

The Epidemiology of Mandibular Fractures Treated at Chiang Mai University Hospital: A Review of 198 Cases

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Background: Mandibular fractures constitute a substantial proportion of maxillo-facial trauma cases in Chiang Mai. The present study investigated the prevalence, sex, age group, alcohol consumption, crash helmet use, causes, site, treatment, and postoperative result of mandibular fractures at Chiang Mai University Hospital, Thailand.

Material and Method: The medical records and radiographs of 198 patients treated for mandibular fracture at Chiang Mai University Hospital over a 1.5 year period (from 1 January 2005 to 30 June 2006) were reviewed. Data on the patients' age, sex, alcohol and helmet use, mechanism of injury, site of fracture, treatment modality, and post-operative result were recorded and assessed.

Results: Men of 21 to 30 years of age sustained the most mandibular fractures. The ratio of males to females was 5:1. Most fractures were caused by motorcycle accidents (MCA) (75.75%), followed by body assault (13.63%), and falls (4.54%). Alcohol consumption was a contributing factor at the time of injury in 79% of fractures according to the information available. The most common fracture sites were, in descending order, the parasymphysis (45.3%), angle (19.51%), condyle (15.68%), symphysis (13.24%), body (3.83%), and ramus (2.09%). Nearly 3/4 of all cases were treated by open reduction (76%).

Conclusion: The incidence and causes of mandibular fracture reflect trauma patterns within the community and can provide a guide to the design of programs geared toward prevention and treatment.

Keywords: Mandibular fractures epidemiology, Mandibular fractures

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The only mobile cranial bone the mandible is vulnerable to fractures. Despite the fact that it is the largest and strongest facial bone, it is the tenth most often injured bone in the body and the second most in the face⁽¹⁾. Mandibular fractures can cause a variety of impairments, including temporomandibular joint syndrome, malocclusion, poor mastication, salivary disorders, obstructive sleep apnea, and chronic pain.

Since the first writing on mandibular fracture dates back to 1650 BC in Egypt⁽²⁾, oral and maxillo-facial surgeons have studied the pattern of without consensus on the most common pattern. The causes

and incidence of mandibular fracture vary with geographic region, socioeconomic status, culture, religion, and era. To this end, independent investigators have conducted numerous studies on population groups from every continent, all with the common goal of elucidating the nature of mandibular fractures.

Etiology

The first description of mandible fractures was as early as 1650 BC⁽²⁾, when an Egyptian papyrus described the examination, diagnosis, and treatment of them. Many patients were either not treated properly or received no treatment at all and subsequently died.

The reported findings in certain aspects of mandibular trauma have been widely substantiated, for example, a higher frequency of such fractures among

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males⁽³⁻⁷⁾, whereas the results in other aspects have differed. Investigators in countries such as Jordan⁽³⁾, Singapore⁽⁸⁾, Nigeria^(4,9), New Zealand⁽¹⁰⁾, Denmark⁽¹¹⁾ and Japan⁽⁵⁾ have found that motor vehicle accidents represent the most common cause of mandibular fractures in those countries, while others, in Finland⁽¹²⁾, Scotland⁽¹³⁾ and Sweden⁽¹⁴⁾ have reported assault as the most common etiological circumstance. There is great variability in how these findings translate in different researches. No recent study has documented the pattern of mandibular fractures in Thailand.

The present study was a prospective analysis of all mandibular fractures treated at Chiang Mai University Hospital over a 1 □ year period (2005 to 2006). It aimed to determine the frequency of mandibular fractures among males and females, and the age group in which injury occurred most often; examine the mechanisms of injury; investigate the possible contributory role of alcohol consumption; report on the modalities of treatment rendered; and examine the frequency of post-operative complications.

Material and Method

The records and radiographs of all patients presenting with mandibular fracture at the department of Surgery, Chiang Mai University Hospital, from 1 January 2005 to 30 June 2006 were reviewed. Chiang Mai University Hospital is a leading health care center serving Chiang Mai's demographically diverse population. All patients with a clinical and radiographic diagnosis of mandibular fracture were included in this investigation. Patient information was collected by means of a medical data form specifically designed for the present study. Data regarding age, sex, cause of injury, involvement of alcohol consumption in trauma, crash helmet use, treatment modality, and post-operative results were gathered from pertinent hospital patient records.

The data were identified and analyzed based on age group, gender distribution, mechanism of action, association with alcohol consumption, crash helmet use, anatomic location (based on the Dingman and Navig classification), and treatment modality. The mechanism of action included motorcycle accidents (MCA), body assault, falls, Gun Shot Wounds (GSW), blast injury, car and pedestrian accidents and sports injury.

Results

The results obtained were reviewed and analyzed using frequency distribution. One hundred

ninety eight patients aged 15 to 76 years were treated for mandibular fracture during the study period.

Mechanism of injury

The causes of mandibular fracture were varied (Fig. 1), however, the primary causative factor was MCA (150 cases (75.75%)). Bodily assaults were the second most frequent cause of fracture (27 cases (13.63%)), followed by injuries from falls (9 cases (4.54%)). Other causes included GSW, blast injury, and car and pedestrian accidents. Trauma resulting from sports injury accounted for only one case (0.51%).

Fracture sites

There were 287 mandibular fractures (Table 1). The most common location, using the Dingman and Navig classification, was the para-symphysis (45.30%) followed by the mandibular angle (19.51%), condyle (15.68%), symphysis (13.24%), and ramus (3.83%). The least common sites were the body (2.09%) and coronoid (0.35%). The incidence of 1, 2, 3, 4, and 5 fracture sites was 198 (59.6%), 73, 5, 5, and 1, respectively.

Age group, sex, alcohol consumption, and crash helmet use

The most common age group affected was that of 21 to 30-year-olds (Fig. 2), followed by the 11 to 20-year-old age group. The least affected population was that of 60 year olds or older. Males and females accounted for 83% and 17%, respectively, of all victims. With regard to the use of alcohol, 79% of the study population had drunk alcohol before a trauma accident and no one wore a safety helmet.

Treatment modality

The surgeons at Chiang Mai University Hospital used several different approaches for the reduction and fixation of mandible fractures. Patients

Table 1. Total sites of the mandibular fracture

Sites of fracture	Number	Percent
Parasymphysis	130	45.30
Angle	56	19.51
Condyle	45	15.68
Symphysis	38	13.24
Ramus	11	3.83
Body	6	2.09
Coronoid	1	0.35
Total	287	100

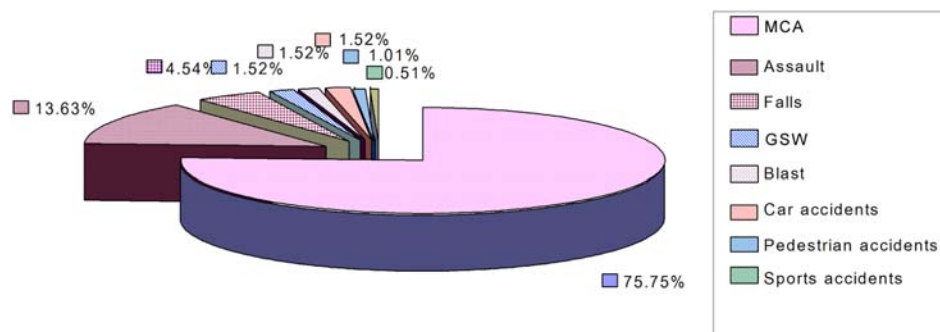


Fig. 1 The causes of mandibular fracture

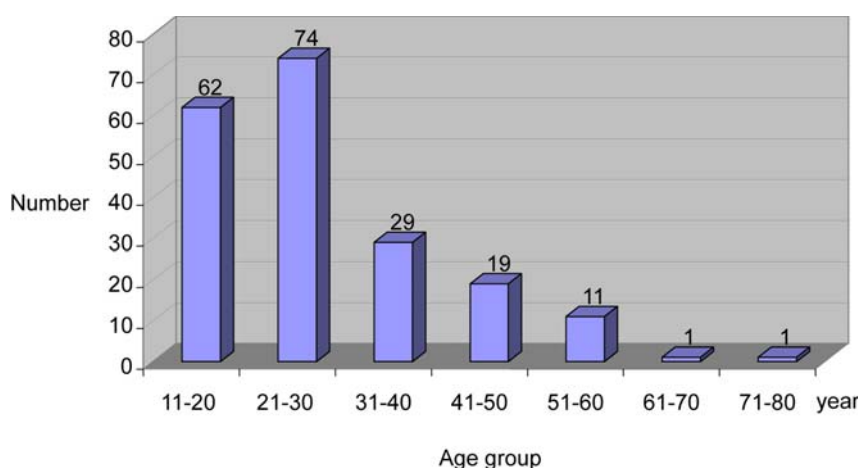


Fig. 2 Age group affected by mandibular fractures

were allocated into five groups according to the type of treatment modality.

Group 1: Intermaxillary for 4 weeks.

Group 2: Open reduction and internal fixation (ORIF) with IOW with (IMF) for 4 weeks.

Group 3: ORIF with Plate & Screws and IMF for 2 weeks.

Group 4: ORIF with two Plates & Screws; no IMF.

Group 5: ORIF with a Reconstruction Plate, no IMF.

In approximately $\frac{1}{4}$ of the 198 patients (151 cases (76%)), for which information about management was available, an open approach involving plates, screws or interosseous wiring (or some combination of these) was used (Table 2). For the remaining 47 patients (24%), treatment was more conservative. Management in these cases involved closed reduction of the fracture and inter-maxillary fixation usually with arch bars or ivy loops.

Patients treated at this institution over the period of evaluation were followed post-operatively

for an average of 6 months. The frequency of post-operative complications was relatively low. Of the 198 study patients, only 13 (7%) experienced a fair post-operative result, due to a significant malocclusion, and they required occlusive adjustment.

Table 2. Management of mandibular fracture

Management	Number of patients	Percent
IMF 4 wks	36	23.74
ORIF & IOW & IMF 4 wks	44	29.29
ORIF & Plate and screws & IMF 2 wks	66	43.94
ORIF & Plate and screws (2 plates), no IMF	3	2.02
ORIF & mandibular plate, no IMF	2	1.01
Total	151	100.00

Discussion

This was the first hospital-based study of the causal mechanisms of mandibular fracture at Chiang Mai University Hospital.

The investigation results of mandibular fracture patients, who were treated at Chiang Mai University Hospital, were largely in agreement with those of previous reports, particularly with regard to age and sex. The gender distribution of the study population over a 1.5 year period showed that most of the patients were male (83%), with females accounting for only one-fifth of the cases (17%). Indeed, the prevalence of mandibular fracture was higher in males of all age groups, with an overall male-to-female ratio of approximately 5:1. Most studies have also shown a lower incidence of maxillo-facial fractures in women^(1,13,15,16), with the highest prevalence of fractures occurring in the second decade.

The finding that men aged 21 to 30 constituted the group with the highest frequency of jaw fracture is consistent with previously published reviews^(15,17). These cohorts make up the most active group in society, and they tend to be more involved in maxillo-facial trauma. It has also been consistently shown that the frequency of mandibular fracture among males is far greater than that for females. Overall ratios of males to females have reportedly ranged from 3:1 to 5.4:1^(3,11,15,18), which is similar to the ratio observed here (5:1).

Olson et al⁽¹⁷⁾ demonstrated that vehicular accidents caused 48% of fractures. In a retrospective study, Fridrich et al⁽¹⁹⁾ demonstrated that altercations accounted for 47% of fractures and automobile accidents for 27%.

Thorn et al⁽²⁰⁾ reported that 156 jaw fractures (90%) in Greenland were due to interpersonal violence. Adekeye⁽²¹⁾, in Nigeria, reported that 76% were related to vehicular accidents. The primary causes of mandible fractures are vehicular accidents and assaults. These vary according to the area in which the survey was taken and the socioeconomic and ethnic status of the community. Other significant causes are falls and sports injuries. In a large retrospective study of 2,137 patients with mandibular fractures, Ellis et al⁽¹⁵⁾ reported that 43% were caused by vehicular accidents, 34% by assaults, 7% were work related, 7% occurred as the result of a fall, 4% occurred in sporting accidents, and the remainder had miscellaneous causes. Vaillant and Benoist⁽²²⁾ described 14 cases of gunshot injuries to the mandible. Patients were aged 6-68 years. Two children were victims of accidents, and the adults were either suicide or assault victims.

Many authors have reported motor vehicle accidents as a major cause of mandibular fracture^(3-5,7-10), whereas others have recorded assault as the main causative factor⁽¹²⁻¹⁵⁾. Consistent with the findings of former investigations, MCA was the single most frequent cause of jaw fracture in the present study (75.75%). The explanation given for this was that a large proportion of the population uses a motorcycle on a daily basis. Those suffering trauma as a result of MCA were mainly males. The second most common cause was bodily assault, obviously because of increasing male aggression in a greater population density, which leads to less tolerance, personal competitiveness, and more assault cases.

Using the Dingman and Navig classification, the anatomical pattern of presentation showed an incidence of para-symphysis involvement of 45.30% followed by the mandibular angle (19.51%), condyle (15.68%), symphysis (13.24%), and ramus (3.83%). The least common sites were the body (2.09%) and coronoid (0.35%).

This follows the same trend as the study of Vetter et al, but is in contrast to Olson et al and many others. This allows the conclusion that the pattern of presentation is a multi-factorial variable.

In the present study, the average number of diagnosed mandibular fractures per person, was therefore 1.44, when counting the diagnosis of 'multiple mandibular fractures' as one diagnosis, and 40.4% of the total patient population presented with more than one fracture site in the mandible. The most common combination was para-symphysis and angle.

In Sweden, alcohol or narcotic involvement in mandibular fractures has been reported as high as 56%, and most of the cases associated with violence (79%) were linked to alcohol abuse⁽⁷⁾. In a study conducted in Finland, 44% of mandibular fractures were associated with alcohol abuse⁽²³⁾. Investigators in Nigeria have suggested that in their region of the world, observed increases in the prevalence of mandibular fractures may be directly related to increased consumption of alcohol after annual periods of fasting⁽⁴⁾. In the present study, alcohol was associated with about 76% of jaw fractures, a proportion significantly higher than figures reported elsewhere. This discrepancy may be explained by underreporting by hospital staff. It may also suggest that the neglected laws governing the sale and consumption of alcohol in Chiang Mai may be an important factor of alcohol-related mandibular fracture.

In general, alcohol consumption, directly or indirectly alters the central nervous system, leading to depression of the inhibitory control mechanism in the brain, and most of the presented patient population had consumed alcohol before an incident.

Hippocrates⁽²⁴⁾ was the first to describe re-approximation and immobilization using circum-dental wires and external bandaging to immobilize the fracture. The importance of establishing proper occlusion first was described in a textbook written in Salerno, Italy, in 1180. Maxillo-mandibular fixation was first mentioned in 1492, in an edition of the book *Cyrugia* printed in Lyons. Chopart and Desault used dental prosthetic devices to immobilize fracture segments. Guglielmo Salicetti was the first to accomplish the use of inter-maxillary fixation.

The management of fractures to the maxillo-facial complex remains a challenge for oral and maxillo-facial surgeons, demanding both skill and a high level of expertise. It has been reported that fractures of the mandible account for 36% to 59% of all maxillofacial fractures^(15,18,25). The large variability in reported prevalence is due to a variety of contributing factors, such as the sex, age, environment, and socio-economic status of the patient, as well as the mechanism of injury. For each patient, the combination of these factors determines the likelihood of a mandibular fracture. A clearer understanding of the demographic patterns of mandibular fractures will assist health care providers as they plan and manage the treatment of traumatic maxillofacial injuries. Such epidemiological information can also be used to guide the future funding of public health programs geared toward prevention.

The current preference for the use of miniplate systems in the treatment of mandibular fracture is evident. Increasing cost of equipment and operating time have frequently been considered a disadvantage of miniplate fixation of mandibular fractures. The major advantage of osteosynthesis is the avoidance, or reduction of IMF duration. Major limitations of the present study were that the group selection was not randomized, there were multiple surgeons, and bias in the patient selection for treatment modality was related to the surgeon's preference and based solely on adherence to the tension band and osteosynthesis theory.

For the 198 patients treated for mandibular fracture, the fair post-operative result rate was only 7%.

A recent case-control study found that crash helmets did not prevent injuries to the upper and mid-face⁽²⁶⁾. Many motorcycle helmets cover the lower

face, which may help to decrease motorcycle mandibular fracture. However, almost all crash helmets used routinely in Thailand do not cover the lower face. Furthermore, they were not worn properly either voluntarily or involuntarily. To date, no studies have been published addressing the effectiveness of motorcycle helmets in protecting the lower face.

The incidence and causes of mandibular fracture reflect trauma patterns within a wide range of social settings. Their causes often reflect shifts in trauma patterns over time. It is hoped that assessments such as the one presented here will be valuable to government agencies and health care professionals involved in planning future programs of prevention and treatment.

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ระบาดวิทยาของผู้ป่วยขากรรไกรล่างหักที่ได้รับการรักษาในโรงพยาบาลมหาราชนครเชียงใหม่: จำนวนผู้ป่วย 198 ราย

วิมล ศิริมหาราช, เกษมศักดิ์ พยุงธนทรัพย์

ภูมิหลัง: ผู้ป่วยกระดูกขากรรไกรล่างหักจากอุบัติเหตุ พบเป็นจำนวนมากในจังหวัดเชียงใหม่ งานวิจัยนี้ต้องการศึกษาถึงปัจจัยต่าง ๆ ที่เกี่ยวข้อง เช่น เพศ อายุ การดื่มแอลกอฮอล์ การสวมหมวกกันน็อค ตำแหน่งที่หัก และผลของการรักษาของผู้ป่วยขากรรไกรล่างหักที่ได้รับการรักษาในโรงพยาบาลมหาราชนครเชียงใหม่ ประเทศไทย

วัตถุประสงค์และวิธีการ: ได้ทำการศึกษาเวชระเบียน และภาพถ่ายรังสีเอกซเรย์ของผู้ป่วยขากรรไกรล่างหักที่ได้รับการรักษาในโรงพยาบาลมหาราชนครเชียงใหม่ ระหว่าง 1 มกราคม พ.ศ. 2548 ถึง 30 มิถุนายน พ.ศ. 2549 เป็นเวลา 1.5 ปี มีผู้ป่วยกระดูกขากรรไกรล่างหักทั้งสิ้น 198 ราย โดยศึกษาเกี่ยวกับเพศ อายุ การดื่มแอลกอฮอล์ การสวมหมวกกันน็อค ตำแหน่งที่หัก และผลของการรักษา

ผลการศึกษา: กลุ่มผู้ป่วยที่พบกระดูกขากรรไกรล่างหักมากที่สุดเป็นผู้ชาย อายุระหว่าง 21-30 ปี อัตราส่วนระหว่างผู้ชายต่อผู้หญิงเท่ากับ 5:1 สาเหตุเกิดจากอุบัติเหตุมอเตอร์ไซด์มากที่สุด 75.75 เปอร์เซ็นต์ ตามด้วย การทำร้ายร่างกาย 13.63 เปอร์เซ็นต์ และการลื่นล้ม 4.54 เปอร์เซ็นต์ พบมีการดื่มแอลกอฮอล์ร่วมด้วยถึง 79 เปอร์เซ็นต์ บริเวณที่พบหักมากที่สุดตามลำดับคือ parasymphysis (45.3%), angle (19.51%), condyle (15.68%), symphysis (13.24%), body (3.83%), and ramus (2.09%). ประมาณ 3 ใน 4 ของผู้ป่วยได้รับการผ่าตัดเปิดจัดกระดูก และยึดตำแหน่งที่หัก (76%)

สรุป: อุบัติการณ์การเกิดขากรรไกรล่างหักที่ได้ทำการศึกษาได้สามารถบอกถึงกลุ่มผู้ป่วยอุบัติเหตุในชุมชนได้ ซึ่งข้อมูลนี้จะช่วยในการวางแผนในการป้องกันและการรักษาผู้ป่วยกลุ่มนี้ในอนาคตได้
