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Article

A FIVE-YEAR EPIDEMIOLOGICAL ANALYSIS OF MANDIBLE FRACTURES IN BALI

Bertha Kawilarang, I Gusti Putu Hendra Sanjaya, & Agus Roy Rusly Hariantana Hamid

Department of Plastic Reconstructive and Aesthetic Surgery, Prof. dr. I.G.N.G. Ngoerah General Hospital, Bali, Indonesia

ABSTRACT

Introduction: This study aims to assess the prevalence, sociodemographic factors, and patterns of mandible fractures at Prof. dr. I.G.N.G. Ngoerah General Hospital, recognizing that more than half of all maxillofacial injuries are due to mandible fractures, attributable to the mandible's prominent structure.
Methods: This retrospective study was held in Prof. dr. I.G.N.G. Ngoerah General Hospital. Data were collected from January 2018 to December 2023. A total of 289 samples were included in this study. Age, gender, anatomical location of the fractures and unilateral/bilateral involvement were reported.
Results: During the period spanning January 2018 to December 2023, a comprehensive analysis of 289 mandible fracture cases was conducted. Notably, the highest incidence was observed in 2022, comprising 72 cases. Predominantly affecting males (72.7%) within the age bracket of 21-30 years (40.1%), these fractures were primarily attributed to road traffic accidents (64.4%), often associated with alcohol influence (43.9%). Remarkably, non-helmet usage was prevalent among the majority of patients (69.9%), particularly motorcycle drivers (53.3%). The parasymphysis region emerged as the most frequently affected area (38.1%), with unilateral involvement prevailing in the majority of cases (61.6%). Additionally, associated injuries were noted in 88.5% of cases, with management predominantly comprising open reduction internal fixation (ORIF) complemented by maxillomandibular fixation (MMF) in 66.8% of cases.
Conclusions: The findings of this study reveal a progressive rise in the annual incidence of mandible fractures. Consequently, there is a pressing need to heighten awareness among healthcare practitioners when managing patients presenting with maxillofacial traumas.

Keywords: *Mandible fracture; Prevalence; Demographics; Pattern*

Latar Belakang: Penelitian ini bertujuan untuk menilai prevalensi, faktor sosiodemografis, serta pola fraktur mandibula di Rumah Sakit Umum Pusat Prof. dr. I.G.N.G. Ngoerah, Bali. Lebih dari setengah cedera maksilofasial disebabkan oleh fraktur mandibula, yang dapat dikaitkan dengan struktur mandibula yang menonjol.
Metode: Penelitian retrospektif ini dilakukan di Rumah Sakit Umum Pusat Prof. dr. I.G.N.G. Ngoerah Bali. Data dikumpulkan dari Januari 2018 hingga Desember 2023, dengan total 289 sampel yang diikutsertakan dalam penelitian ini. Variabel yang dianalisis mencakup usia, jenis kelamin, lokasi anatomis fraktur, serta keterlibatan unilateral/bilateral.
Hasil: Selama periode penelitian dari Januari 2018 hingga Desember 2023, sebanyak 289 kasus fraktur mandibula dianalisis secara komprehensif. Insidensi tertinggi tercatat pada tahun 2022 dengan 72 kasus. Fraktur ini terutama dialami oleh laki-laki (72,7%), dengan rentang usia paling banyak pada kelompok 21-30 tahun (40,1%). Penyebab utama fraktur adalah kecelakaan lalu lintas (64,4%), yang sering dikaitkan dengan konsumsi alkohol (43,9%). Penggunaan helm yang tidak adekuat ditemukan pada mayoritas pasien (69,9%), dengan pengendara sepeda motor sebagai kelompok yang paling banyak terdampak (53,3%). Wilayah parasimfisis merupakan area yang paling sering mengalami fraktur (38,1%), dengan keterlibatan unilateral lebih dominan (61,6%). Selain itu, cedera terkait ditemukan pada 88,5% kasus, dengan modalitas tata laksana utama berupa *open reduction internal fixation* (ORIF) yang dikombinasikan dengan *maxillomandibular fixation* (MMF) pada 66,8% kasus.
Kesimpulan: Hasil penelitian ini menunjukkan adanya peningkatan progresif dalam insidensi tahunan fraktur mandibula. Oleh karena itu, diperlukan peningkatan kesadaran di kalangan praktisi kesehatan dalam menangani pasien dengan trauma maksilofasial.

Kata kunci: *Fraktur mandibula; Prevalensi; Demografi; Pola*

Conflicts of Interest Statement:
The author(s) listed in this manuscript declare the absence of any conflict of interest on the subject matter or materials discussed.

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INTRODUCTION

Mandible fracture contributes to a significant portion of all maxillofacial injury cases. Due to the prominence of the mandible position, the mandibular becomes a more vulnerable target for injury to occur. In the facial region, the mandible plays an important role in facilitating the ability to speak, chew, and swallow. Therefore, an injury to this region poses a serious problem for functionality of patients. Several anatomical locations of the mandible are also more prone to injury. The parasymphysis and condyle were reported to be the most commonly affected regions, while the ramus, dentoalveolar, and coronoid were the least affected areas.[1,2]

Variations in the prevalence, distribution, and patterns of mandibular fractures are evident across different countries. In developing nations, road traffic accidents (RTAs) remain the primary cause, while interpersonal violence or assaults predominate in developed countries.[1,2,3] An epidemiological study based on data from the National Trauma Data Bank in the United States (2001-2005) documented 13,142 cases of mandibular fractures, with 80% occurring in males, predominantly among individuals aged 18 to 54 years.[3] Similarly, a retrospective study conducted at Hospital Universiti Sains Malaysia (HUSM) identified 222 mandibular fracture cases from January 2011 to December 2015. The peak incidence was observed in the 10 to 19 years age group, with a male-to-female ratio of 5.5:1. Parasymphysis was the most commonly injured anatomical location, followed by the condyle and angle of the mandible, with motor vehicle accidents accounting for 91% of cases.[4]

In Indonesia, the incidence of road traffic accidents remains alarmingly high. According to 2016 national police data, there were 106,431 reported cases of traffic accidents, resulting in 31,170 deaths and 20,660 severe injuries. Despite these staggering figures, there is a notable lack of studies documenting the prevalence of mandible fractures in Indonesia. A study conducted by Putri et al. at Riau Province General Hospital from January 2011 to December 2013 reported a total of 206 cases during this period, with a striking male-to-female ratio of 8:1. The disparity in incidence rates between developing and developed countries is evident, with daily traffic accidents more prevalent in developing nations, largely due to the widespread reliance on motorcycles as a primary mode of transportation.[5,24]

Bali stands as a premier tourist destination in Indonesia, renowned for its allure and vibrant culture. Motorcycle transportation reigns supreme on this island, facilitated by numerous rental options, often accessible to tourists without international driving licenses. However, this convenience is contrasted with the harsh reality of frequent road traffic accidents, often resulting in visits to the emergency department. Regrettably, no prior investigations have endeavored to quantify the true prevalence of mandibular fractures in this context. Thus, the present study aims to address this gap by elucidating the prevalence, sociodemographic characteristics, and patterns of mandibular fractures in Bali. This research is conducted at Prof. Dr. I.G.N.G. Ngoerah Hospital, serving as the primary referral center for Bali and extending its services to neighboring islands like NTT and NTB. Its pivotal role in accommodating cases referred from peripheral hospitals due to limited availability of plastic surgeons underscores its significance in this study.

METHOD

This retrospective study was conducted at Prof. dr. I.G.N.G. Ngoerah General Hospital, encompassing patients admitted with mandible fractures from January 2018 to December 2023. Patients with incomplete medical records were excluded, resulting in a cohort of 289 eligible cases. Variables examined included age, gender, alcohol influence, helmet usage, anatomical site of injury (classified into distinct regions), unilateral or bilateral involvement, associated injuries, and treatment modalities. Statistical analysis was performed using SPSS version 26, with results presented in tabular and graphical formats.

RESULTS

A total of 289 patients with mandible fractures were identified, with cases distributed across the years as follows: 22 in 2018, 33 in 2019, 34 in 2020, 60 in 2021, 72 in 2022, and 68 in 2023 (Fig. 1). Among them, 210 were male (72.7%) and

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79 were female (27.3%). The highest incidence of fractures occurred in the 21-30 age group (40.1%), with the majority of cases (78.1%) falling within the 11-40 age range. Mechanisms of injury varied, with 186 cases (64.4%) attributed to road traffic accidents (RTAs), 61 (21.1%) to falls, 34 (11.8%) to altercations/assaults, and 8 (2.7%) to impacts with objects. Alcohol influence was noted in 127 cases (43.9%), while helmet use was reported in only 87 cases (30.1%).

Table 1. Demographic characteristics of patients with mandible fractures at Prof. dr. I.G.N.G. Ngoerah General Hospital from January 2018 to December 2023

Sosiodemographic		Frequency	Percentage
Gender	Male	210	72.7%
	Female	79	27.3%
Age (years old)	0-10	3	1.0%
	11-20	77	26.6%
	21-30	116	40.1%
	31-40	33	11.4%
	41-50	29	10.0%
	51-60	18	6.2%
	>60	13	4.5%
Mechanism of injury	Road traffic accidents (RTAs)	186	64.4%
	Altercation/ assault		
	Fall from height	34	11.8%
	Hit against object	61	21.1%
		8	2.7%
Alcohol influence	Yes	127	43.9%
	No	162	56.1%
Helmet use	Yes	87	30.1%
	No	202	69.9%
Role of patient	Motorcycle driver	154	53.3%
	Motorcycle passenger	108	37.4%
	Car driver	6	2.1%
	Car passenger	3	1.0%
	Pedestrian	18	6.2%
Anatomical sites of injury	Symphysis	45	15.6%
	Parasymphysis	110	38.1%
	Corpus	71	24.6%
	Angle	45	15.6%
	Ramus	12	4.2%
	Subcondyle	39	13.5%
	Condyle	73	25.3%
	Coronoid	30	10.4%
	Dentoalveolar	57	19.7%
Fracture involvement	Unilateral	178	61.6%
	Bilateral	111	38.4%
Associated injuries	Head	109	37.7%
	Thorax	46	15.9%
	Abdomen	38	13.1%
	Vertebral	11	3.8%
	Extremities	52	20.1%
Treatment	MMF + ORIF	193	66.8%
	ORIF	65	22.5%
	MMF	31	10.7%

The distribution of fracture location according to the etiology can be seen in Table 2. An association between the anatomical sites with etiology of mandible fracture was observed (p

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<0.001), except in the ramus region (p >0.05). The distribution of age group according to the etiology of mandible fracture can be seen in Table 3. No association was found between age group and the etiology of mandible fracture (p >0.05). In Table 4, the association between alcohol influence and etiology of mandible fracture was observed (p <0.001).

Table 2. Distribution of anatomical sites of injury according to the etiology of mandible fracture

Anatomical sites	RTA	Altercation/ assault	Fall from height	Hit against object	p-value
Symphysis	42 (22.6%)	3 (8.8%)	0 (0.0%)	0 (0.0%)	<0.001
Parasymphysis	96 (51.6%)	14 (41.2%)	0 (0.0%)	0 (0.0%)	<0.001
Corpus	34 (18.3%)	6 (17.6%)	27 (44.3%)	4 (50.0%)	<0.001
Angle	13 (7.0%)	32 (94.1%)	0 (0.0%)	0 (0.0%)	<0.001
Ramus	6 (3.2%)	1 (2.9%)	4 (6.6%)	1 (12.5%)	0.423
Subcondyle	37 (19.9%)	0 (0.0%)	2 (3.3%)	0 (0.0%)	<0.001
Condyle	73 (39.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	<0.001
Coronoid	11 (5.9%)	0 (0.0%)	16 (26.2%)	0 (0.0%)	<0.001
Dentoalveolar	35 (18.8%)	0 (0.0%)	22 (36.1%)	0 (0.0%)	<0.001

*Kruskal-Wallis

Table 3. Association between age group and etiology of mandible fracture

Age (years old)	RTA	Altercation/ assault	Fall from height	Hit against object	p-value
0-10	1 (0.5%)	0 (0.0%)	2 (3.3%)	0 (0.0%)	0.641
11-20	46 (24.7%)	12 (35.3%)	16 (26.2%)	3 (37.5%)	
21-30	80 (43.0%)	14 (41.2%)	19 (31.1%)	3 (37.5%)	
31-40	18 (9.7%)	3 (8.8%)	12 (19.7%)	0 (0.0%)	
41-50	22 (11.8%)	2 (5.9%)	5 (8.2%)	0 (0.0%)	
51-60	11 (5.9%)	2 (5.9%)	4 (6.6%)	1 (12.5%)	
>60	8 (4.3%)	1 (2.9%)	3 (4.9%)	1 (12.5%)	

*Kruskal-Wallis

Table 4. Association between alcohol influence and etiology of mandible fracture

Alcohol Influence	RTA	Altercation/ assault	Fall from height	Hit against object	p-value
Yes	103 (55.4%)	9 (26.5%)	14 (23.0%)	2 (25.0%)	<0.001
No	83 (44.6%)	25 (73.5%)	47 (77.0%)	6 (75.0%)	

*Kruskal-Wallis

Among the patients, 154 (53.3%) were motorcycle drivers, 108 (37.4%) were passengers, 18 (6.2%) were pedestrians, 6 (2.1%) were car drivers, and 3 (1.0%) were car passengers. The most frequently affected anatomical sites, in descending order, were the parasymphysis (38.1%), condyle (25.3%), corpus (24.6%), dentoalveolar (19.7%), angle (15.6%), symphysis (15.6%), subcondyle (13.5%), coronoid (10.4%), and ramus (4.2%). Bilateral involvement was observed in 111 cases (38.4%), while the remainder were unilateral. Associated injuries included head injuries in 109 cases (37.7%), extremity injuries in 52 (20.1%), thoracic injuries in 46 (15.9%), abdominal injuries in 38 (13.1%), and vertebral injuries in 11 (3.8%). The predominant treatment approach involved maxillomandibular fixation (MMF) combined with open reduction and internal fixation (ORIF) using miniplates and screws (66.8%) (Table 1).

DISCUSSION

Mandible fractures remain among the most prevalent maxillofacial injuries today. Globally, they constitute approximately 36% to 59% of all

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maxillofacial fractures.[7,8,9] A previous study by Wiradana and Wiargitha at Prof. dr. I.G.N.G. Ngoerah General Hospital found that mandible fractures accounted for 60.12% of all maxillofacial injuries recorded from January 2012 to November 2018. However, the incidence and characteristics of mandible fractures often vary from country to country, influenced by geographical, cultural, and socioeconomic factors.[10,11]

In the present study conducted at Prof. dr. I.G.N.G. Ngoerah General Hospital in Bali, a total of 289 mandible fracture cases were documented from January 2018 to November 2023. We observed a consistent increase in the number of mandible fracture cases each year, with the peak occurring in 2022, totaling 72 cases. The majority of cases occurred in individuals aged 21-30 years (40.1%), with a male-to-female ratio of 2.66:1. This age distribution aligns with previous reports, reflecting the heightened activity levels and potential for careless behavior during the second and third decades of life. Moreover, the higher incidence among males can be attributed to their increased participation in risky activities compared to females, who often spend more time in safer environments, such as at home.[6,12]

Fracture location has been noted to correlate with the mechanism of trauma. Road traffic accidents (RTAs) often result in fractures in the condylar, symphysis, and parasymphysis regions, while interpersonal violence is commonly associated with fractures in the angle region.[13,14,17] In this study, we found that 64.4% of cases were attributed to RTAs, 21.1% to falls from height, 11.8% to altercations/assaults, and 2.7% to impacts against objects. Among the anatomical sites of injury, the parasymphysis (38.1%) was the most commonly affected location, followed by the condyle (25.3%) and corpus (24.3%). Additionally, the coronoid (10.4%) and ramus (4.2%) regions were least commonly affected. Fractures in the symphysis, parasymphysis, corpus, dentoalveolar, condyle, and subcondyle regions were significantly associated with RTAs ($p < 0.001$). Conversely, fractures in the coronoid region were associated with falls ($p < 0.001$), while fractures in the angle region were linked to altercations/assaults ($p < 0.001$). Our findings regarding the association of fracture location with the mechanism of trauma are consistent with previous studies.

The study conducted by Subyakto et al. at Dr. Hasan Sadikin General Hospital in Bandung similarly found that the parasymphysis region was the most common site of mandible fractures (25.26%), while the ramus (2.16%) and coronoid (0.8%) regions were least affected. In their research, the majority of cases were attributed to road traffic accidents (RTAs) (82.95%), followed by assault (3.76%). This pattern reflects a common trend in many developing countries, where mandible fractures are predominantly caused by RTAs. Conversely, in developed countries, interpersonal violence, such as assault, often accounts for a larger proportion of cases. In Indonesia, RTAs remain a significant concern, with approximately 28,000 fatalities attributed to accidents on roads and streets in 2014. The estimated fatality rate from traffic accidents was 12 per 100,000 population, which is notably higher than neighboring countries such as Singapore (4.8 per 100,000) and Australia (5.2 per 100,000).[18]

This study also reveals a significant association between alcohol consumption and road traffic accidents (RTAs) ($p < 0.001$). Among the 186 RTAs recorded, approximately 55.4% involved individuals under the influence of alcohol. Elevated alcohol levels can markedly impair one's cognitive function, thereby heightening the risk of RTAs. Furthermore, our findings indicate that 43% of RTAs occurred within the 21 to 30 years age group. Additionally, we observed that 69.9% of patients did not utilize helmets. This trend can be attributed to both the high-risk behaviors prevalent in this age demographic and the easy accessibility of motorcycles in Bali, where rentals are readily available even without a license. Conversely, in very young (0-10 years old) or elderly (>60 years old) individuals, mandible fractures often result from low-risk activities[19]. However, this study did not identify any association between age groups and the etiology of mandible fractures.

We discovered that the majority of mandible fractures, approximately 88.6% (256 out of 289 cases), were accompanied by other injuries. Among these associated injuries, head injuries were the most prevalent (37.7%), followed by extremity injuries (20.1%), thoracic injuries (15.9%), abdominal injuries (13.1%), and vertebral injuries (3.8%). This association between head injuries and maxillofacial trauma has been documented by previous studies. For instance, a prospective study by Joshi et al. found that 67% of maxillofacial trauma cases were concomitant with head injuries, with head concussion being the most common type. Furthermore, Sobin et al. reported that 75% of concussions were linked to isolated mandible fractures.[20] Consequently, the

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authors suggest implementing screening protocols for concussion in cases of mandible fractures.[21]

The management of mandible fractures necessitates effective fracture reduction and stabilization, which can be accomplished through either closed or open techniques. Recent research suggests that the open technique may notably enhance patients' quality of life. In our current study, 66.8% of cases were treated with a combination of maxillomandibular fixation (MMF) and open reduction internal fixation (ORIF), 22.5% underwent ORIF alone, and 10.7% received MMF alone.[22,23]

CONCLUSION

Our study highlights the growing concern surrounding maxillofacial injuries, particularly mandibular fractures, necessitating targeted interventions. The majority of cases observed were attributed to road traffic accidents, predominantly affecting males in their productive years. Alarmingly, over half of the patients involved were not wearing helmets, and nearly half were under the influence of alcohol. Based on these findings, it is imperative for government authorities to implement regulatory measures aimed at prevention strategies particularly in Bali as a popular tourist destination. This includes reinforcing laws mandating the compulsory use of helmets and addressing drinking and driving behaviors.

Correspondence regarding this article should be addressed to:
Bertha Kawilarang. Department of Plastic Reconstructive and Aesthetic Surgery, Prof. dr. I.G.N.G. Ngoerah General Hospital. Jl. Diponegoro, Dauh Puri Klod, Kec. Denpasar Bar., Kota Denpasar, Bali 80113, Indonesia.
E-Mail: berthakawilarang12@gmail.com

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