue injuries: (i) laceration only (61.2%), (ii) laceration + abrasion (19.4%), and (iii) abrasion only (10.9%). Three commonest dentoalveolar trauma: (i) crown fracture only (36.5%), (ii) subluxation only (19.0%), and (iii) avulsion only (17.5%). Three commonest facial bone fractures: (i) zygoma only (24.4%), (ii) angle of mandible only (11.1%), and (iii) zygoma + parasymphisis (6.7%).

Table 4. Concomitant injuries among study sample (n = 194)

Variable	No	% (95% CI)
None	124	63.9 (56.7, 70.7)
Head injury (intracranial haemorrhage, contusion, concussion)	59	30.4 (24.0, 37.4)
Chest	2	1.0 (0.1, 0.4)
Extremities	6	3.1 (1.1, 6.6)
Others	3	1.5 (0.3, 4.4)
Total	194	100.0

significant differences in the soft tissue and dentoalveolar injuries between the two groups (Table 5).

Discussion

In this study, the commonest occurrence of maxillofacial injuries was among those in the age bracket of 20–29 years, which is in agreement with many other studies (1, 16–18). The majority of the patients were Malays while Chinese and Indians were almost equally distributed with the ratio between Malays:Chinese:Indians: others of 7:2:2:1.

When analyzed by sex distribution, the male-to-female ratio was about 4.5:1, which is higher than those reported in a few studies (7, 12, 14, 19) but appears to be lower than the ratios reported in several other studies (1, 9, 18). There is no clear indication why there is a higher male preponderance, but as motorcycle accident was the main contributory factor in this study, it is perhaps related to the fact that more men tend to ride motorcycles than women. This is confounded by the generally active nature of the individuals in the lower age group and their relative lack of experience in vehicle handling. A study examining the characteristics of injured motorcyclists in Malaysia found that the majority of seriously injured but surviving riders were men of age less than 25 years and having a valid license for less than 3 years only (20).

The lack of protection offered by motorcycles easily exposes the motorcyclists to body injuries in accidents, and thus, it is not surprising that the subjects in this study who were involved in motorcycle accidents had significantly higher bone fractures than those who had sustained maxillofacial injuries due to other causes. A study on injured motorcycle riders in California reported facial injuries in 24.4% of their subjects (21). However, the associations with soft tissue and dentoalveolar injuries in our study were not significant. Falls was the next highest contributing factor, and qualitative enquiries revealed that the subjects in this group were mostly involved in industrial constructions. However, we could not establish the evidence if the subjects of these two incidents were wearing safety helmets during the accident, although many of them claimed that they did. It will be an interesting factor to explore as there is a study in which no significant association was found between helmet application and maxillofacial fractures (22).

Table 5. Association between maxillofacial injuries vs motorcycle and non-motorcycle accident-related causes (n = 188)

	Motorcycle accident-related causes Freq (%)	Non-motorcycle accident-related causes Freq (%)	χ^2 statistic (df)[1]	P value
Soft tissue injury				
Yes	90 (90.0)	74 (84.1)	1.468 (1)	0.226
No	10 (10.0)	14 (15.9)		
Dentoalveolar trauma				
Yes	39 (39.0)	26 (29.5)	1.850 (1)	0.174
No	61 (61.0)	62 (70.5)		
Facial bone fracture				
Yes	69 (69.0)	14 (14.0)	5.855 (1)	0.016
No	31 (31.0)	31 (31.0)		

[1]Chi-square test for independence.

In this study, we found that the most frequent injuries noted involved the soft tissues. The commonest variant was laceration, and this is in agreement with another Malaysian study in which 69% of the subjects with maxillofacial injuries were reported to have laceration or laceration along with other wounds (5). Dentoalveolar injury was another frequent finding with crown fracture being the most frequent incident. However, a study conducted in Brazil reported that the most prevalent dental trauma in their study were luxation and avulsion injuries (40.3% each) (23). Facial bone fractures in our study were mostly in the midfacial region, specifically the zygoma, and in the mandible, a finding consistent with the results of a few other studies (12, 18, 24).

We also found that the majority of the subjects sustained pure maxillofacial injuries with no other concomitant injuries. However, some of them had sustained head injuries which included intracranial hemorrhage, contusion as well as concussion. This, however, has to be interpreted cautiously as there is a possibility that there were data that were not captured as some of the more seriously injured cases may have been sent directly to the trauma ward without being referred to the maxillofacial department for evaluation.

Conclusion

The present study showed that more men were involved in maxillofacial injuries with the highest occurrence among those in the 20–29 age group. The main contributory factor was MVA, specifically involving the motorcycles. The community and relevant authorities need to come up with appropriate road safety and awareness interventions to reduce the risk of accidents particularly focusing young male motorcyclists.

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Conflict of Interest

None.

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