Epidemiology of Maxillofacial Fractures and Concomitant Injuries in a Craniofacial Unit: A Retrospective Study

A Devadiga, K Prasad

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Abstract

Aim: To investigate epidemiological characteristics of maxillofacial fractures and concomitant injuries in patients admitted to Craniofacial Unit, S. D. M. College of Dental Sciences and Hospital, Dharwad.
Methodology: Records of patients admitted to unit over 5 yrs were accessed. Data collected included socio-demographic factors, type and etiology of injury, concomitant injuries, and post-surgery complications.
Results: 598 cases ranging from 1-78 yrs were reported, with male: female ratio of 7:1. 21-30yr age group was the most affected at 41.30% (n=247). Road traffic accidents constituted 60.37%, (n=361) of fractures. 62% (n=371) suffered isolated mandibular fractures. Parasymphyseal and zygomatic complex fractures were most common fractures. Among the concomitant injuries, neurological injuries at 45.33%, (n=267) were reported. Infection (47.89%, n= 91) and malocclusion (17.89%, n= 34) were frequent postoperative complications observed.
Conclusions: Data on the number and etiology of maxillo-facial injuries in a region is therefore important in the organization of regional trauma services and to provide information about new ways of prevention.

DEPARTMENT AND INSTITUTION TO WHICH WORK IS CREDITED

Department of Community Dentistry,
S.D.M College of Dental Sciences and Hospital,
Sattur, Dharwad
Karnataka state, India

INTRODUCTION

The human face is the first focus of human interaction and a source of man's fascination with the idea of beauty. Ironically, the facial area is one of the most frequently injured areas of the body.

Injuries accounted for 9% of the world's deaths and 12% of the world's burden of disease in the year 2000. More than 90% of the world's deaths from injuries occur in low and middle-income countries [1].

Hence, the following study aimed to collect information regarding the epidemiology of oral and maxillofacial fractures and concomitant injuries from the Craniofacial Unit (CFU) of S.D.M. College of Dental Sciences, Dharwad as it serves as a tertiary referral centre for the entire Dharwad district and adjacent areas. The objectives were: 1) Review the maxillofacial fractures treated in the CFU over a period of 5 yrs retrospectively, by assessing patient records. 2) Identify patterns of maxillofacial fractures. 3) Identify concomitant injuries and 4) Assess the extent of postoperative complications.

METHODOLOGY

A descriptive retrospective study was conducted to investigate the epidemiological characteristics of maxillofacial fractures and concomitant injuries in patients admitted to the Craniofacial Unit, S.D.M. College of Dental Sciences and Hospital, Dharwad. The records of patients who were admitted to the unit over a period of 5 yrs, i.e., between 1 st January 2001 and December 31 st 2005 were accessed for the purpose of the present study. The records prior to this date were not assessed due to lack of completeness and availability.

Information relevant to the study was accessed by manually perusing case records of patients after obtaining ethical clearance from the ethical committee of the institution and written permission from the head of the unit.

Collection of data: A proforma was designed to enable collection of relevant data based on the above objectives.

The cause of the injury was classified as Road Traffic Accidents (RTAs), falls, assaults and others (animal attacks, industrial and agricultural accidents, pathologic, sports, etc.).

The anatomic location of the mandibular fractures was classified according to Ivy and Curtis[2] , while zygomatic complex fractures were classified as fractures of the arch, body of the zygomatic bone and comminuted fractures. The maxillary fractures were classified as Lefort I, II, and III [3] .

The systems-injuries were grouped into integumental, abdominal, neurological, pulmonary, cardiac, ophthalmologic and orthopedic systems.

STATISTICAL ANALYSIS

The data was entered into the MS-Office Excel 2007 and subjected to statistical analysis using the statistical package – XLSTAT- 2008.

The associations between age, sex, type and cause of fractures was assessed for statistical significance using chi-square test. The level of significance was set at 5%.

RESULTS

A total of 598 records were assessed for the present study. 52% of the patients treated at the unit had received primary care before being referred to the unit. The average duration of hospital stay was 5-9 days.

The patient's ages ranged from 1-78 years, with mean age of 29.65 (SD= 17.27 to 42.03) years. 87.29% (n=522) were males, resulting in a male to female ratio of 7:1.

Age and Sex distribution (Table 1): Overall (41.3%, n=247) and in the males (37.79%, n=226) the 21-30 yr age group were the most affected while for females the age ranged from 21-40yrs (7%, n=42). (Chi square 22.67= p value=0.001, df =5).

Figure 1

Table 1: Age and Sex Distribution Of Patients With Maxillofacial Fractures

AGE	SEX		
	Males n=522 (87.29 %)	Females n=76 (12.71%)	TOTAL n=598 (100%)
1-10yrs	22 (3.68%)	10 (1.67%)	32 (5.35%)
11-20yrs	87(14.55%)	6 (1.00%)	93(15.55%)
21-30yrs	226(37.79%)	21(3.51%)	247(41.30%)
31-40yrs	103 (17.22%)	21(3.51%)	124 (20.74%)
41-50yrs	51(8.53%)	12 (2.01%)	63 (10.54%)
51-60yrs	28 (4.68%)	5 (0.84%)	33 (5.52%)
61-70yrs	4 (0.67%)	1(0.17%)	5 (0.84%)
71-80yrs	1(0.17%)	0 (0.00%)	1 (0.17%)

Distribution according to the cause of injury (Table 2, 3, 4, 5): RTAs constituted 60.37%, n=361 of injuries, followed by falls (20.23%, n=121) and assaults (13.38%, n=80). Other causes (6.02%, n=36) included animal attacks (2.34%, n=14) and sports injuries (1.84%, n=11). Only age and sex distribution of patients with fractures due to assaults was found to be statistically significant (Chi square =7.934, p-value = 0.006 DF= 2)

Irrespective of the cause for trauma, the most affected age group was 21-30yrs, expect for assaults where the affected age group was 31-40 yrs in females.

Figure 2

Table 2: Distribution of Patients According To Cause of Injury

CAUSES	Sex		Total
	Males n=521 (87.12%)	Females n=77(12.88%)	n=598 (100%)
RTA	317 (53.01	44 (7.36%)	361 (60.37%)
Assault	71 (11.87	9 (1.51%)	80 (13.38%)
Falls	102 (17.06	19 (3.18%)	121 (20.23%)
Others	31 (5.184	5 (0.84%)	36 (6.02%)

Figure 3

Table 3: Distribution Of Patients Age And Sex In Relation To Road Traffic Accidents

AGE	SEX		
	Males n=317 (87.81%)	Females n=44 (12.19%)	TOTAL n=361(100%)
1-10 yrs	11(3.05%)	4(1.11%)	15(4.16%)
11-20 yrs	46(12.74%)	5(1.39%)	51(14.13%)
21-30 yrs	142(39.34%)	12(3.32%)	154(42.66%)
31-40 yrs	64(17.73%)	11(3.05%)	75(20.78%)
41-50 yrs	31(8.59%)	9(2.49%)	40(11.08%)
51-60 yrs	21(5.82%)	3(0.83%)	24(6.65%)
61-70 yrs	2(0.55%)	0	2(0.55%)

Figure 4

Table 4: Distribution of Patients By Age And Sex In Relation To Assault

Age	SEX		
	Males n=71(88.75%)	Females n= 9 (11.25%)	TOTAL n=80 (100%)
11-20yrs	13 (16.25%)	0	13 (16.25%)
21-30yrs	34 (42.50%)	1 (1.25%)	35 (43.75%)
31-40yrs	15 (18.75%)	5 (6.25%)	20 (25.00%)
41-50yrs	7 (8.75%)	1 (1.25%)	8 (10.00%)
51-60yrs	1 (1.25%)	1 (1.25%)	2 (2.50%)
61-70yrs	1 (1.25%)	1 (1.25%)	2 (2.50%)

Figure 5

Table 5: Distribution of Patients Age And Sex In Relation To Falls

AGE	SEX		
	Males n=102 (84.30%)	Females n=19 (15.70%)	TOTAL n=121 (100%)
1-10yrs	9 (7.44%)	4 (3.31%)	13 (10.74%)
11-20yrs	21 (17.36%)	1 (0.83%)	22 (18.18%)
21-30yrs	38 (31.40%)	8 (6.61%)	46 (38.02%)
31-40yrs	20 (16.53%)	4 (3.31%)	24 (19.83%)
41-50yrs	8 (6.61%)	1 (0.83%)	9 (7.44%)
51-60yrs	4 (3.31%)	1 (0.83%)	5 (4.13%)
61-70yrs	1 (0.83%)	0	1 (0.83%)
71-80yrs	1 (0.83%)	0	1 (0.83%)

Monthly distribution of fractures (p-value=0.006, df =33): Over 5 years, the months of March, May [13.04% (n=78) each] and June [10.7% (n=64)] admitted the highest number of patients while the least occurred in the month of November at 4.3% (n=26).

Distribution of fractures in patients according to the area of involvement: 62% (n=371) had isolated mandibular fractures and 23% (n=140) suffered isolated midfacial injuries. The distribution of fractures in patients according to the cause of injury (Table 6) was found to be statistically significant (Chi square= 18.721, p-value=0.005 at df = 6):

Figure 6

Table 6: Distribution of Maxillofacial Fractures According To Cause Of Injury

CAUSES	PATTERN OF FACIAL FRACTURES			
	Mid-face alone n=140 (23.41%)	Mandible alone n= 371 (62.04%)	Mandible + middle 1/3rd n=87 (14.55%)	TOTAL n=598 (100%)
RTAs	92 (15.38%)	204 (34.11%)	67 (11.20%)	363 (60.70%)
Assaults	20 (3.34%)	54 (9.03%)	4 (0.67%)	78 (13.04%)
Falls	21 (3.51%)	88 (14.72%)	12 (2.01%)	121 (20.23%)
Others	7 (1.17%)	25 (4.18%)	4 (0.67%)	36 (6.02%)

Distribution pattern of Mandibular and Mid-facial fractures and as related to cause of injury : The most common site involved was the parasymphysis at 44.98% (n= 291) and Zygomatic complex at 29.81% (n= 93) both with greater predilection for the right side. The coronoid and zygomatic body were the least affected.

In case of the mandible, RTA's were responsible for 60% (n=384). Parasymphysis was the most common site affected irrespective of the cause of injury. Mandibular fractures as related to cause of injury was statistically significant (Chi square=33.089 p-value=0.045, df=21).

In the midfacial region 70.51% (n= 220) fractures were caused due to RTA's and falls respectively. In both cases, fractures of the zygomatic complex were the highest at 22.76% (n=71) and 3.85% (n=12). Of the 10.90% (n= 34) caused due to assaults, 1.96% (n=6) comprised of Lefort fractures. Midfacial fractures as related to cause of injury were not found to be statistically significant. (Chi square=24.5 p-value= 0.139 DF=18)

Distribution of associated systems injuries: 589 concomitant injuries were observed in 598 patients with neurological injuries at 45.33% (n=267) followed by orthopedic and ophthalmic injuries at 14.26% (n= 84), and 7.47% (n= 44) respectively.

Loss of consciousness contributed to 35.65% (n= 210) of the

neurological injuries, and was frequently associated with fractures of the zygomatic complex (32.31%, n= 42) and parasymphysis (48.72%, n= 114) while least with fractures of the zygomatic body and coronoid process at 0.43% (n=1).

Treatment Methods Employed: Open reduction and internal fixation (ORIF) method was employed in 85.45% (n= 511) cases and closed reduction in 10.87% (n= 65). The rest did not receive treatment if the fracture fragments were stable or the patients declined treatment against medical advice.

Postoperative Complication: Of the 572 patients treated, postoperative complications were observed in 190 patients (32%). Infection was the most common complication at 47.89% (n= 91) followed by malocclusion at 17.89% (n= 34). 25% cases of postoperative infection underwent removal of the infected plate resulting in further extension of hospital stay.

Year Wise Distribution of Postoperative Complications (Table 7): Over the 5yrs the rates of postoperative complications reached a high of 8.39% in the year 2002 which tapered to 3.15 % in the year 2005. The decrease in post operative complication over the 5 years was found to be statistically significant (p-value=0.010 DF=4).

Figure 7

Table 7: Year wise Distribution of Post Operative Complications in Patients Treated for Maxillofacial Fractures

		Total no treated	
	Total cases	at the unit	Complications
YEARS	n=598	n=572	n=190 (33.22 %)
2001	105 (17.56 %)	98 (17.13 %)	46 (8.04 %)
2002	130 (21.74 %)	127 (22.20 %)	48 (8.39 %)
2003	129 (21.57 %)	122 (21.33 %)	41 (7.17 %)
2004	114 (19.06 %)	110 (19.23 %)	37 (6.47 %)
2005	120 (20.07 %)	115 (20.10 %)	18 (3.15 %)

DISCUSSION

The evolution of man has made the frontal regions of the face susceptible to trauma and fractures. Maxillofacial injuries though rarely fatal, are responsible for subjecting tremendous physical and psychological anguish on the affected.

Worldwide differences in the distribution and occurrence of maxillofacial fractures have been stated to be a result of differing socio-economic, cultural and environmental influences [4].

In the present study the male to female ratio was 7:1, which is in contrast to high ratios in Turkey [5] (25:1) & Nigeria [6] (16.9:1) and low ratios in Jordan [7] (1:1), and Scotland [8] (3:1). Studies, which mimic ratios of our study, were seen Nairobi [9] (8.4:1) and Libya [10] (7:1). The higher preponderance of male subjects could be attributed to the fact that males are the bread earners of the family and work out-doors, likely to be involved in violent conduct, participate in sports, and drive recklessly [4].

The most commonly affected age was 21-30 yrs which is similar to findings of other studies [6,10,11], which could be attributed to greater physical activity and self-mobility seen in this group .

In the present study, RTA's constituted the most common cause of injury; similar to studies conducted in Greece [12] and Iran [13]. In contrast, studies conducted in Glasgow [8] and Shimla [14], found assaults and falls respectively to be more common causes. RTAs as a cause for morbidity and mortality are on the rise in India. Liberalization in the early 90's, rapid urbanization and the improving Indian economy has led to a huge increase in motorization. However, improvements in infrastructure have not kept up with the surge in vehicular traffic on Indian roads. Poor vehicle maintenance, lack of enforcement of traffic rules, poor educational status of the drivers, inadequate trauma care, legislation and political will compound the problem.

Summer months of March, May and June had the highest number of injuries [5,13]. The reason could be good weather conditions for the scheduling of vacations, leading to greater opportunities for outdoor activities and traveling.

Various studies confirmed isolated fractures of the mandible to be the most common bone affected [5,15]. This preponderance could be due to the fact that the mandible is the most prominent and the only moveable facial bone and is fractured more often than the well-articulated midfacial bones. While parasymphysis as the most common site was confirmed by Vetter et al [7], contrasting results were obtained showing the condyle [15] and body [5] as frequently affected sites.

In the present study, among the fractures of the midfacial

region, the zygomatic complex factures were most common followed by Lefort fractures. Similar results were obtained in other studies [6,7,11] . The midfacial region tends to act like a 'crumple zone' for the cranium and skull base when excessive forces are absorbed [16] .

In the present study, we found fractures of the parasymphysis, the most frequent fractures irrespective of the cause on injury which is in contrast to a study where body of the mandible was the affected site in RTA's and assaults [8] .Review of literature reveals that the most common site of involvement in case of falls was the condyle [17] , which is in contrast with the present study. This could probably be due to the false reporting of fractures due to assaults and/or RTAs as occurring due to falls for fear of reprisal or to avoid medico-legal complications.

The present study illustrated that facial fractures can occur in combination with other injuries, which is corroborated by findings from other studies [6,18,19] . Hence immediate diagnosis and intelligent cooperation of general surgical, orthopedic, plastic, maxillofacial, neurosurgical and ophthalmic and dental teams is of paramount importance.

Multiple fracture patterns serve a neuroprotective function, allowing dissipation of force and resulting in the transmission of less residual energy to the cranial vault. When the jaw sustains fewer or less severe fractures, more forces travel to the vault as the jaw absorbs less energy [20] , thereby leading to loss of consciousness. This was corroborated in the present study where nearly 50% of patients with isolated parasymphyseal fractures suffered from loss of consciousness.

In the present study, open method of fracture reduction was employed in 85.45%, higher than values of 60% found in study by Vetter [7] , 40% by Hosein [21] .

The present study indicated that 32% suffered from post-operative complications, which is higher than that found by Hosein [21] (18%) and lower than that found by Aboise [22] (61.54%). The high rates of infection in the present study could be ascribed to the use of ORIF methods of treatment [16] . Over the 5 yrs the rates of postoperative complications have decreased drastically, which could probably be due to decrease in rates of postoperative infections.

CONCLUSIONS

The number of injuries in a region is important not only in the organization of regional trauma services but also for introducing legislation, instituting measures for prevention, assessing the effectiveness of existing preventive measures, audits and conducting new research. In the present study adequate information could not be obtained on some factors like occupation, level of education, drink driving, helmet/seatbelt use, and type of RTAs etc. An appropriate recording format therefore needs to be developed which would enable collection and retrieval of data for future studies more efficient.

Due to continuing changes in the trends of maxillofacial trauma, further epidemiologic studies of facial fractures are essential which might throw additional light on the etiology of maxillofacial fractures and also suggest novel ways of prevention.

APPENDIX

Abbreviations used RTA - Road Traffic Accidents ORIF – Open Reduction and Internal Fixation CFU – Craniofacial unit SD - standard deviation df - degrees of freedom

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Author Information

Arishka Devadiga, BDS, MDS
Assistant Professor, Department of Community Dentistry, Yenepoya Dental College

K.S.V. Prasad, BDS, MPH
Professor and Head, Department of Community Dentistry, S.D.M Dental College and Hospital