

## Trends in the Pattern of Facial Fractures in Different Countries of the World

### Tendencias en el Patrón de Fracturas Faciales en Diferentes Países del Mundo

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**SUMMARY:** The aim of the present study was to examine the changes in the pattern of maxillofacial fractures between developed and developing countries over two time periods; (1987-1999) and (2000-2007). A comprehensive search of the literature using PubMed was conducted for publications on maxillofacial injuries published during the last 20 years. Only 45 articles met the inclusion criteria and the full-texts of these articles were thoroughly examined. For each of the included studies, different parameters were recorded. Calculated "weighed" percentages of each parameter across the total number of all patients were performed. The mandible was the most frequently fractured facial bone (57%). In the total period, the mean age of patients with facial fractures was 24.4 years and the incidence of facial fractures was higher in males (81.3%) than in females. The male to female ratio of patients with facial fractures was greater in developing countries (5.1:1.0) than that in developed countries (3.7:1.0) in the total period. Road traffic accident-related injuries had significantly decreased in developed countries and increased in developing countries over the two periods. However, assault-related facial injuries had significantly increased in developed countries and decreased in developing countries over the two periods. The body of the mandible was the most common mandibular fracture site (27.2%). It was concluded that mandibular fractures are more common than middle third injuries of the facial skeleton. Most patients affected by facial fractures in different countries were young adult males.

**KEY WORDS:** Epidemiology; Maxillofacial fracture; Mandibular fracture; Road traffic accident.

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### INTRODUCTION

Data concerning maxillofacial trauma are plentiful, however few contain meaningful information as local demographic and socioeconomic factors greatly influence the results of any study. Literature showed that mandibular fractures are more common than middle third injuries of the facial skeleton (Layton *et al.*, 1994; van Beek & Merckx, 1999; Iida *et al.*, 2001; Olasoji *et al.*, 2002; Motamedi, 2003; Adebayo *et al.*, 2003; Al Ahmed *et al.*, 2004; Ansari, 2004; Erol *et al.*, 2004; Laski *et al.*, 2004; Cheema & Amin, 2006; Brasileiro & Passeri, 2006; Kadkhodaie, 2006; Al-Khateeb & Abdullah, 2007; Subhashraj *et al.*, 2007) (Table I). For example, in Scotland and Greenland, mandibular fractures were reported in 84 % and 65 % of facial fractures, respectively (Lindqvist *et al.*, 1986; Adi *et al.*, 1990), however, it reached 97 % out of 129 cases of facial trauma in an 18-month period study in Greenland (Thorn *et al.*, 1986). This was lower in the United States of America (USA), where mandibular fractures were 51% of the reported facial fractures (Vetter *et al.*, 1991). Earlier studies in European countries reported lower incidence of mandibular

fractures (Van Hoof *et al.*, 1977; Brook & Wood, 1983). In other regions of the world, these types of fractures showed a relevant or higher incidence in Nigeria, Iraq, and Jordan (Abiose, 1986; Kummoona & Muna, 2006; Oji, 1999; Le *et al.*, 2001; Karyouti, 1987; Bataineh, 1998; Ma'aita, 1999).

Generally, the incidence of maxillofacial fractures was higher in males than in females (Table II). This was well illustrated by different reports from different countries (Mwaniki & Guthua, 1990; Vetter *et al.*; Hill *et al.*, 1998; Kruger *et al.*, 2006; Fasola *et al.*, 2003a; Bakardjiev & Pechalova, 2007) with peak incidence between the ages of 20 to 30 years (Chambers & Scully, 1987; Allan & Daly, 1990; Adi *et al.*; Rix *et al.*, 1991; Bataineh; Bochlogyros, 1998; Ma'aita; Oji; Brasileiro & Passeri, 2006; Kadkhodaie, 2006) (Table II).

Many factors have been implicated in the aetiology of facial trauma. The causes of fracture of the facial skeleton vary from one study to another, but they are chiefly road

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Table I. Location of study, year of study, number of patients analyzed and number of patients with mandibular fractures in studies dealing with maxillofacial fractures.

Author(s)	Country of Study	Year of Publication	Unit Type	Target Fractures	N° of Patients	Mandible (N° of Patients)
Bakardjiev <i>et al.</i>	Bulgaria	2007	Hosp.	Maxfac.	1706	1261
Al-Khateeb <i>et al.</i>	UAE	2007	Hosp.	Maxfac.	288	203
Deogratius <i>et al.</i>	Tanzania	2003	Emerg	Maxfac.	314	222
Brasileiro <i>et al.</i>	Brazil	2006	Emerg	Maxfac.	1024	423
Kadkhodaie	Iran	2006	Hosp.	Maxfac.	7200	3089
Cheema & Amin	Pakistan	2006	Tert.	Maxfac.	702	473
Erol <i>et al.</i>	Turkey	2004	Hosp.	Maxfac.	2901	2111
Adebayo <i>et al.</i>	Nigeria	2003	Emerg	Maxfac.	443	305
Motamedi	Iran	2003	Emerg	Maxfac.	237	180
Subhashraj <i>et al.</i>	India	2007	Emerg	Maxfac.	2748	1176
Al Ahmed <i>et al.</i>	UAE	2004	Hosp.	Maxfac.	230	170
Ansari	Iran	2004	Emerg	Maxfac.	2268	1194
Olasoji <i>et al.</i>	Nigeria	2002	Emerg	Maxfac.	306	225
van Beek <i>et al.</i>	Netherlan-ds	1999	Emerg	Maxfac.	1379	822
van Beek <i>et al.</i>	Netherlan-ds	1999	Emerg	Maxfac.	1324	707
Ugboko <i>et al.</i>	Nigeria	1998	Tert.	Maxfac.	442	288
Bataineh	Jordan	1999	Hosp.	Maxfac.	563	419
Oji	Nigeria	1999	Tert.	Maxfac.	900	661
Fasola <i>et al.</i> (2003b)	Nigeria	2003b	Tert.	Maxfac.	341	348
Fasola <i>et al.</i> (2003b)	Nigeria	2003b	Tert.	Maxfac.	483	362
Aksoy <i>et al.</i>	Turkey	2002	Hosp.	Maxfac.	553	417
Iida <i>et al.</i>	Japan	2001	Emerg	Maxfac.	1502	955
Klenk <i>et al.</i>	UAE	2003	Hosp.	Maxfac.	144	97
Sakr <i>et al.</i>	Egypt	2006	Hosp.	Mand.	509	##
Ortako_lu <i>et al.</i>	Turkey	2002	Hosp.	Maxfac.	157	120
King <i>et al.</i>	USA	2004	Tert.	Mand.	134	##
Atanasov	Bulgaria	2003	Hosp.	Mand.	2252	##
Dongas	Australia	2002	Hosp.	Mand.	251	##
Schön <i>et al.</i>	Australia	2001	Hosp.	Maxfac.	203	114
Mohammadi <i>et al.</i>	Australia	2007	Hosp.	Maxfac.	200	60
Allan <i>et al.</i>	Australia	1990	Hosp.	Mand.	1162	##
Khan	Zimbabwe	1988	Emerg	Maxfac.	311	234
Layton <i>et al.</i>	UK	1994	Tert.	Maxfac.	760	426
Dimitroulis <i>et al.</i>	UK	1991	Tert.	Maxfac.	439	246
Perkins <i>et al.</i>	UK	1988	Tert.	Maxfac.	360	202
Telfer <i>et al.</i>	UK	1991	Tert.	Maxfac.	4305	2411
Adi <i>et al.</i>	Scotland (UK)	1990	Tert.	Maxfac.	692	378
Vetter <i>et al.</i>	USA	1991	Tert.	Maxfac.	311	157
Ashar <i>et al.</i>	UAE	1996	Hosp.	Maxfac.	170	109
Sawhney <i>et al.</i>	India	1988	Emerg	Maxfac.	262	123
Guven	Turkey	1988	Hosp.	Maxfac.	190	139
Guven	Turkey	1988	Hosp.	Maxfac.	212	154
Sugiura <i>et al.</i>	Japan	1997	Emerg	Maxfac.	1170	646
Karyouti	Jordan	1987	Hosp.	Maxfac.	131	70
Mwaniki <i>et al.</i>	Kenya	1988	Emerg	Mand.	355	##

(##: Not applicable; Hosp.: Hospital; Emerg.: Emergency; Tert.: Tertiary; Maxfac.: Maxillofacial; Mand.: Mandibular).

traffic accidents (RTA), interpersonal violence, falls, sports and industrial accidents (Table II).

Road traffic accidents have, in the past, been the most frequent cause of facial fractures in many countries including

Table II. Sex distribution, mean age and number of patients with facial fractures due to main aetiological factors.

Author(s)	Sex Distribution (N° of Males)	Mean Age	RTA-Related Injuries (N° of Patients)	Assault-Related Injuries (N° of Patients)
Bakardjiev <i>et al.</i>	1406	25.5	264	1040
Al-Khateeb & Abdullah	253	27.5	161	26
Deogratius <i>et al.</i>	261	24.5	43	181
Brasileiro <i>et al.</i>	818	25.5	461	231
Kadkhodaie	6646	24.5	6552	208
Cheema & Amin	596	25.5	382	56
Erol <i>et al.</i>	2248	27.0	1104	299
Adebayo <i>et al.</i>	363	30.0	246	50
Motamedi	211	38.0	128	23
Subhashraj <i>et al.</i>	2163	25.5	1710	93
Al Ahmed <i>et al.</i>	212	24.5	174	18
Ansari	1800	24.6	1360	227
Olasoji <i>et al.</i>	210	29.0	111	147
van Beek <i>et al.</i>	1033	28.4	940	104
van Beek <i>et al.</i>	979	29.9	668	178
Ugboko <i>et al.</i>	356	25.5	318	37
Bataineh	424	28.8	311	95
Oji	677	25.5	747	75
Fasola <i>et al.</i> (2003b)	295	25.5	264	30
Fasola <i>et al.</i> (2003b)	370	30.0	334	58
Aksoy <i>et al.</i>	457	33.5	498	15
Iida <i>et al.</i>	1110	19.5	787	233
Klenk <i>et al.</i>	120	26.5	85	6
Sakr <i>et al.</i>	400	25.0	198	83
Ortakoulu <i>et al.</i>	151	22.8	69	42
King <i>et al.</i>	120	30.0	39	67
Atanasov	1876	24.5	452	1570
Dongas	205	25.5	26	133
Schön <i>et al.</i>	124	24.5	20	128
Mohammadi <i>et al.</i>	178	27.5	84	72
Allan <i>et al.</i>	947	24.5	250	443
Khan	252	25.5	46	254
Layton <i>et al.</i>	638	28.0	77	472
Dimitroulis <i>et al.</i>	369	28.0	70	243
Perkins <i>et al.</i>	294	28.0	68	136
Telfer <i>et al.</i>	3616	28.0	745	2158
Adi <i>et al.</i>	283	24.5	53	213
Vetter <i>et al.</i>	230	29.7	124	115
Ashar <i>et al.</i>	146	24.5	102	10
Sawhney <i>et al.</i>	208	30.5	131	34
Güven	149	25.5	91	56
Güven	158	35.5	94	67
Sugiura <i>et al.</i>	848	19.5	646	184
Karyouti	104	14.5	80	51
Mwaniki <i>et al.</i>	317	30.0	50	260

Nigeria (Adekeye, 1980; Abiose), Libya (Kalil & Shaladi, 1981), Europe (Van Hoof *et al.*; Afzclius & Rosen, 1980) and USA (Hagan & Huelke, 1961). Studies in the last two decades have shown that assaults are now the most common

cause of maxillofacial fractures in many developed countries (UK (Winstanley, 1984; Ellis *et al.*, 1985; Layton *et al.*), Australia (Allan & Daly), Bulgaria (Bakardjiev & Pechalova), USA (King *et al.*, 2004)). Nevertheless, RTAs

Table III. Number of fracture locations in the mandible, body, parasymphysis (including symphysis), condyle and angle.

Author	Mandible (N° of Fractures)	Body (N° of Fractures)	Parasymphyseal (N° of Fractures)	Condyle (N° of Fractures)	Angle (N° of Fractures)
Bakardjiev <i>et al.</i>	#	#	#	#	#
Al-Khateeb <i>et al.</i>	270	107	42	33	47
Deogratus <i>et al.</i>	#	#	#	#	#
Brasileiro <i>et al.</i>	618	133	139	162	113
Kadkhodaie	3089	942	666	790	506
Cheema & Amin	#	#	#	#	#
Erol <i>et al.</i>	#	#	#	#	#
Adebayo <i>et al.</i>	#	#	#	#	#
Motamedi	173	22	51	55	35
Subhashraj <i>et al.</i>	512	42	156	96	60
Al Ahmed <i>et al.</i>	150	30	27	38	35
Ansari	1633	364	277	325	218
Olasoji <i>et al.</i>	273	155	75	31	12
van Beek <i>et al.</i>	1324	509	0	610	180
van Beek <i>et al.</i>	1187	459	0	532	163
Ugboko <i>et al.</i>	358	151	40	44	31
Bataineh	584	134	17	59	104
Oji	730	264	112	190	127
Fasola <i>et al.</i> (2003b)	#	#	#	#	#
Fasola <i>et al.</i> (2003b)	#	#	#	#	#
Aksoy <i>et al.</i>	507	51	294	42	75
Iida <i>et al.</i>	1508	356	252	507	327
Klenk <i>et al.</i>	150	18	46	44	28
Sakr <i>et al.</i>	792	157	221	142	164
Ortako_lu <i>et al.</i>	161	49	30	42	25
King <i>et al.</i>	225	46	79	27	34
Atanasov	3326	857	651	399	1136
Dongas	#	#	#	#	#
Schön <i>et al.</i>	154	40	25	14	66
Mohammadi <i>et al.</i>	87	17	13	13	24
Allan <i>et al.</i>	#	#	#	#	#
Khan	272	134	12	13	99
Layton <i>et al.</i>	#	#	#	#	#
Dimitroulis <i>et al.</i>	#	#	#	#	#
Perkins <i>et al.</i>	#	#	#	#	#
Telfer <i>et al.</i>	#	#	#	#	#
Adi <i>et al.</i>	632	166	121	165	123
Vetter <i>et al.</i>	290	35	96	73	84
Ashar <i>et al.</i>	185	15	41	59	22
Sawhney <i>et al.</i>	123	25	41	27	30
Güven	102	32	18	7	18
Güven	113	26	17	9	19
Sugiura <i>et al.</i>	#	#	#	#	#
Karyouti	#	#	#	#	#
Mwaniki <i>et al.</i>	#	#	#	#	#

#: Not mentioned in the study.

remain the most frequent cause of injury in many developing areas (Jordan (Bataineh; Ma'aita), Egypt (Sakr *et al.*, 2006), Iran (Ansari) and Pakistan (Cheema & Amin, 2006)).

As mentioned earlier, the mandible was the most common bone affected by fractures of the facial skeleton. In studies that have reported RTA related facial fractures,

The body of the mandible was the most common mandibular fracture site (Ugboko *et al.*, 1998; Adebayo *et al.*; Kadkhodaie; Al-Khateeb & Abdullah). In contrast, patients with mandibular fractures caused by alleged assault in Scotland had body fractures accounted for 33% followed by the angle of the mandible (31%) (Ellis *et al.*) (Table III).

From the above mentioned literature, there were only few studies from different institutions that compared the pattern of maxillofacial fractures over time (Layton *et al.*; van Beek & Merckx; Olasoji *et al.*). The present comparison was undertaken to examine the trends in the pattern of maxillofacial fractures between developed and developing countries over two time periods; (1987-1999) and (2000-2007).

## MATERIAL AND METHOD

**Literature Search and Data Collection.** A comprehensive computerized search of the literature was performed (PubMed-National Library of Medicine, NCBI). Key words applied in the search were epidemiology, maxillofacial, fractures and mandibular. Only papers written in English were included as translation for other languages was not available. Search included articles on maxillofacial and mandibular injuries published during the last 20 years, from January 1st/1987 to March 1st/2008, to obtain relatively recent, applied and sufficient data. The abstracts and full-texts of all these articles were thoroughly examined. References were manually searched in these articles to look for additional relevant non-PubMed articles or abstracts. Personal contacts were also made with institutions and investigators of previous studies for missing data and also for the provision of articles found suitable for the review.

A total of 134 full-text articles and abstracts were identified. A total of 45 studies were included in this review; 39 studies dealt with patients who sustained maxillofacial fractures and the remainder 6 articles dealt with patients who had mandibular fractures alone (Tables I & IV). These 45 articles were included according to the following criteria:

- Availability of the full-text article; in order to obtain all or most of the characteristics of facial fractures.
- Retrospective or prospective studies dealing with all age groups (children and adults) and civilian-type injuries.
- Studies where the diagnoses of fractures were made on the basis of presenting complaints, clinical examination, and were confirmed radiographically, especially orthopantomographic radiographs, and by the findings at operation.
- Studies where fractures were received and managed in maxillofacial units related to hospitals or emergency units or tertiary of primary units.

Five categories with a total of 89 articles were excluded:

- Studies dealing with a certain age group (21 studies) or a single specific aetiology (24 studies) or a certain site of facial fractures (4 studies).
- Studies dealing with patients with solitary head injuries (2 studies) or solitary fractures of the alveolar process or pure dental injuries, possibly in combination with other injuries (3 studies).
- Studies dealing with patients with severe or serious facial fractures (4 studies).
- Studies dealing with complications (10 studies) or treatments (11 studies) of facial fractures.
- Studies where fractures were received and diagnosed in surgical or in Ear, Nose and Throat (ENT) units.
- Unavailability of the full-text article (10 articles).

For each of the included 45 studies, multiple parameters were recorded (Tables I-III). A data collection form was designed and used for the collection of data (Table appendice).

For example, country of treatment was classified into developed and developing. According to the United Nations definition, the term developed country, or advanced country, is used to categorize countries with developed economies in which the tertiary and quaternary sectors of industry dominate. In contrast, a developing country is that country which has relatively low standard of living, an undeveloped industrial base, and a moderate to low Human Development Index (HDI) score and per capita income, but is in a phase of economic development. Usually all countries which are neither a developed country nor a failed state are classified as developing countries. Twenty-six studies were conducted in developing countries and 19 in developed countries.

Furthermore, year of publication ranged from 1987 to 2007, were considered. This period was divided into two periods; period 1 (1987-1999) and period 2 (2000-2007), as this would permit a comparison of the "state of facial injuries" in recent years to ten-to-twenty year old articles around the world.

Due to the heterogeneity of the study methodologies in this review, it was not possible to apply the traditional methods of a systematic review. A meta-analysis is only suitable if there is sufficient similarity in the populations studied and the measurements used. This was not the case with the studies identified in this review. Therefore, calculated "weighed" percentages of each parameter across the total number of all patients were performed.

**Statistical Analysis.** Data analysis was undertaken using SPSS version 16 (SPSS Inc., Chicago, IL, USA) statistical software program, including frequency distribution and cross-tabulation. The Chi-Square test was selected to assess the significance of differences in the calculated "weighed" percentages between developed and developing countries over the two periods of treatment. P-value of < 0.05 was accepted as significant.

## RESULTS

**Incidence.** In maxillofacial fracture, mandibular fractures were more common than zygomatic and middle third injuries. This study dealt with 37871 patients who sustained maxillofacial injuries in the period 1987-2007 (Table IV). Mandibular fractures were recorded in 21769 patients (57%) (Table I).

**Age and Sex distribution.** In the period 1987-2007, the mean age of patients with facial fractures in different countries of the world was 24.4 years. The mean age of the patients in developed and developing countries over the two periods are presented in Table V. The mean age of patients in developed and developing countries in the period 2000-2007, in comparison to the period 1987-1999, decreased specially in developing countries. The mean age of all patients in the first period was 26.9 years and in the second period 23.3 years. The mean age of all patients in developed countries was 25.8 years and in developing countries 23.3 years.

In the period 1987-2007, the incidence of facial fractures in different countries of the world was higher in males (81.3%) than in females. The male to female ratio of patients with facial fractures in developed and developing countries in the period 1987-2007 are presented in Table VI. The male to female ratio of patients with facial fractures recorded in the period 1987-2007 was greater in developing countries (5.1:1.0) than that in developed countries (3.7:1.0).

**Aetiology.** RTA was the major cause of facial injuries in developing countries (65.8%). However, assault was the major cause in developed countries (40.2%) (Table VII). The percentage of patients with facial fractures due to RTA in the period 1991-2004, in comparison to the period 1987-1999, had significantly ( $p < 0.005$ ) decreased in developed countries and increased in developing countries. In contrast, the percentage of patients with assault-related facial fractures in the period 2000-2007, in comparison to the period 1987-1999, had significantly ( $p < 0.005$ ) increased in developed countries and decreased in developing countries (Tables VIII and IX).

**The most common site of fractured mandible.** Of the 19528 fractures that occurred in 15509 patients with mandibular fractures over the period 1987-2007 (Table X), 27.2% were located in the body, being the most common site followed by the condylar process (23.2%), the angle (19.9%) and parasymphysis (including symphysis) (18.2%). Only 11.1% were located in the ramus and coronoid regions, being the least common sites of mandibular fractures.

The body of the mandible was the most common fracture site in developing countries (26.7%), where the major aetiology of facial fractures was road traffic accident. It was also the most common fracture site in developed countries (27.9%), where the major aetiology was assault. However, the second most common fracture site was parasymphysis (including symphysis) in developing countries (21.4%) and condylar process in developed countries (26.7%) (Table X).

The fracture location in the mandible in different types of units, emergency, hospital and tertiary, over the period 1987-2007 are presented in Table XI. For example, of the 7623 mandibular fractures received in emergency units over the period 1987-2007, 30.9% were diagnosed in the condyle, being the most common site followed by the body (28.8%), the angle (16.2%) and parasymphysis (including symphysis) (13.1%). Only 11.8% were located in the ramus and coronoid regions, being the least common sites of mandibular fractures diagnosed in emergency units.

Table IV. Division of patients of the included studies according to localization of facial fractures.

Localization	Number of Studies	Number of Patients	%
Maxillofacial fractures	39	37871	89
Mandibular fractures	6	4663	11
Total	45	42534	100

Table V. The mean age of patients in developed and developing countries over periods 1987-1999, 2000-2007 and 1987-2007.

Country of Study	Developed	Period of Treatment		
		1987-1999	2000-2007	1987-2007
	Developed	26.8	24.4	25.8
	Developing	27.4	22.6	23.3
	Both	26.9	23.3	24.4

Table VI. The male to female ratio of patients with facial fractures in developed and developing countries over the period 1987-2007.

Country of Study		Period of Treatment	
		1987-2007	
Country of Study	Developed	Male: 15074 (78.6%) Female: 4097 (21.4%) Male: Female 3.7:1	
	Developing	Male: 19547 (83.6%) Female: 3813 (16.4%) Male: Female 5.1:1	
	Both	Male: 34621(81.3%) Female: 7910 (18.7%) Male: Female 4.4:1	

Table VII. Main aetiological factors of facial fractures in developed and developing countries.

Aetiology of Fracture	Country of the Study	Country of the Study			
		Developing N° of Patients	(%)	Developed N° of Patients	(%)
Road Traffic Accidents	Road Traffic Accidents	15389	65.8	5774	30.1
	Assault	2501	10.7	7720	40.2
	All Other Causes	5470	23.5	5680	29.7
Total		23360	100	19174	100

Table VIII. Main aetiological factors of facial fractures over periods 1987-1999 and 2000-2007 in developed countries.

Developed Countries		Period of Treatment			
		1987-1999		2000-2007	
		N° of Patients	%	N° of Patients	%
Developed Countries	Assault	3774	33.8	3946	49.1
	Road traffic accident	3564	31.9	2210	27.5
	All Other Causes	3804	34.1	1876	23.3
Total		11142	100	8032	100

Table IX. Main aetiological factors of facial fractures over periods 1987-1999 and 2000-2007 in developing countries

		Period of Treatment			
		1987-1999		2000-2007	
		N° of Patients	%	N° of Patients	%
Developing Countries	Assault	752	41.7	1776	8.2
	Road Traffic Accidents	756	41.9	14633	67.8
	All Other Causes	294	16.3	5149	23.8
Total		1802	100	21558	100

Table X. Number (%) of fracture location in the mandible in developed and developing countries over the period 1987-2007.

Localization	Developing	Developed	Both
Body	2718 (26.7%)	2618 (27.9%)	5336 (27.2%)
Parasymphiseal and symphyseal	2183 (21.4%)	1376 (14.7%)	3559 (18.2%)
Condyle	2046 (20.1%)	2502 (26.7%)	4548 (23.2%)
Angle	1655 (16.2%)	2250 (24.0%)	3905 (19.9%)
Ramus and Coronoid	1575 (15.4%)	605 (6.4%)	2180 (11.1%)
Total	10177 (100%)	9351 (100%)	19528 (100%)

Table XI. Number (%) of fracture location in the mandible in different units over the period 1987-2007.

Localization	Emergency	Hospital	Tertiary	Total
Body	2199 (28.8%)	2475 (25.6%)	662 (29.6%)	5336 (27.2%)
Parasymphiseal	1003 (13.1%)	2108 (21.8%)	448 (20%)	3559 (18.2%)
Condyle	2358 (30.9%)	1691 (17.5%)	499 (22.3%)	4548 (23.2%)
Angle	1237 (16.2%)	2269 (23.5%)	399 (17.9%)	3905 (19.9%)
Ramus	896 (11.8%)	1127(11.7%)	227 (10.2%)	2180 (11.1%)
Total	7623 (100%)	9670 (100%)	2235 (100%)	19528 (100%)

## DISCUSSION

The result of the present study revealed that the incidence and aetiology of maxillofacial fractures vary widely between different countries as a result of various contributing factors, such as age, gender, environment and the socioeconomic status and culture of the patient (Kruger *et al.*).

Most facial bone fractures involve the mandible and this might be related to the direction and quantity of force that the mandible is exposed to (Al Ahmed *et al.*). The mobility of the mandible and the fact that it has less bony support than the maxilla had been implicated (Kelly & Harrigan, 1975).

In this study, most patients affected by facial fractures were young adult males with a mean age of 24.4 years. A tendency towards an equal mean age was observed between earlier and later studies across the world. The possible explanation for this is that individuals between the ages of 21 and 30 years frequently take part in dangerous exercises and sports, drive motor vehicles carelessly, and are more likely to be involved in violence (Oji). In men, the third decade of life is an active period when they are more energetic, involved in high-speed transportation, and engaged in outdoor activities, which are leading causes of maxillofacial trauma (Cheema & Amin).



This study showed that the incidence of facial fractures in different countries of the world was higher in males (81.3%) than in females. The male-to-female ratio of patients with facial fractures was greater in developing countries than that in developed countries (Table VI). This can be attributed to the high percentage of women who are used to stay at home, not work in outdoor and high-risk occupations in developing countries, thus becoming less exposed to RTA and other causes of maxillofacial injuries (Fasola *et al.*, 2003b; AlAhmed *et al.*). These results were in agreement with those achieved in developing countries (Al-Balbissi, 2003; Al Ahmed *et al.*; Ghaffar *et al.*, 2004; Roudsari *et al.*, 2004; Hofman *et al.*, 2005).

In contrast, in developed countries where women participate directly in social activities and consequently are more susceptible to traffic accidents and urban violence (Lindqvist *et al.*; Thorn *et al.*; Gassner *et al.*, 1999), the male-to-female ratio incurring maxillofacial injuries reached as low as 2.1:1.0 (Gassner *et al.*). Women's facial injury rates in developed countries are more than that in developing countries, showing that certain socioeconomic conditions are necessary for women to play a more active part in these developed societies (Lindqvist *et al.*; Thorn *et al.*; Peden *et al.*, 2005; Kruger *et al.*).

In this study, RTA was the major cause of facial injuries in developing countries (65.8%). The percentage of patients with facial fractures due to RTA in the period 2000-2007, in comparison to the period 1987-1999, had significantly ( $p < 0.005$ ) decreased in developed countries and increased in developing countries. These findings are in agreement with reports from other developing countries where RTA remains the major aetiologic factor of maxillofacial injuries (Fasola *et al.*, 2003a; AlAhmed *et al.*; Ansari; Nwoku & Oluyadi, 2004).

Facial fractures related to RTA are explained by the increase of vehicles, insufficient stress on the use of seat belts, recklessness on the highways, badly maintained roads, and lack of enforcement of traffic rules and regulations (Kalil & Shaladi; Hill *et al.*, 1984; Ugboko *et al.*; Fasola *et al.*, 2003b; Kobusingye, 2004). In 1995, The World Health Organisation (WHO) has estimated that nearly 25% of all injury fatalities worldwide are a result of road traffic crashes, with 90% of the fatalities occurring in developing countries (Kobusingye). Therefore, there is an urgent need to get down to what the developed nations have done to reduce and/or prevent road traffic crashes.

In this study, assault was the major cause of facial fractures in developed countries (40.2%). The percentage of patients with assault-related facial fractures in the period 2000-2007, in comparison to the period 1987-1999, had significantly ( $p < 0.005$ ) increased in developed countries and decreased in developing countries. These findings are in agreement with

reports from developed countries where assaults and interpersonal violence have replaced RTA as the major cause of maxillofacial injuries (McDade *et al.*, 1982; Andersson *et al.*, 1984; Shepherd *et al.*, 1988; Magennis *et al.*, 1998; Fasola *et al.*, 2003b; King *et al.*; Laski *et al.*).

In Scandinavian countries, alcohol or narcotic involvement in facial fractures had been reported between 44 % to 56 %, and most of the cases associated with violence were linked to alcohol abuse (Heimdahl & Nordenram, 1977; Oikarinen *et al.*, 1992). In contrast, alcohol does not play a major role for facial fracture aetiology in the Middle East where it is forbidden in some countries (Saudi Arabia, Iran and Libya) and consumed minimally in the other countries due to religious and cultural beliefs.

Regarding the fracture site of the mandible, the body was the most common fracture site in developing countries (26.7%) where the major aetiology of facial fractures was road traffic accident as revealed by this study. It was also the most common fracture site in developed countries (27.9%) where the major aetiology was assault. The prevalence of fractures of the mandibular body also confirmed the previous reports by Adekeye and Abiose in Nigeria and Khalil & Shaladi in Libya. However, most reports from Europe and North America showed the condyle as the most common site of mandibular fracture (Beck, 1989). This might indicate that there is no clear association between the aetiological factors and the fracture site of the mandible (Ellis *et al.*; Vetter *et al.*; Ugboko *et al.*; Adebayo *et al.*; Brasileiro & Passeri; Kadkhodaie).

In this study, mandibular body fractures were the most fracture location diagnosed in hospitals and tertiary units, while condylar fractures were the most fracture location diagnosed in emergency units. This might be attributed to the common use of orthopantomograph for the diagnosis of mandibular fractures, especially in the condylar region, in emergency units more than other units.

Finally, civilization, culture, and individual characteristics are major factors that determine trends of maxillofacial trauma. Public awareness of traffic regulations and alcohol intake, and good quality of socioeconomic status might affect the trends of these types of trauma.

## CONCLUSIONS

Within the limits of the included maxillofacial literature that dealt with the incidence, aetiology, sex, and age, it was concluded that mandibular fractures are more common than middle third injuries of the facial skeleton.

Most patients affected by facial fractures were young adult males. The male-to-female ratio of patients with facial fractures was greater in developing countries than that in

developed countries. Assault was the most common aetiology in developed- compared to developing countries, where RTA was the major aetiology.

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SHAYYAB, M.; ALSOLEIHAT, F.; RYALAT, S. & KHRAISAT, A. Tendencias en el patrón de fracturas faciales en diferentes países del mundo. *Int. J. Morphol.*, 30(2):745-756, 2012.

**RESUMEN:** El objetivo del estudio fue examinar los cambios en el patrón de las fracturas maxilofaciales entre los países desarrollados y en vías de desarrollo en dos períodos de tiempo (1987-1999) y (2000-2007). Una búsqueda exhaustiva de la literatura en PubMed se llevó a cabo entre las publicaciones de lesiones maxilofaciales publicados durante los últimos 20 años. Sólo 45 artículos cumplieron con los criterios de inclusión, y los textos completos de estos artículos fueron examinados a fondo. En cada uno de los estudios incluidos se registraron diferentes parámetros. Se calculó el porcentaje de "peso" de cada parámetro a través del número total de pacientes. La mandíbula fue el hueso facial más fracturado (57%). En todo el periodo evaluado, la media de edad de los pacientes con fracturas faciales fue de 24,4 años y la incidencia de las fracturas faciales fue mayor en hombres (81,3%) que en mujeres. La razón hombre-mujer de los pacientes con fracturas faciales fue mayor en los países en vías de desarrollo (5,1:1,0) que en los países desarrollados (3,7:1,0) en todo el período. Las lesiones relacionadas con accidentes de tránsito disminuyeron considerablemente en los países desarrollados, mientras que aumentó en los países en vías de desarrollo durante los dos períodos. Sin embargo, las lesiones faciales relacionadas con asaltos aumentaron considerablemente en los países desarrollados y disminuyó en los países en vías de desarrollo durante los dos períodos. El cuerpo de la mandíbula fue el sitio de fractura más común (27,2%). Se concluyó que las fracturas mandibulares son las lesiones más comunes en el tercio medio del esqueleto facial. La mayoría de los pacientes afectados por fracturas faciales en los diferentes países fueron hombres jóvenes.

**PALABRAS CLAVE:** Epidemiología; Fractura maxilofacial; Fractura mandibular; Accidente de tránsito.

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