Dental Traumatology 2013; **29**: 291–296; doi: 10.1111/j.1600-9657.2012.01173.x

Dental trauma in patients with single mandibular fractures

Hai-Hua Zhou[1,2], David Ongodia[1,2], Qi Liu[1,2], Rong-Tao Yang[1,2], Zu-Bing Li[1,2]

[1]The State Key Laboratory Breeding Base of Basic Science of Stomatology (Hubei-MOST) & Key Laboratory of Oral Biomedicine Ministry of Education, School & Hospital of Stomatology, Wuhan University, Wuhan, Hubei, China; [2]Department of Oral and Maxillofacial Surgery, College and Hospital of Stomatology, Wuhan University, Wuhan, Hubei, China

Abstract – *Purpose*: The purposes of this study were to investigate the occurrence and patterns of dental trauma in patients with single mandibular fracture and to evaluate the relationships between dental injury and fracture site of mandible. *Materials and Methods*: From January 2000 to December 2009, 869 patients with mandibular fractures were registered. Only the patients with single mandibular fracture were included. The information and data collected included age, gender, mechanism of injury, type of mandibular fracture, and type of dental injury. *Results*: Single mandibular fractures were sustained in 294 (33.8%) patients. Of these, 43.5% (128 patients) presented with associated dental injuries (509 injured teeth). The patients' male/female ratio was 2.46:1 (91 males and 37 females). Patients in 30–39 year age group possessed the highest risk of suffering dental trauma (odds ratio = 2.004, $P = 0.014$). Road traffic accidents were the most common mechanism of injury (54, 42.2%). Lower-anterior teeth were more often injured in patients with symphysis fracture ($P < 0.001$), and patients with condylar fracture more frequently sustained upper-posterior teeth injury ($P < 0.001$). Lower-posterior teeth injury was mostly found in patients with mandibular body fracture ($P < 0.001$) or angle fracture ($P < 0.001$). Dental injuries were more prone to occur in patients who sustained only symphysis fractures (odds ratio = 3.283, $P < 0.001$), and the risk was only 0.193-fold in patients who sustained only mandible angle fractures (odds ratio = 0.193, $P < 0.001$). *Conclusions*: The occurrence and type of dental injury were significantly related to the fracture site of mandible.

Key words: dental trauma; mandibular fracture; prevalence

Correspondence to: Zu-Bing Li, Department of Oral and Maxillofacial Surgery, College and Hospital of Stomatology, Wuhan University, 237 Luoyu Road, Wuhan 430079, China
Tel.: +86 27 87686215
Fax: +86 27 87873260
e-mail: lizubing0827@163.com

Accepted 3 July, 2012

As the only mobile bone of the facial skeleton, the mandible is vulnerable to fractures. Numerous studies have shown that mandibular fractures are the commonest of all maxillofacial fractures ranging from 23.8% to 81.3% (1–3). Dental injuries are the most common injuries occurring in the facial region (4), especially the patients with a fracture of the mandible (1, 5, 6).

The primary goal when treating mandibular fractures is to establish the pre-injury occlusion (7); however, multiple dental injuries in patients with mandibular fractures distract the normal occlusion (8). Maxillomandibular fixation by means of arch bars is widely used in clinical treatment; under these circumstances, careful evaluation of the dentition and mandibular fractures may be required to attain the appropriate occlusal relationship (7). Several articles focus on the relationship between dental injury and facial trauma (1, 2, 4, 9, 10); however, only few articles have described the type and frequency of dental injuries in association with mandibular fractures (5, 8).

Single mandibular fracture can be regarded as an excellent model to evaluate the relationship between dental injury and fracture of mandible. The main aims of this study were to investigate the occurrence and patterns of dental trauma in patients with single mandibular fracture and to evaluate the relationships between dental injury and fracture site of mandible.

Materials and methods

The protocol, survey, and consent forms were approved by the Institutional Review Board of Wuhan University. From January 2000 to December 2009, 869 patients with mandibular fractures were registered in the Department of Oral and Maxillofacial Surgery, Stomatology College and Hospital, Wuhan University. In this study, only the patients with single mandibular fracture were included. The inclusion criterion captured 294 (33.8%) patients. The information and data collected included age, gender, mechanism of injury, type of mandibular fracture, and type of dental injury.

The mechanism of injury was classified as assaults, road traffic accidents (motor vehicle accidents, motorcycle accidents, and bicycle accidents), fall at ground level or from a height, sports- or work-related accidents, and others.

Mandibular fracture was classified as symphysis, condylar, body, angle, ramus, coronoid, or alveolar fracture.

Type of dental injuries was based on the description by Thorén et al.(4) and further improved as follows: crown fracture, root fracture, crown-root fracture, concussion (marked reaction to percussion but without mobility), subluxation (mobile but without displacement), extrusive luxation (partial displacement of tooth out of its socket), intrusive luxation (displacement of tooth into its socket), lateral luxation (displacement of tooth to lingual side or buccal side), and avulsion (complete displacement of tooth from the socket).

The severity of dental injuries was divided into two categories based on the description of Ignatius et al. (5): (i) mild injury including crown fracture, concussion, subluxation, extrusive luxation, and lateral luxation; (ii) serious injuries consisting of crown-root fractures, root fracture, avulsion, and intrusive luxation.

Type of dental injury was classified as dental hard tissue (including crown fracture, crown-root fractures, and root fracture) or periodontal tissue injury (concussion, subluxation, extrusive luxation, intrusive luxation, lateral luxation, and avulsion).

Site of dental injury was classified as mandibular or maxillary and further classified as incisor, canine, premolar, or molar. The dentition was also divided into four groups (upper-anterior teeth, lower-anterior teeth, upper-posterior teeth, and lower-posterior teeth). The anterior teeth included incisors and canine, and the posterior teeth included premolars and molars.

To assess relationships between the predictor variables and outcome variables, statistical analysis was performed with SPSS software (version 16.0; SPSS, Chicago, IL, USA). The continuous variables were reported as the mean ± SD and were assessed by *t*-test (two groups) or one-way ANOVA (three or more groups). The chi-squared test was used when categoric variables were compared. The Fisher's exact test was carried out when the observation in any cell of the 2 × 2 table was expected to be <5. Odds ratio and 95% confidence interval were used to assess the risk of sustaining the dental injuries. Logistic regression analysis was used to control for confounding variables as necessary. Probabilities of $P < 0.05$ were considered significantly different.

Results

In the 10 years records retrieved during this study, 1131 patients were found to have sustained maxillofacial fractures. Of them, 869 patients sustained a total of 1493 mandibular fractures. Of these, 294 (33.8%) patients sustained single mandibular fracture, 219 were male and 75 were female with a male/female ratio of 2.92:1. Of these, 43.5% (128 patients) presented with associated dental injuries (509 injured teeth, averaged 3.98 teeth for each patient) with a male/female ratio of 2.46:1 (91 male and 37 female). The age range of the patients with dental injuries was 3–72 years (average, 32.38 ± 14.49 years). The age group with the most dental trauma was 30–39 years (37 patients, 28.9%); patients in 30–39 years age group also possessed the highest risk of suffering dental trauma (odds ratio = 2.004, $P = 0.014$) (data not listed in Tables). In the majority of patients, road traffic accidents were the most common mechanism of injury (54, 42.2%), followed by falls (41, 32.0%) (Table 1).

The risk of sustaining dental injuries according to age, gender, and etiology is summarized in Table 1. Older patients were at greater risk of dental trauma when compared with younger patients ($P = 0.005$). No significant relationship was found between gender, etiology, and dental trauma.

The average age of patients with different mandibular fracture sites is summarized in Table 2. The patients with symphysis fracture associated with dental trauma were far older than patients without dental trauma (33.88 ± 13.61 vs 21.18 ± 12.50, $P = 0.001$). Among the four groups of patients who sustained different fracture site of mandible without dental trauma, the average

Table 1. Logistic regression analysis: risk of dental injuries in patients by age, gender, and etiology

	Dental injuries					
	Present (n = 128)	Absent (n = 166)	Significance (crude)	Odds ratio (adjusted)	95% confidence interval	Significance (adjusted)
Sex						
Male	91	128	0.241	0.728	0.416–1.273	0.266
Female	37	38				
Age	32.38 ± 14.49	28.80 ± 15.98	0.049	0.976	0.960–0.993	0.005
Etiology						
Assault	17	34	0.106	0.468	0.103–2.133	0.327
Bicycle	14	13	0.361	1.227	0.244–6.161	0.804
MVA	25	36	0.651	0.671	0.150–3.005	0.602
Motorcycle	15	19	0.942	0.902	0.189–4.303	0.897
Fall ground	23	28	0.805	0.817	0.179–3.726	0.795
Fall high	18	8	0.006	2.609	0.504–13.50	0.253
Sport	4	3	0.462	1.612	0.204–12.72	0.650
Other	8	21	0.068	0.329	0.065–1.679	0.181
Total	128	166				

MVA, motor vehicle accident.
The variable of 'work' was excluded as 'redundancy' by logistic regression analysis procedure.

Table 2. Average age related to different fracture site in patients with or without dental injuries

Fracture site	Patients with DI	Patients without DI	*P* value
Symphysis	33.88 ± 13.61	21.18 ± 12.50	0.001
Condyle	32.49 ± 16.23	26.84 ± 16.93	0.062
Body	31.39 ± 12.58	34.84 ± 16.56	0.401
Angle	31.17 ± 13.80	32.38 ± 12.52	0.830
P value	0.911[1]	0.005[2]	

DI, dental injuries.
[1] $F = 0.178$.
[2] $F = 4.493$.

Table 4. Etiologies vs the mild or serious dental injuries

	Mild DI (%)	Serious DI (%)	Total (%)	*P* value
Assault	22 (14.6)	39 (10.7)	61 (11.9)	0.222
Bicycle	8 (5.3)	28 (7.7)	36 (7.0)	0.328
MVA	46 (30.5)	55 (15.2)	101 (19.6)	<0.001
Motorcycle	8 (5.3)	74 (20.4)	82 (16.0)	<0.001
Fall ground	29 (19.2)	72 (19.8)	101 (19.6)	0.870
Fall high	18 (11.9)	60 (16.5)	78 (15.2)	0.185
Sports	4 (2.6)	15 (4.1)	19 (3.7)	0.417
Work	6 (4.0)	5 (1.4)	11 (2.1)	0.090
Other	10 (6.6)	15 (4.1)	25 (4.9)	0.232
Total	151 (100.0)	363 (100.0)	514 (100.0)	

age of patients with symphysis fracture was also the youngest ($F = 4.493$, $P = 0.005$).

The relationships between etiologies and type of dental trauma are shown in Tables 3 and 4. Assault-related injuries and motor vehicle accidents tended to result in periodontal injuries ($P = 0.001$ and $P = 0.002$ respectively), while falls (fall at ground level or fall from a height) and motorcycle accidents were more prone to lead to hard dental tissue injuries ($P = 0.020$, $P = 0.006$, and $P = 0.015$, respectively) (Table 3).

Motor vehicle accidents more frequently resulted in mild dental injury (30.5% in mild vs 15.2% in serious, $P < 0.001$), while motorcycle accidents more frequently resulted in serious dental trauma (20.4% in serious vs 5.3% in mild, $P < 0.001$) (Table 4).

The risks of sustaining dental injuries in association with different fracture site of mandibular are summarized in Table 5. Dental injuries were more prone to occur in patients who sustained only symphysis fractures (odds ratio, 3.283; 95% confidence interval, 1.832–5.882; $P < 0.001$) and the risk was only 0.193-fold in patients who sustained mandibular angle fractures (odds ratio, 0.193; 95% confidence interval, 0.078–0.476; $P < 0.001$).

Correlations between different fracture site of mandible and location of dental injury are shown in Table 6. Significant relationships were found between them. Lower-anterior teeth were more often injured in patients with symphysis fracture ($P < 0.001$), patients with condylar fracture most frequently sustained upper-posterior teeth injury ($P < 0.001$). Lower-posterior teeth injury was mostly found in patients with mandibular body fracture ($P < 0.001$) or angle fracture ($P < 0.001$).

Table 3. Etiologies vs type of dental trauma

	Periodontal injuries (%)	Hard dental tissue injuries (%)	Total (%)	*P* value
Assault	56 (14.5)	5 (3.9)	61 (11.9)	0.001
Bicycle	28 (7.2)	8 (6.3)	36 (7.0)	0.720
MVA	88 (22.7)	13 (10.2)	101 (19.6)	0.002
Motorcycle	53 (13.7)	29 (22.8)	82 (16.0)	0.015
Fall ground	67 (17.3)	34 (26.8)	101 (19.6)	0.020
Fall high	49 (12.7)	29 (22.8)	78 (15.2)	0.006
Sports	11 (2.8)	8 (6.3)	19 (3.7)	0.100
Work	11 (2.8)	0 (0.0)	11 (2.1)	0.074
Other	24 (6.2)	1 (0.8)	25 (4.9)	0.014
Total	387 (100.0)	127 (100.0)	514 (100.0)	

Table 7 shows the distribution of dental hard tissue or periodontal tissue injuries in patients with different fracture site of mandible. The chi-squared test revealed that patients with symphysis fracture were more often associated with periodontal tissue injury (44.1%, $P = 0.004$), whereas condylar fracture patients were more prone to sustain hard dental tissue injury (57.6%, $P < 0.001$).

When comparing the type of tooth injury and the location, we found that most teeth injuries (278 of 509, 54.6%) were diagnosed in the mandible (data not listed in Tables). More crown fractures ($P < 0.001$) and intrusive luxations ($P = 0.013$) were observed in the maxilla, whereas more periodontal tissue injuries (concussion [$P = 0.044$], subluxation [$P = 0.002$], and lateral luxations [$P = 0.005$]) occurred in mandible (Table 8).

The average number of injured teeth in patients with different fracture site of mandible was also analyzed and compared; no significant difference was found (symphysis, 4.98 ± 3.85; body, 3.74 ± 2.72; angle, 2.50 ± 1.87; condyle, 3.85 ± 3.07, $P = 0.175$).

The detailed information of patients with ramus ($n = 1$), coronoid ($n = 1$), or alveolar fractures ($n = 5$) was not listed in tables, owing to the small sample and few dental injuries.

Discussion

It is difficult to make it clear on the evaluation of relationship between dental trauma and multi-mandiblular fractures, because of various confounding factors such as age (bone development in different periods), gender, overall health, environmental exposures, and external force on the site of mandible. For example, authors found that the presence of mandibular third molars increases the risk of angle fracture and simultaneously decreases the risk of condylar fracture (11, 12). Previous study had revealed that the dental injuries in patients with condylar fractures were highly different from the patients with fracture of mandibular body (5); even the dental trauma in patients with bilateral condylar fractures differs from patients with unilateral condylar fracture (8). In the present study, we evaluated and analyzed the pattern of dental trauma in patients with single mandibular fracture; the relationships between dental injury and fracture site of mandi-

Table 5. Odds ratio and 95% confidence intervals relating to the risk of dental injuries in association with maxillofacial fractures

	Patients with dental injuries					
Site of fracture	Present (%)	Absent (%)	Total (%)	Significance	Odds ratio	95% confidence interval
Symphysis	42 (33.9)	22 (13.5)	64 (22.3)	<0.001	3.283	1.832–5.882
Condyle	53 (42.7)	73 (44.8)	126 (43.9)	0.730	0.920	0.575–1.474
Angle	6 (4.8)	34 (20.9)	40 (13.9)	<0.001	0.193	0.078–0.476
Body	23 (18.5)	34 (20.9)	57 (19.9)	0.627	0.864	0.479–1.558
Total	124 (100.0)	163 (100.0)	287 (100.0)	–	–	–

Table 6. Relationships between dental injuries and site of mandibular fracture

	Lower anterior (%)	Upper anterior (%)	Lower posterior (%)	Upper posterior (%)	*P* value
Symphysis	97 (57.4)	62 (43.1)	25 (24.0)	21 (24.1)	<0.001
Condyle	36 (21.3)	70 (48.6)	32 (30.8)	60 (69.0)	<0.001
Body	34 (20.1)	11 (7.6)	35 (33.7)	6 (6.9)	<0.001
Angle	2 (1.2)	1 (0.7)	12 (11.5)	0 (0.0)	<0.001
Total	169 (100.0)	144 (100.0)	104 (100.0)	87 (100.0)	

Table 7. Mandibular fracture site vs types of dental injuries

	Hard dental tissue injuries (%)	Periodontal injuries (%)	Total (%)	*P* value
Symphysis	37 (29.6)	169 (44.1)	206 (40.6)	0.004
Condyle	72 (57.6)	129 (33.7)	201 (39.6)	<0.001
Body	15 (12.0)	71 (18.5)	86 (16.9)	0.091
Angle	1 (0.8)	14 (3.7)	15 (3.0)	0.132
Total	125 (100.0)	383 (100.0)	508 (100.0)	

Table 8. Type distribution of dental injury in upper jaw or lower jaw

	Maxilla (%)	Mandible (%)	Total (%)	*P* value
Crown fracture	69 (29.5)	34 (12.1)	103 (20.0)	<0.001
Crown-root fracture	3 (1.3)	4 (1.4)	7 (1.4)	1.000
Root fracture	5 (2.1)	12 (4.3)	17 (3.3)	0.175
Concussion	1 (0.4)	8 (2.9)	9 (1.8)	0.044
Subluxation	43 (18.4)	85 (30.4)	128 (24.9)	0.002
Avulsion	102 (43.6)	125 (44.6)	227 (44.2)	0.811
Intrusion	8 (3.4)	1 (0.4)	9 (1.8)	0.013
Extrusion	3 (1.3)	2 (0.7)	5 (1.0)	0.663
Lateral luxation	0 (0.0)	9 (3.2)	9 (1.8)	0.005
Totals	234 (100.0)	280 (100.0)	514 (100.0)	

ble were taken into account. We mainly found that the occurrence and type of dental injury were significantly related to the fracture site of mandible.

It is well known that childhood is the period of high susceptibility to dental trauma (4, 13). However, in this study, the 30–39 years age group sustained most dental trauma, in contrast to a study by Da Silva et al. (9), who demonstrated a higher incidence of trauma in patients ranging from 11 to 20 years. They attributed this phenomenon to the intense social activity of school age patients.

An interesting finding was that the average age of patients with dental trauma was higher than patients without. Alveolar bone or jaw of young victims is more elastic (5) or more resilient (14) than adults', which may result in partial absorption and reduction of the external force, thus leading to less dental trauma in young patients. It is also reasonable that the average age of patients with symphysis fracture who sustained dental trauma was older than patients without dental trauma. Additionally, we speculated that the teeth of older patients with fillings often suffered most dental injuries, because filled teeth are less resistant to external force (8).

Until now, the exact mechanisms leading to various dental injuries still remain unknown (1, 13). Our results revealed that assault-related injuries and motor vehicle accidents tended to lead to periodontal injuries, while falls and motorcycle accidents resulted more in hard dental tissue injuries. Our study is in agreement with the statement by Ignatius et al. (5), who also stated that the vast majority (81%) of dental trauma in association with mandibular fractures caused by violence were periodontal injuries. Silvennoinen et al. (8) also revealed that falls tended to injure the hard dental tissue, whereas traffic accidents resulted in periodontal injury. However, in contrast to our study, they found violence more frequently resulted in hard tissue injuries. Oikarinen (15) explained that a resilient surface or resilient object resulted in periodontal tissue injuries more often than did a hard surface or hard object, due to the fact that the low velocity and the resilient surface distribute the energy among several teeth and give them time to adapt to the force and transmit it to the supporting tissues. The fists in assault were of the resilient object, motor vehicle accidents usually hit the body or extremities first, and the teeth tended to be hit by an indirect force or a resilient surface like the airbag. Patients injured in mechanisms of falling at ground level or from a height or motorcycle accidents usually hit the hard ground, subsequently resulting in hard dental tissue injuries.

We found that motor vehicle accidents resulted in mild dental injury more frequently. Our results are consistent with Ignatius et al. (5), who stated that most (59%) of the patients who sustained dental injuries in traffic accidents were mild; however, our results do not agree with another study by Silvennoinen et al. (8), who found dental injuries caused by traffic accidents were more often severe as compared to other etiologies.

Dental injuries were associated most frequently with symphysis fracture of the mandible (odds ratio = 3.283, $P < 0.001$). It is in accordance with the findings by Lieger et al. (1). Interestingly, patients who sustained exclusively mandibular angle fracture had the lowest risk of dental trauma (odds ratio = 0.193, $P < 0.001$). This could be due to a small number of teeth at the mandible angle area; additionally, most of the wisdom teeth in this area had been extracted preventively (5).

A notable finding that statistical analysis revealed was that the teeth near the fracture area had the highest risk of being injured. Teeth in the lower-anterior segment were most involved in patients with symphysis fractures, teeth in the upper-posterior segment were highly injured in patients with condylar fractures, while patients with mandibular body or angle fractures most frequently sustained lower-posterior teeth injury. Ignatius et al. (5) also reported that patients with condylar fractures more often injured upper premolar and molar teeth. These findings remind us that physicians and surgeons should attach more importance to the dental state in the vicinity of a fracture.

Patients with condylar fracture were more prone to sustain hard dental tissue injury. Our findings are in agreement with the statements by Ignatius et al. (5) and Andreasen (14). Andreasen gave the explanation that condylar fractures were often caused by a so-called indirect mechanism, which means an impact on the chin causing forceful closure of the jaws. This produces typically crown and crown-root fractures in the upper premolar and molar region and especially the palatal cusp fractures.

We found that patients with mandibular body fracture were highly associated with serious dental injuries ($P = 0.001$, data not listed in Tables). The body is the strongest part of the lower jaw (16), the structural strength and stability of the mandibular body is enhanced with the existence of lateral and medial oblique lines. Under these circumstances, we speculated that the external force was great enough to fracture the mandible body and also damage the teeth.

When statistically comparing and analyzing the type and distribution of dental injury in the maxilla and mandible, a greater number of teeth in the maxilla were of crown fracture and intrusion, whereas in the mandible, the injuries were mainly concussion, subluxation, and lateral luxation. According to the classification and description of the severity of dental injuries by Ignatius et al. (5), it can be concluded that the dental injury in the maxilla was more severe than in the mandible. Several reasons are attributed to this phenomenon; owing to the large maxillary overjet (13) and protrusion in the sagittal plane (15), teeth in the upper jaw are more prone to be directly struck against an object (14). In contrast, teeth in the lower jaw are protected by the maxilla during occlusion (17), thus encountered a lesser force. Consequently, the mandibular teeth were less seriously injured.

We acknowledge some flaws existed in such a retrospective study. A small group of patients was included, because of only one institution being involved. We believe a prospective, multicenter, and large sample study should be conducted in future. Through the above efforts, the relationship between dental trauma and single mandibular fracture can be evaluated in more detail and more accurately.

In conclusion, we found that the type and location of dental injury were significantly different in patients with different fracture sites of the mandible. Additionally, dental injury distribution in the maxilla or mandible was also dependant on various etiologies. The dental trauma and pattern of mandibular fracture were also apparently affected by patients' age.

Reference

1. Lieger O, Zix J, Kruse A, Iizuka T. Dental injuries in association with facial fractures. J Oral Maxillofac Surg 2009;67:1680–4.
2. Gassner R, Tuli T, Hachl O, Rudisch A, Ulmer H. Craniomaxillofacial trauma: a 10 year review of 9,543 cases with 21,067 injuries. J Craniomaxillofac Surg 2003;31:51–61.
3. Erol B, Tanrikulu R, Gorgun B. Maxillofacial fractures. Analysis of demographic distribution and treatment in 2901 patients (25-year experience). J Craniomaxillofac Surg 2004;32:308–13.
4. Thoren H, Numminen L, Snall J, Kormi E, Lindqvist C, Iizuka T et al. Occurrence and types of dental injuries among patients with maxillofacial fractures. Int J Oral Maxillofac Surg 2010;39:774–8.
5. Ignatius ET, Oikarinen KS, Silvennoinen U. Frequency and type of dental traumas in mandibular body and condyle fractures. Endod Dent Traumatol 1992;8:235–40.
6. Emshoff R, Schoning H, Rothler G, Waldhart E. Trends in the incidence and cause of sport-related mandibular fractures: a retrospective analysis. J Oral Maxillofac Surg 1997;55:585–92.
7. Ellis E 3rd, Miles BA. Fractures of the mandible: a technical perspective. Plast Reconstr Surg 2007;120:76S–89.
8. Silvennoinen U, Lindqvist C, Oikarinen K. Dental injuries in association with mandibular condyle fractures. Endod Dent Traumatol 1993;9:254–9.
9. Da Silva AC, Passeri LA, Mazzonetto R, De Moraes M, Moreira RW. Incidence of dental trauma associated with facial trauma in Brazil: a 1-year evaluation. Dent Traumatol 2004;20:6–11.
10. Gassner R, Bosch R, Tuli T, Emshoff R. Prevalence of dental trauma in 6000 patients with facial injuries: implications for prevention. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1999;87:27–33.
11. Duan DH, Zhang Y. Does the presence of mandibular third molars increase the risk of angle fracture and simultaneously decrease the risk of condylar fracture? Int J Oral Maxillofac Surg 2008;37:25–8.
12. Iida S, Nomura K, Okura M, Kogo M. Influence of the incompletely erupted lower third molar on mandibular angle and condylar fractures. J Trauma 2004;57:613–7.
13. Bastone EB, Freer TJ, McNamara JR. Epidemiology of dental trauma: a review of the literature. Aust Dent J 2000;45:2–9.

14. Andreasen JO. Etiology and pathogenesis of traumatic dental injuries. A clinical study of 1,298 cases. Scand J Dent Res 1970;78:329–42.
15. Oikarinen K. Pathogenesis and mechanism of traumatic injuries to teeth. Endod Dent Traumatol 1987;3:220–3.
16. Miloro M, Ghali GE, Larsen PE, Waite PD. Peterson's principles of oral and maxillofacial surgery, 2nd edn. Hamilton, ON, London: BC Decker; 2004.
17. Gutmann JL, Gutmann MS. Cause, incidence, and prevention of trauma to teeth. Dent Clin North Am 1995;39:1–13.