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Originals

Relationship Between the Severity of Oral and Maxillofacial Injuries and Helmet Use by Type in Motorcycle Accidents

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SUMMARY

Helmets are known to be effective in reducing the severity of head injuries in motorcycle accidents. Although, to our knowledge, few reports have examined the relationship between the severity of oral and maxillofacial injuries and helmet use by type in motorcycle accidents. We retrospectively analyzed 54 patients with oral and maxillofacial injuries from motorcycle accidents and attempted to clarify the relationship between injury severity and the protective effects of a helmet. We studied 40 men and 14 women with a mean age of 26.1 ± 15.0 years (range, 15 to 79 years) who sustained oral and maxillofacial injuries in motorcycle accidents treated in Dokkyo University Hospital from 1994 through 2003. In each case, we examined the mechanism of injury, type of helmet, the injury severity score, the 1990 revision of the Abbreviated Injury Scale (AIS-90) score, and the length of hospitalization. Of these 54 patients, 47 patients wore a helmet. Of these 47 patients, 8 (14.8%) wore a full-face type of helmet and 39 (72.2%) wore an open-face type of helmet. The injury severity scores and the Abbreviated Injury Scale scores for head and neck were not significantly different by helmet use or type of helmet. However, the AIS-90 scores for facial injuries were significantly decreased with helmet use. The scores for facial injuries in the patients who wore the full-face type of helmets (1.4 ± 0.5) were significantly lower than those in the patients who wore the open-face type of helmets (1.8 ± 0.4, $p < 0.05$) and in patients without helmets (1.9 ± 0.4, $p < 0.05$). Wearing a helmet effectively prevented oral and maxillofacial injuries ; although, it could not fully prevent all oral and maxillofacial injuries in motorcyclists. These injuries may have been caused by indirect forces transmitted through the helmet.

Key Words : motorcycle accident, maxillofacial injury, helmet, severity of injury, oral surgery

INTRODUCTION

Oral and maxillofacial injuries are frequent results of traffic accidents, falls, sports, and assaults. Traffic accidents are the leading cause of these injuries and motorcycle accidents are involved in 20.1% to 44.1% of traffic accidents[1～7]. Oral and maxillofacial injuries,

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particularly soft tissue injuries and fractures of the maxilla, mandible, and zygoma, are usually treated by oral and maxillofacial surgeons. Patients with oral and maxillofacial injuries often have long-term consequences, both functionally and esthetically, and require long-term treatment.

In Japan, there were 173,398 persons involved in motorcycle accidents in 2003. Of these, 169,433 (97.7%) wore a helmet, 3,177 (1.8%) did not, and 788 (0.5%) were undetermined[8]. There were many reports suggesting the relationship between head injuries and helmet use ; however, to our knowledge, few reports have examined the relationship between the severity of oral and maxillofacial injuries and helmet use by the type of helmet used in motorcycle accidents[9].

We retrospectively analyzed patients with oral and maxillofacial injuries from motorcycle accidents and attempted to clarify the relationship between the severity of injury and the protective effects of a helmet.

PATIENTS AND METHODS

Patients

Hospital records were reviewed for all patients who sustained oral and maxillofacial injuries in motorcycle accidents at the unit of Oral and Maxillofacial Surgery, Dokkyo University Hospital, from 1994 through 2003. Age, sex, and medical histories of the patients were collected. The methods of treatment and the length of hospitalization in each case were also examined.

Mechanism of injury

We determined where and how each accident occurred. Furthermore, we examined whether the patients wore a helmet, what type of helmet they wore, and how they came to the hospital. As well, with the help of police and emergency personnel, we collected the accident information, including the direction of each collision and the estimated speeds of the vehicles involved.

Type of helmet

We classified helmets as either a full-face type or an open-face type. The open-face type of helmets included half helmets covering only the top of the head and jet-type helmets covering the top and sides of the head but not the face or chin.

The information of helmet use or type of helmet was obtained from hospital data files, the help of police, and emergency crew record.

Estimation of injury severity

Objective measures of injury severity, the injury severity score (ISS) and the 1990 revision of the Abbreviated Injury Scale (AIS-90), were determined[10, 11]. The AIS-90 is used to categorize injury type and severity. The body is divided into six regions (head and neck, face, chest, abdomen, extremities, and external) in which injuries are graded from 1 (minor) to 6 (clinically untreatable). The ISS, which is useful for assessing the severity of multiple injuries, is the sum of the squares of the highest AIS-90 scores in each of the three most severely injured body regions. The severity of oral and maxillofacial injuries was also estimated from the AIS-90 scores.

Statistical analysis

One-way analysis of variance was used for statistical analysis. Differences with a p value of less than 0.05 were considered significant.

RESULTS

General aspects of patients with oral or maxillofacial injuries

A total of 366 patients who had oral or maxillofacial injuries from trauma were treated at our hospital during a period of 10 years from 1994 to 2003. Of these, 201 (54.9%) patients were involved in traffic accidents. Furthermore, of these 201 patients, 54 patients were involved in motorcycle accidents. These 54 patients were subjects in this study. Forty patients (74.1%) were men and 14 (25.9%) were women. Their ages ranged from 15 to 79 years, with a mean age of 26.1 ± 15.0 years. More than 90% of the patients were less than 50 years, and interestingly, more than 50% of the patients were less than 20 years old (Fig. 1).

Regarding the types of accidents, 28 patients (51.9%) were involved in frontal collisions, 22 patients (40.7%) fell without impact with another vehicle, and 4 patients (7.4%) were in side collisions. We found it interesting that such a high percentage of injuries was caused by falls without direct collisions. Thirty-five patients (64.8%) came to our hospital by an ambulance. Of these 35

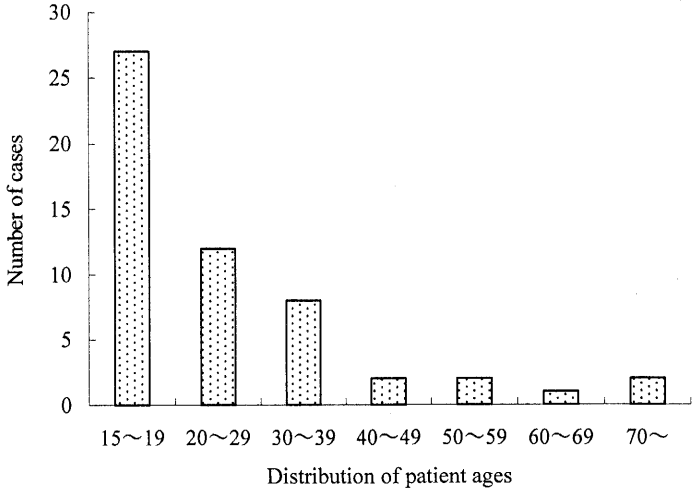

Fig. 1 The distribution of patient ages.

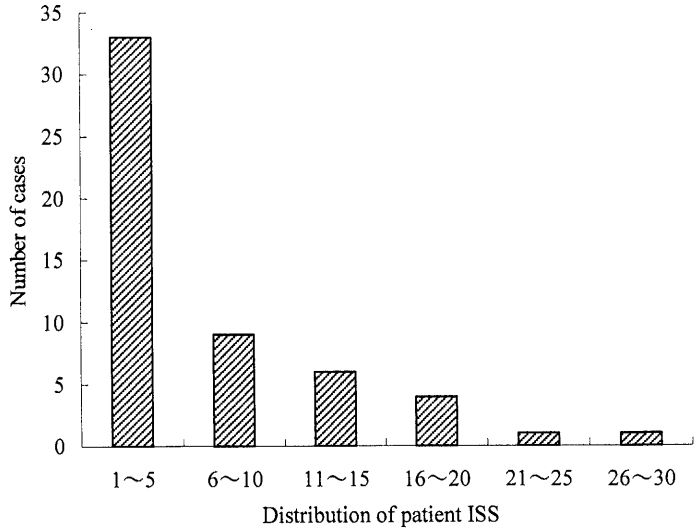

Fig. 2 The distribution of injury severity scores of all patients.

patients, 14 patients came from the accident scene directly and 21 patients were transferred from another hospital. On the other hand, 19 patients (35.2 %) came to our hospital in their family's car, a taxi, their own car, or the car with which they collided. Of these 19 patients, 3 came from the accident scene directly and 16 patients were transferred from another hospital.

Forty-seven patients (87.0 %) wore a helmet. Of these 47 patients, 8 patients (14.8 %) wore a full-face type of helmet and the other 39 (72.2 %) wore an open-face type of helmet.

The ISS in all patients ranged from 1 to 29 (average, 7.1 ± 5.9). All cases had relatively a low ISS. More than 60 % of patients had an ISS of 5 or less and more than 90 % had an ISS of 20 or less (Fig. 2). Two patients with multiple injuries to the head and neck, chest, and extremities had an ISS of 21 or more. Most patients (81.5 %) were not severely injured ; in other words, they had no injured body region with an AIS-90 score of 3 or more. Although, 14.8 % of the patients had at least one severely injured body region.

The mean length of hospitalization was 38.8 ± 22.0 days, which was relatively long compared to that for other injuries.

Outcomes of patients were generally good. Fifty-three patients (98.1 %) had no disability of oral and maxillofacial function and only 1 patient had a remaining functional disability (masticatory disturbance).

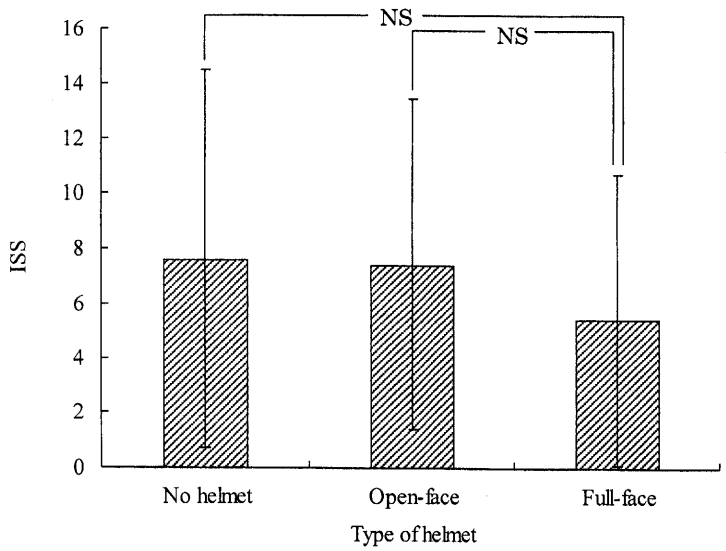

Fig. 3 The relationship between injury severity score and type of helmet. Each column shows the injury severity score in patients with a full-face type of helmet, an open-face type of helmet, or without a helmet. Bars indicate standard deviations. NS : statistically not significant.

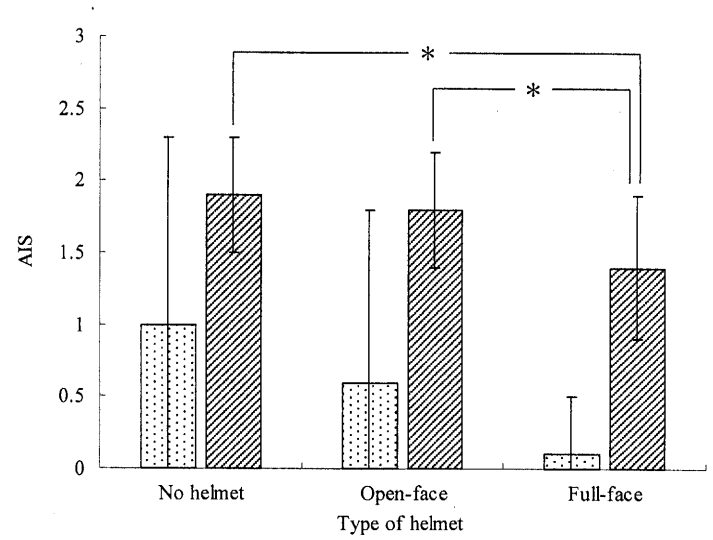

Fig. 4 The relationship between the Abbreviated Injury Score for head and neck or face and the type of helmet.
Each columns show AIS-90 scores for head and neck (⁘) or face (▨). Bars indicate standard deviations. * : statistically significant, $p < 0.05$.

Injury severity and type of helmet

The relationship between ISS and type of helmet was analyzed (Fig. 3). The ISS in the patients wearing a full-face type of helmet (5.4 ± 5.3) was similar to those in the patients wearing an open-face type of helmet (7.4 ± 6.0) and in patients without a helmet (7.6 ± 6.9) ($p = 0.6793$) .

We also examined the relationship between the AIS-90 scores for head and neck or face and the type of helmet. There was no significant difference in the AIS-90 scores for head and neck injuries among the patients wearing the full-face type of helmet (0.1 ± 0.4) or an open-face type of helmet (0.6 ± 1.2) and the patients without helmets (1.0 ± 1.3) (Fig. 4). However,

the AIS-90 scores for facial injuries in the patients wearing the full-face type of helmet (1.4 ± 0.5) were significantly lower than those in patients wearing an open-face type of helmet (1.8 ± 0.4, $p < 0.05$) and in patients without helmets (1.9 ± 0.4, $p < 0.05$). The AIS-90 scores for injuries to the chest, abdomen, and extremities were similar among these three groups ($p > 0.05$).

We also analyzed the relationship between helmet use or type of helmet with the age of patients and the length of their hospitalization. Of the 54 patients, 7 did not use a helmet. The mean age (17.0 ± 1.6 years) of the patients who did not use a helmet was significantly younger ($p < 0.05$) than that of the patients who wore either the full-face type of helmet (8 patients, 31.6 ± 15.6 years) or the open-face type of helmet (39 patients, 26.6 ± 15.7 years). However, no significant differences were found in the mean length of hospitalization by helmet use or type of helmet (36.4 days to 39.4 days, $p > 0.05$, Table 1).

Table 1 The relationship among patient age, number of days of hospitalization, and type of helmet. (*: statistically significant, $p < 0.05$)

		Cases	Age	Days of hospitalization
No helmet		7	17.0 ± 1.6	38.3 ± 17.2
Helmet use	Open face	39	26.6 ± 15.7*	39.4 ± 23.6
	Full face	8	31.6 ± 15.6**	36.4 ± 18.8

DISCUSSION

Motorcyclists have one primary protective device, the helmet, although motor vehicle occupants have several factory-installed protective devices, such as seat belts and air bags. Furthermore, the motor vehicle's frame protects the bodies of the vehicle's occupants[12, 13]. Therefore, motorcyclists are at greater risk of injury than motor vehicle occupants are, and they often sustain severe injuries in multiple anatomic regions. It has been shown that helmet use diminishes the severity of head injuries, the mortality rate, and the cost of medical treatment associated with motorcycle accidents[13~16]. In fact, the rates of head injuries were significantly decreased by helmet use after comprehensive helmet-use laws were enacted[13, 14, 17~19]. In this study, we examined the relationship between the severity of oral and maxillofacial injuries and helmet use by type of helmet in motorcycle accidents.

The ISS in all patients ranged from 1 to 29 (average 7.1 ± 5.9) and there were no significant differences in the ISS by helmet use or type of helmet. Interestingly, all cases had generally low ISS.

The AIS-90 scores (full-face type of helmet : 0.1 ± 0.4, open-face type of helmet : 0.6 ± 1.2, no helmet : 1.0 ± 1.3) for head and neck injuries were not significantly decreased by helmet use. However, this result does not always mean that helmets are not effective in preventing head and neck injuries. Although our present mean AIS-90 scores for head and neck injuries did not quite reach statistical significance by helmet use or type of helmet, these were all extremely low. It seems that this result is natural, because the clinical unit is different depending on part and level of the injury. Generally, when patients suffered serious or fatal injuries to the head and neck or other body regions, those injuries were treated in another clinical unit before their oral and maxillofacial injuries were treated in ours. In addition, this result suggests that oral and maxillofacial injury has been received special treatment in the department of oral and maxillofacial surgery. Therefore, analyzing of the oral and maxillofacial injury from this result has the meaning.

On the other hand, the AIS-90 scores for facial injuries were significantly decrease by helmet use. The scores for facial injuries in the patients wearing a full-face type of helmet (1.4 ± 0.5) were significantly lower than those in the patients wearing an open-face type of helmet (1.8 ± 0.4, $p < 0.05$) and in those without helmets (1.9 ± 0.4, $p < 0.05$). Wearing a helmet, especially a full-face type of helmet, effectively prevented oral and maxillofacial injuries ; however, it could not fully prevent all oral and maxillofacial injuries in motorcyclists. These injuries may have been caused by indirect forces transmitted through the helmet.

We found that helmets are effective for preventing oral and maxillofacial injuries resulting from motorcycle accidents ; wearing a full-face type of helmet might especially decrease the severity of those injuries, more than wearing an open-face type of helmet. However, the mean age of patients who wore a full-face type of helmet was significantly older than those

of the other two groups (Table 1). Furthermore, all of the patients who did not wear a helmet were less than 20 years old. This suggests that young people do not understand the risk of motorcycle accidents and the importance of wearing a full-face type of helmet to prevent oral and maxillofacial injuries. Therefore, getting more effective information to young people about the risk of motorcycle accidents and the importance of wearing a full-face type of helmet to prevent oral and maxillofacial injuries caused by motorcycle accidents is needed.

Furthermore, a more detailed analysis regarding the mechanism and characteristics of these injuries and the effect of wearing a helmet in motorcycle accidents is needed.

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