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Differences in the etiology of mandibular fractures in Kuwait, Canada, and Finland

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Abstract – We studied causes of mandibular fractures treated in oral and maxillofacial units in three countries in years 1990–2000 in Kuwait ($n = 596$), 1995–2000 in Canada ($n = 228$), and 1990–99 in Finland ($n = 268$). Of the Finnish patients, 27% were women. Corresponding percentages in Kuwait and Canada were 13 and 17%, respectively. Traffic crashes were the cause of injury in 55% of the cases in Kuwait and 33% in Oulu, but only 7% in Toronto. In Kuwait, the victims were often young people, which is why more traffic education, more control of speed, and more control of the use of safety belts should be implemented. Assault was the cause in 54% in Toronto, 12% in Kuwait, and 37% in Oulu. Falling was the cause in 22% of the cases in Kuwait. Alcohol was implicated in 21% of cases in Canada and 15% in Finland.

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Traffic crashes and assault are the two main causes of mandibular fractures world wide. Road traffic crashes are the most common cause of these injuries in countries such as the Netherlands (1), Jordan (2), Singapore (3), Nigeria (4), USA (5–7), Saudi Arabia (8), Austria (9), New Zealand (10), Japan (11), and Canada (12). Assault is the most common cause of facial or mandibular fractures in Finland (13), Germany (14), Kenya (15,16), Scotland (17), Pakistan (18), and Sweden (19–21). Orbital fractures in the USA are also a result of assault and violence, especially in women (22).

Some reports have shown that the proportion of assault as a cause of maxillofacial trauma has increased since the 1960s, while the proportion resulting from traffic crashes has decreased (1, 23, 24). In 1992–97, facial injuries in Kuwait were caused mostly by crashes. Half of the fractures were of the mandible, one-third were in the mid-face, and 15% were combined mandibular and midfacial fractures (24). As most previous studies of facial trauma have been national surveys, we now report on the differences in the causes of injuries in three countries from three different continents.

Patients and methods

Prospective data was collected from several hospitals in Kuwait, Toronto Central Hospital in Canada, and Oulu University Hospital in Finland. Data was from 1990–2000 in Kuwait, 1995–2000 in Canada, and 1990–99 in Finland.

The data was from patients' records and radiographs in Canada and Finland, where panoramic radiographs was available in each case. In Kuwait, the data was collected prospectively. The patients' files do not include radiographs in Kuwait as they are owned by the patients themselves. The diagnosis in Kuwait was based on clinical judgement and skull radiographs, but not always on panoramic radiographs.

Altogether, 596 patients were recorded in Kuwait, 228 in Canada, and 268 in Finland. Causes were grouped into five categories: road traffic crashes, falls, violence, sports, and other causes. Falls included falls both on the ground and from a height. We recorded the age and sex of the patients and the cause, day, and month of the injury.

The material in Kuwait is derived from a large study on facial trauma published recently (24). Some

Table 1. Numberof patients with mandibular fractures in various years in Kuwait, Finland, and Canada

Year	Kuwait	Finland	Canada
1990	14	–	–
1991	14	31	–
1992	50	34	–
1993	45	25	–
1994	50	36	–
1995	60	29	22
1996	69	28	23
1997	97	27	52
1998	72	31	61
1999	68	27	38
2000	57	–	32
Total	596	268	228

data from Canada was also based on previously published material (25). There have been several previous reports published on mandibular fractures form Finland (13, 26–30). Statistical analysis was done using the statistical package for the Social Sciences. Proportions were compared using the Chi-square test.

Results

Patients with mandibular fractures were more often male in Kuwait (male:female ratio 6.5 : 1) and in Toronto (5.0 : 1) than in Oulu (2.7 : 1). The mean age (SD) of the patients was 26 years (SD 14) in Kuwait, 32 years in Toronto (SD 14) and 31 years (SD 12) in Oulu. The highest number of cases in Kuwait was during the years 1997 and 1998. In Canada, the peak was in 1998, while in Finland, it was in 1994 (Table 1).

Alcohol was associated with 21% of mandibular fractures in Canada and 15% in Finland. No alcohol-associated injuries were recorded in Kuwait. Traffic was more often the cause of mandibular fractures in Kuwait (55%) than in Oulu (33%) or Toronto (7%; $P < 0.001$). Violence as a cause for mandibular fractures was more common in Toronto (54%) than in Oulu (37%) or in Kuwait (12%; $P < 0.001$). Sport as the cause varied between the three countries, being most common in Oulu ($P < 0.001$). Falling was more common in Kuwait and in Oulu than in Toronto. The difference, however, was not statistically significant (Table 2).

Table 2. Variationin etiology of mandibular fractures in Kuwait, Finland, and Canada in the 1990s

Etiology	Kuwait	Finland	Canada	*P*-value
Traffic crash	330 (55.4)	88 (32.8)	15 (6.6)	<0.001
Falls	130 (21.8)	42 (15.7)	50 (21.9)	0.21
Violence	69 (11.6)	99 (36.9)	123 (53.9)	<0.001
Sports	23 (3.9)	15 (5.6)	27 (11.8)	<0.001
Others	44 (7.4)	24 (9.0)	13 (5.7)	0.96
Total	596	268	228	–

P-value is of the difference between Kuwait and the rest.

Analysis of the causes between the sexes showed some statistical differences. Falls as the cause of mandibular fractures were more common among women in Kuwait ($P < 0.001$) and in Toronto ($P < 0.001$). Traffic was more commonly the cause in female patients in Oulu ($P < 0.03$) and violence in male patients in Toronto ($P < 0.001$; Table 3). Those injured in road crashes in Kuwait were often aged less than 20 years (64% of all injuries in this age group were caused by traffic) compared with Oulu (52%) or Toronto (4%; $P < 0.001$; Table 4).

Mandibular fractures resulting from violence were most common in the age group of 20–30 years in Kuwait and Canada and in the age group of 31–40 years in Finland. The incidence in Kuwait was

Table 4. Variationin the proportion of road traffic accident as a cause of mandibular fractures in the 1990s over various age groups in Kuwait, Finland, and Canada

Etiology	Kuwait	Finland	Canada	*P*-value
<20	147/229 (64.2)	30/58 (51.7)	2/50 (4.0)	<0.001
20–30	83/170 (48.8)	22/72 (30.6)	6/74 (8.1)	<0.001
31–40	50/102 (49.0)	11/66 (16.7)	3/49 (6.1)	<0.001
≥41	31/67 (46.3)	25/72 (34.7)	4/58 (6.9)	<0.001
Total	31/568	88/268	15/231	–

Data are number (%).
P-value is of the difference between Canada and the rest.

Table 3. Variationin etiologies between men and women in Kuwait, Finland, and Canada during 1990–2000

	Kuwait ($n = 596$)			Finland ($n = 268$)			Canada ($n = 228$)		
Cause	Male *n* (%)	Female *n* (%)	*P*-value	Male *n* (%)	Female *n* (%)	*P*-value	Male *n* (%)	Female *n* (%)	*P*-value
Traffic crash	288 (55.8)	42 (52.5)	0.66	56 (28.7)	32 (43.8)	0.03	11 (5.8)	4 (10.5)	0.47
Falls	101 (19.6)	29 (36.3)	<0.001	29 (14.9)	13 (17.8)	0.69	28 (14.7)	22 (57.9)	<0.001
Violence	64 (2.4)	5 (6.3)	0.16	78 (40.0)	21 (28.8)	0.12	116 (61.1)	7 (18.4)	<0.001
Sport	23 (4.5)	–	–	13 (6.7)	2 (2.7)	0.34	26 (13.7)	1 (2.6)	0.10
Others	40 (7.8)	4 (5.0)	0.52	19 (9.7)	5 (6.8)	0.62	9 (4.7)	4 (10.5)	0.31
Total	516	80	–	195	73	–	190	38	–

Data are number (%).

Table 5. Variation in the proportion of violence as a cause of mandibular fractures over various age groups in Kuwait, Finland, and Canada

Etiology	Kuwait	Finland	Canada	*P*-value
<20	21/229 (9.2)	13/58 (22.4)	25/50 (50.0)	<0.001
20–30	27/170 (15.9)	30/72 (41.7)	50/74 (67.6)	<0.001
31–40	11/102 (10.8)	35/66 (53.0)	24/49 (49.0)	<0.001
≥41	7/67 (10.4)	21/72 (29.2)	24/58 (41.4)	<0.001
Total	66/568	99/268	143/231	–

P-value is of the difference between Kuwait and the rest.

Table 6. Variationin mandibular fractures over days of the week in Kuwait, Finland, and Canada during the 1990s

Days	Kuwait	Finland	Canada	*P*-value
Saturday	102 (17.1)	74 (27.6)	37 (17.0)	<0.001
Sunday	102 (17.1)	42 (15.7)	27 (12.4)	0.95
Monday	75 (12.6)	36 (13.4)	30 (13.8)	0.90
Tuesday	86 (14.4)	22 (8.2)	25 (11.5)	0.03
Wednesday	61 (10.2)	25 (9.3)	32 (14.7)	0.40
Thursday	91 (15.3)	25 (9.3)	33 (15.1)	0.02
Friday	79 (13.3)	44 (16.4)	34 (15.6)	0.36
Total	596	268	218	–

Data are number (%).
P-value is of the difference between Finland and the rest.

Table 7. Variationin mandibular fractures by months of occurrence in Kuwait, Finland, and Canada in the 1990s

Months	Kuwait	Finland	Canada
January	46 (7.7)	16 (6.0)	16 (7.3)
February	41 (6.9)	13 (4.9)	10 (4.6)
March	51 (8.6)	13 (4.9)	12 (5.5)
April	47 (7.9)	19 (7.1)	20 (9.2)
May	52 (8.7)	10 (3.7)	14 (6.4)
June	60 (10.1)	41 (15.3)	23 (10.6)
July	49 (8.2)	24 (9.0)	16 (7.3)
August	50 (8.4)	46 (17.2)	27 (12.4)
September	56 (9.4)	26 (9.7)	20 (9.2)
October	45 (7.6)	23 (8.6)	23 (10.6)
November	45 (7.6)	20 (7.5)	16 (7.3)
December	54 (9.1)	17 (6.3)	21 (9.6)
Total	596	268	218

Data are number (%).

significantly lower than in the other two countries of all ages (Table 5). The number of mandibular fractures differed on the various days of the week in all three countries (Table 6). Of all mandibular fractures in Oulu, almost one-third occurred on Saturdays, while less than one-fifth occurred on the same day in Kuwait and Toronto. The incidence of fractures on Tuesdays and Thursdays was lower in Oulu than in Toronto or Kuwait (Table 6).

June was the most and February was the least common month for mandibular fractures in Kuwait. In Finland, the high accident months were August and June; fewer injuries occurred in February and March. Canadian mandibular fractures occurred mostly in August, October, or June (Table 7).

Table 8. Trends in the number of mandibular fracture patients and the proportion of various causes in the 1990s in Kuwait, Canada and Finland

	β(95% CI)	*P*-value
Total number		
Kuwait	0.95 (0.35 to 1.5)	<0.01
Finland	−0.18 (−0.58 to 0.22)	NS
Canada	0.71 (−4.10 to 6.41)	NS
Kuwait		
RTA	−0.21 (−0.36 to 0.06)	<0.01
Violence	0.31 (−0.01 to 0.63)	NS
Sports	0.44 (−0.63 to 1.50)	NS
Falls	0.15 (−0.13 to 0.42)	NS
Canada		
RTA	−0.31 (−0.57 to 0.05)	<0.05
Violence	0.14 (0.25 to 0.26)	<0.05
Sports	0.08 (−0.69 to 0.85)	NS
Falls	−0.20 (−0.45 to 0.05)	NS
Finland		
RTA	0.13 (−0.23 to 0.49)	NS
Violence	−0.20 (−0.48 to 0.07)	NS
Sports	0.52 (−0.09 to 1.13)	NS
Falls	0.18 (−0.15 to 0.52)	NS

Minus trend indicates that the number of cases or proportion of that particular cause was decreasing toward the end of the decade. RTA, road traffic accident.

The proportion of traffic crashes decreased towards the end of the observation period in Kuwait and Canada (Table 8).

Discussion

This study reports on differences of the etiology of mandibular fractures in three countries during a rather long period of time. No major changes occurred in the status of the emergency units in these countries, which is why the changes in the etiology must have been because of alterations in the demographic patterns of these victims.

Violence and traffic are the two main causes of all kinds of facial bone fractures in many countries. In this study, they were the main causes in Finland. The proportions resulting from violence and traffic in Oulu were less than in previous reports (13, 26). This might indicate general changes in the society.

Association with alcohol was not recognized in Kuwait. Alcohol was associated with the accidents in one-fifth of the cases in Canada and in 15% of the cases in Finland. In Canada, the high incidence of violence must be associated with alcohol. Alcohol-associated mandibular fractures in Oulu were less common in this series than in the previous one that was collected in the 1980s (28).

Falling is a category that cannot be defined precisely. It included falling on the ground at home and at work. In some cases, these could have been listed under traffic crashes or sports accidents, but

because of the lack of more accurate information, they were classified as falls. Less than 5% of facial bone fractures are caused by occupational accidents (4, 31). Most occupational injuries occur in construction work and factories and almost 90% of these patients are men (31).

Falling from a height in Kuwait is a serious problem and is suspected to be the result of deficiencies in safety measures in construction work or industry. The Kuwaiti population is constantly growing, which is why both public and private buildings are continuously built. The frequency of falling accidents should be taken into serious consideration and improvement of safety of employees should be given high priority in Kuwait.

Traffic was more often the cause of mandibular fractures in Kuwait than in Canada or Finland. Despite the well-kept roads and good vehicles, accidents in Kuwait are common. Kuwait implemented seat belt law in 1994, but in practice, this law is not obeyed with the same diligence as in western countries.

Facial injuries from traffic crashes were reduced in both number and severity the implementation of a compulsory safety belt law (1, 24, 32) and after the introduction of airbags (33). Similar reductions in the proportion of crash injuries toward the end of the decade were seen in Kuwait and Canada.

The fact that victims of road crashes were often young people should also arouse attention. Driving is one of the most popular leisure time activities in Kuwait. Cars are good and the highways are constructed with a view to safety. One of the reasons for the large number of young victims might be neglect in the use of safety belts, reckless driving, and less experienced young drivers. The high incidence of violence in Toronto should also be taken seriously.

Sports accidents were not common as a cause of mandibular fractures. This confirms some earlier studies (1). There are, however, few injuries that could be prevented by protective helmets (34). High frequency of fractures caused by sports in Canada could be estimated to be a result of ice-hockey, for example. Unfortunately, exact etiology of sports-related fractures was not available. Information on the causes of injuries could serve as an aid to plan the preventive measures.

The highest risk of mandibular fracture in Finland is on Saturdays. There has been no change in 10 years from the data collected in the 1980s (13). No such similar risk was observed in Canada, even though violence was the most common cause of accidents. In Kuwait, the weekend is Thursday and Friday; these days, however, did not differ from the rest in the incidence of mandibular fractures.

Seasonal variation in Finland followed the beginning and end of the summer vacation. This result is similar to a 10-year previous result (13) and also resembles the findings in adolescents in Sweden (21). Traffic, in particular, is busy in these months when the schools end or start their academic year. In Kuwait, the most common month to get a mandibular fracture is June. This is the time when many foreigners and Kuwaitis leave the country to escape the hot summer.

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References

1. Van Beek GJ, Merkx CA. Changes in the pattern of fractures of the maxillofacial skeleton. Int J Oral Maxillofac Surg 1999;28:434–8.
2. Bataineh AB. Etiology and incidence of maxillofacial fractures in the north of Jordan. Oral Surg Oral Med Oral Pathol 1998;86:31–5.
3. Tay AG, Yeow VK, Tan BK, Sng K, Huang MH, Foo CL. A review of mandibular fractures in craniomaxillofacial trauma center. Ann Acad Med Singapore 1999;28:630–3.
4. Oji C. Jaw fractures in Enugu, Nigeria, 1985–95. Br J Oral Maxillofac Surg 1999;37:106–9.
5. Ellis E, Moos KF, El-Attar A. Ten years of mandibular fractures: an analysis of 2137 cases. Oral Surg Oral Med Oral Pathol 1985;59:120–9.
6. Goldschmidt MJ, Castiglione CL, Assael LA, Litt MD. Craniomaxillofacial trauma in the elderly. J Oral Maxillofac Surg 1995;53:1145–9.
7. Huang V, Moore C, Bohrer P, Thaller SR. Maxillofacial injuries in women. Ann Plast Surg 1998;41:482–4.
8. Lawoyin DO, Lawoyin JO, Lawoyin TO. Fractures of the facial skeleton in Tabuk North West Armed Forces Hospital: a five-year review. Afr J Med Med Sci 1996;25:385–7.
9. 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.
10. Adams CD, Januszkiewcz JS, Judson J. Changing patterns of severe craniomaxillofacial trauma in Auckland over eight years. Aust N Z J Surg 2000;70:410–44.
11. Tanaka N, Tomitsuka K, Shionoya K, et al. Aetiology of maxillofacial fractures. Br J Oral Maxillofac Surg 1994;32:19–23.
12. Posnick JC, Wells M, Pron GE. Pediatric facial fractures: evolving patterns of treatment. J Oral Maxillofac Surg 1996;51:838–44.
13. Oikarinen K, Ignatius E, Kauppi H, Silvennoinen U. Mandibular fractures in northern Finland in the 1980s. A 10-year study. Br J Oral Maxillofac Surg 1993;31:23–7.
14. Freidl S, Bremerich A, Gellrich NC. Mandibular fractures. An epidemiological study of a 10-year cohort (in German). Acta Stomatol Belg 1996;93:5–11.
15. Mwaniki DL, Guthua SW. Occurrence and characteristics of mandibular fractures in Nairobi, Kenya. Br J Oral Maxillofac Surg 1990;28:200–2.
16. Akama MK, Chindia ML, Ndungu FL. Occurrence and pattern of mandibular fractures at Kisii District Hospital, Kenya. East Afr Med J 1993;70:732–3.

17. Adi M, Ogden GR, Chisholm DM. An analysis of mandibular fractures in Dundee, Scotland (1977 to 1985). Br J Oral Maxillofac Surg 1990;28:194–9.
18. Asadi SG, Asadi Z. The aetiology of mandibular fractures at an urban center. J R Soc Health 1997;117:164–7.
19. Andersson L, Hultin M, Nordenram A, Ramstrom G. Jaw fractures in the county of Stockholm (1978–1980). Part I. General survey. Int J Oral Maxillofac Surg 1984;13: 194–9.
20. Eriksson L, Willmark K. Jaw fractures in Malmo 1952–62 and 1975–85. Swed Dent J 1987;11:31–6.
21. Andersson L, Hultin M, Kjellman O, Nordenram A, Ramstrom G. Jaw fractures in the county of Stockholm (1978–1980). Jaw fractures in children and adolescents. Swed Dent J 1989;13:201–7.
22. Hartzell KN, Botek AA, Goldberg SH. Orbital fractures in women due to sexual assault and domestic violence. Ophthalmology 1996;103:953–7.
23. Dimitroulis G, Eyre J. A 7-year review of maxillofacial trauma in a central London hospital. Br Dent J 1991;170: 300–2.
24. Schutz P, Safar S, Al-Yassin SM, Belal MS, Korinek P. Maxillofacial fractures in Kuwait between 1992–1997. Asian J Oral Maxillofac Surg 2001;13:195–201.
25. Sojat AJ, Meisami T, Sàndor GKB, Clockie CML. The epidemiology of mandibular fractures treated at the Toronto General Hospital. A review of 246 cases. J Can Dent Assoc 2001;67:636–40.
26. Oikarinen K, Kauppi H, Altonen M, Laitakari K. Causes and types of mandibular fractures in Northern Finland. An analysis of 200 cases. Proc Finn Dent Soc 1988;84:227–33.
27. Oikarinen K, Altonen M, Kauppi H, Laitakari K. Treatment of mandibular fractures. Need for internal rigid fixation. J Craniomaxillofac Surg 1989;17:24–30.
28. Oikarinen K, Ignatius E, Silvennoinen U. Frequency of alcohol associated mandibular fractures in Northern Finland in the 1980s. Alcohol Alcohol 1992;27:189–93.
29. Silvenoinen U, Iizuka T, Lindqvist C, Oikarinen K. Different patterns of condylar fractures: an analysis of 382 patients in a 3-year period. J Oral Maxillofac Surg 1992;50:1032–7.
30. Oikarinen K, Silvennoinen U, Ignatius E. Treatment of mandibular fractures in the 1980s. J Craniomaxillofac Surg 1993;21:245–50.
31. Iizuka T, Randell T, Guven O, Lindqvist C. Maxillofacial fractures related to work accidents. J Craniomaxillofac Surg 1990;18:255–9.
32. Kahnberg KE, Gothberg KA. Le Fort fractures. Part I. A study frequency, etiology and treatment. Int J Oral Maxillofac Surg 1987;16:154–9.
33. Major MS, MacGregor A, Bumpous JM. Patterns of maxillofacial injuries as a function of automobile restrain use. Laryngoscope 2000;110:608–11.
34. Gassner R, Ulmer H, Tuli T, Emshoff R. Incidence of oral and maxillofacial skiing injuries to different injury mechanism. J Oral Maxillofac Surg 1999;57:1068–73.