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Evaluation of Mandibular Fractures in a Tertiary Military Hospital: A 10-year Retrospective Study

ABSTRACT

Objectives: The study aimed to evaluate mandibular fractures in a tertiary military hospital, to determine the age group in which injury occurred most often, to examine the various mechanisms of injury, to determine the anatomical part of the mandible most frequently affected and to determine if there were significant relationships between the various mechanisms of injury and the different fracture sites.

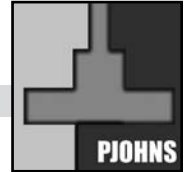
Methods:

Design: Cross-sectional retrospective study

Setting: Tertiary Public Military Hospital

Patients: Medical records of 328 active military personnel and their dependents, treated for mandibular fracture at the Department of Otorhinolaryngology – Head and Neck Surgery, Armed Forces of the Philippines Medical Center from January 1999 – December 2009 were retrospectively reviewed for data regarding sex, age, various mechanisms of injury and fractured anatomical part of the mandible. The number of fractures per site according to mechanism of injury was tabulated and prevalence ratios (95% confidence intervals) and p values were computed for the different fracture sites among the various mechanisms of injury. The probability or risk of sustaining fractures in these sites based on mechanism of injury was then computed.

Results: The most fractured anatomical part of the mandible was the body (28%), followed by the parasymphysis (24%), angle (17%), symphysis (12%), ramus (8%), condyle (7%), alveolar ridge (3%) and coronoid (1%). There were associated injuries in 54% of those with mandibular fractures. In these patients, zygomaticomaxillary complex fractures occurred in 25%, head and neck abrasions and lacerations in 30%, head injuries in 28%, ocular injuries in 10%, nasal fractures in 8% and cervical spine fractures in 5%. Other injuries present were extremity trauma



in 60%, thoracic trauma in 5% and abdominal trauma in 3%. Males dominated with a ratio of 99:1. Males 21 to 30 years of age sustained the most mandible fractures. Most fractures were caused by vehicular accidents (60%), followed by gunshot wounds (31%), falls (4%), violent assault (4%) and sports activities (1%). Alcohol was a contributing factor at the time of injury in 20.6% of fractures. All cases were treated by open reduction and internal fixation with plating or wiring.

Conclusion: The body was the most commonly fractured anatomic region of the mandible in this series. There appeared to be a statistically significant relationship between violent assault and fractures of the ramus, but not between the other mechanisms of injury and the site of fracture. Its prevalence ratio of 3.32 (95% confidence interval: 1.13; 9.74, *p* value 0.039) suggests that the prevalence of fractures of the ramus among those exposed to violent assault was 3 times higher than those who were not.

Keywords: *mandibular fractures, etiology, maxillofacial injuries, trauma*

The mandible occupying a very prominent and vulnerable position on the face is the 2nd most commonly fractured bone of the face and the 10th most fractured bone in the whole body.¹ Surveys of mandible fractures have shown that the etiology varies from one country to another and even within the same country depending on the prevailing socioeconomic, cultural and environmental factors.²

However, different sources list differing anatomic regions of the mandible that are commonly fractured. The aim of this study was to determine the age group, etiology, frequency and classification of mandibular fractures seen in a tertiary military hospital, and to determine if there are significant relationships between the various mechanisms of injury and the different fracture sites.

METHODS

This study was a cross-sectional retrospective analysis of all mandibular fractures treated at the Armed Forces Medical Center over a 10-year period (1999-2009). Data regarding sex, age, various mechanisms of injury and fractured anatomical part of the mandible were gathered from hospital inpatient records and radiographic examinations.

The specific anatomic region of the mandible fracture was determined and sites were classified according to the fractured anatomical part of the mandible as parasymphysis, body, angle,

symphysis, alveolar ridge, condyle, ramus and coronoid fractures. Each fracture line was counted separately. The number of fractures per site according to mechanism of injury was tabulated, and prevalence ratios (95% confidence intervals) and *p* values were computed for the different fracture sites among the various mechanisms of injury using the statistical software Epi Info™ Version 3.5.3 (Centers for Disease Control, Atlanta GA, USA). The probability or risk of sustaining fractures in these sites based on mechanism of injury was then computed using the same statistical software.

RESULTS

A total of 328 patients aged 21 to 45 were treated for mandibular fracture during the study period. Most (282) of those treated belonged to the 21-30 year old group with a mean age of 26.98 ± 4.12 years (range 22.86 to 31.1 years). As expected in a military setting, most of the patients were male (99.1%), with females accounting for only 0.9% of the cases. Among males, the highest prevalence of mandibular fractures occurred in the 21-30 year-old group, whereas only women constituted the above 40-year-old group.

The causes of mandibular fracture were varied (*Table 1*); however, the primary causative factor was vehicular accidents which were not work-related in 190 cases (57.9%). Combat-related injuries resulting from

Table 1. Frequency of mandibular fractures according to site and mechanism of injury among the 328 patients treated at the AFP Medical Center (1999-2009)

Site	Number of fractures according to mechanism of injury					Total (%)
	Vehicular accident	Combat-related	Fall	Violent assault	Sports-related	
Body	103	65	11	5	4	188 (27.77%)
Parasymphysis	95	56	6	7	2	166 (24.52)
Angle	75	32	6	2	4	119 (17.58)
Symphysis	42	25	3	5	1	76 (11.23)
Ramus	30	14	3	5	0	52 (7.68)
Condyle	32	11	4	2	1	50 (7.38)
Alveolar ridge	12	7	2	0	0	21 (3.10)
Coronoid	3	2	0	0	0	5 (0.74)
Total	392	212	35	26	126	677

gunshots were the second most frequent cause of fracture in 102 cases (31.1%), followed by accidental falls (17 or 5.2%), violent assault (13 or 4.0%) and sports-related injuries (6 or 1.8%). On closer examination, obvious differences between sexes in the causes of fracture were readily apparent (Table 1). Males most frequently sustained fractures as the result of vehicular accidents involving the use of motorcycles (190 cases or 58.5% of the male population), followed by combat-related injuries secondary to gunshot (101 cases or 31.3% of the males). In contrast, two of the three female cases reported falls as the cause of injury.

Of the 328 patients included in this study, 300 (91.50%) sustained multiple fracture sites while only 28 (8.50%) had a single fracture site. Overall, a total of 677 fractures were noted. In this study, the most commonly fractured site was the body of the mandible (188 cases or 27.77% of all fractures), followed by the parasymphysis (166 of the cases or 24.52% of all fractures). The angle, symphysis, ramus and condyle had prevalence rates of 17.58%, 11.23%, 7.68%, and 7.38%, respectively. The least commonly affected sites were the alveolar ridge and the coronoid being seen in only 21 and 5 cases, respectively. Among the various mechanisms of injury, the body of the mandible was still the most frequently affected site. Even among those patients who suffered a single fracture, the body was still noted to be the most affected area of the mandible. Among those with multiple fracture sites, the most commonly encountered combination involved the body and parasymphysis.

To determine if there was a relationship between the various mechanisms of injury and the site of mandibular fracture, prevalence ratios were computed and are summarized in Table 2. It appears that violent assault and fractures of the ramus have a statistically significant relationship. Its prevalence ratio of 3.32 (95% confidence interval: 1.13; 9.74, p value 0.039) shows that the prevalence of fractures of the ramus among those exposed to violent assault was three times higher than those who were not.

Associated injuries were present among 43% of those with mandible fractures. Among these patients, zygomaticomaxillary complex fractures occurred in 25%, head and neck abrasions and lacerations in 30%, head injuries in 28%, ocular injuries in 10%, nasal fractures in 8% and cervical spine fractures in 5%. Other injuries present in this group were extremity trauma in 60%, thoracic trauma in 10% and abdominal trauma in 5%.

The mandible fractures were managed by open reduction and internal fixation with wires (2%) or titanium plates (98%).

Table 2. Prevalence ratios (95% confidence intervals) and p values of different sites of mandibular fracture among the various mechanisms of injury

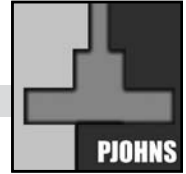
Site of Fracture	Mechanism of Injury				
	Vehicular accident	Combat-related	Fall	Violent assault	Sports-related
Body	0.88 (0.73; 1.06)	1.16 (0.96; 1.41)	1.14 (0.79; 1.64)	0.47 (0.16; 1.39)	1.49 (0.28; 8.02)
p value	0.22	0.16	0.70	0.26	1.00
Parasymphysis	0.97 (0.78; 1.21)	1.13 (0.90; 1.41)	0.69 (0.36; 1.32)	1.14 (0.39; 3.32)	0.49 (0.09; 2.63)
p value	0.88	0.35	0.29	0.96	0.44
Angle	1.24 (0.92; 1.67)	0.81 (0.59; 1.13)	0.97 (0.50; 1.88)	0.32 (0.07; 1.42)	3.51 (0.65; 18.89)
p value	0.20	0.26	0.86	0.14	0.19
Symphysis	0.90 (0.60; 1.33)	1.09 (0.72; 1.65)	0.75 (0.26; 2.14)	2.07 (0.70; 6.15)	-
p value	0.69	0.81	0.77	0.19	-
Ramus	0.99 (0.60; 1.64)	0.82 (0.46; 1.44)	1.12 (0.39; 3.23)	3.32 (1.13; 9.74)	-
p value	0.91	0.58	0.74	0.039	-
Condyle	1.29 (0.76; 2.20)	0.62 (0.33; 1.17)	1.59 (0.65; 3.90)	1.01 (0.23; 4.42)	1.11 (0.13; 9.32)
p value	0.43	0.18	0.31	1.00	1.00
Alveolar ridge	0.97 (0.42; 2.23)	1.11 (0.46; 2.66)	1.93 (0.49; 7.60)	-	-
p value	0.88	0.99	0.30	-	-
Coronoid	1.09 (0.18; 6.43)	1.48 (0.25; 8.71)	-	-	-
p value	1.00	0.65	-	-	-

DISCUSSION

The management of fractures to the maxillofacial complex remains a challenge for oral and maxillofacial surgeons demanding both skill and a high level of expertise. In our institution, mandibular fractures account for 45% of all maxillofacial fractures.

The results of this investigation of patients with mandible fractures who were treated at the Armed Forces of the Philippines Medical Center differ from other series' in the literature, particularly with regard to the most commonly involved anatomic region in mandible fractures. Table 3 summarizes other studies that reveal mandible fracture sites that differ from our findings.^{3,4,5,6}

The results of this study show consistency with that of other studies with regards to the predominant age group sustaining mandibular fractures, which was the 21-30 year-old group.⁷ A possible explanation for the higher frequency of fractures in this group is that the second



and third decades of life are the most active, making people in these age groups vulnerable to trauma. It has also been consistently shown that the frequency of mandible fractures among males is far greater than for females.⁸

Previous epidemiologic studies reported road traffic accidents^{9,10} followed by falls as the leading cause of mandibular fractures in developing countries, others have reported assault as the main causative factor.⁸ The reported findings of certain aspects of mandible trauma have been widely substantiated. For example, investigators in countries such as Jordan,¹¹ Singapore,¹² Nigeria,^{13,14} New Zealand,¹⁵ Denmark¹⁶ and Japan¹⁷ have found that motor vehicle accidents represent the most common cause of mandible fractures in those countries, while others in Finland,¹⁸ Scotland¹⁹ and Sweden²⁰ have reported assault as the most common etiology. In our setting, motor vehicle accidents were the single most frequent cause of mandible fractures (60%). Those suffering trauma as a result of violence were mainly males; females reported assault as the second most frequent reason for their injuries, after falls. In all too many cases, however, the clinical findings did not corroborate the history of a fall, and health care providers often suspect domestic violence. It is highly possible that a good number of females who received their injuries as a result of assault may have reported a fall as the cause.⁹

Alcohol was a contributing factor at the time of injury in 21% of fractures for which this information was available in our institution. This may reflect the deleterious effects of alcohol on psychomotor skills and the lack of preventive mechanisms to respond to situational hazards.²¹ In Australia, alcohol involvement in mandible fractures has been reported to be as high as 41.4%, and most of the cases associated with violence (73%) were linked to alcohol abuse.²² In a study conducted in Finland, 44% of mandible fractures were associated with alcohol abuse.²² In our study, alcohol was associated with about 20.6% of mandible fractures a proportion significantly lower than figures reported elsewhere. However, this discrepancy may also be explained by underreporting by hospital staff.

The mandible fracture site depends upon the mechanism of injury, magnitude and direction of impact force, prominence of the mandible and anatomy of site.³ Its resistance to compression is greater but tends to fracture at the site of tensile strain.³ In addition, it is more sensitive to lateral impact especially the body and ramus.³ In our setting, the body of the mandible was the most commonly fractured part of the

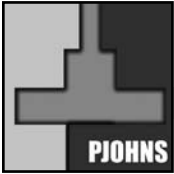
Table 3. Comparison of the literature on the most commonly fractured part of mandible

	Symphysis	Parasymphysis	Body	Angle	Ramus	Condyle	Coronoid
Caparas et al. ⁶ (1993)	14%	—	21%	20%	3%	36%	2%
Sirimaharaj & Pyungtanasp ⁵ (2008)	13.24%	45.3%	3.83%	19.51%	2.09%	15.68%	—
Khan et al. ³ (2009)	11.1%	27.4%	22.2%	23.3%	2.3%	12.8%	0.5%
Kamali & Pohchi ⁴ (2009)	16.7%	23%	20.1%	23%	1.7%	15.5%	—
This Study Galvan 2001	12%	24%	28%	17%	8%	7%	1%

mandible. Fractures of the mandible body often are unfavorable because the actions of the masseter, temporalis and medial pterygoid muscles distract the proximal segment supero-medially²⁰ while the mylohyoid and anterior belly of the digastric muscles displace the fractured segment posteriorly and inferiorly.²³

Prevalence ratios were computed to determine if there was a relationship between the various mechanisms of injury and the site of mandibular fracture. Statistical analysis showed that even if the body was the most frequent site affected, the relationship between the various mechanisms of injury and the site of fracture were not statistically significant. However, there was a statistically significant relationship between violent assault and fractures of the ramus. Its prevalence ratio of 3.32 (95% confidence interval: 1.13; 9.74, p value 0.039) shows that the prevalence of fractures of the ramus among those exposed to violent assault was 3 times higher than those who were not.

Our study has determined the body as the most common region involved in mandible fractures in the Armed Forces of the Philippines Medical Center. Mandible fractures occur in people of all ages and races, in 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 the Armed Forces of the Philippines and military surgeons involved in planning future programs of prevention and treatment. Further studies among non-military hospitals will be valuable in extending our findings to the general population.



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