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An audit of maxillofacial fractures in patients attending the Medunsa Oral Health Centre, University of Limpopo, Medunsa Campus

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An Audit of Maxillofacial Fractures in Patients attending the Medunsa Oral Health Centre, University of Limpopo, Medunsa Campus

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfillment of the requirements for the degree of

Master of Science in Dentistry

June, 2009

DECLARATION

I, Dr. A.S. Singh declare that this research report is my own work. It is being submitted for the degree of Master of Science in Dentistry to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University



……
Dr. A.S. Singh

10th day of June 2009

Dedication

I dedicate this research report to my loving wife (Jerusha), son (Rohit), daughter (Kritika) and parents for their sacrifices, time and motivation to help complete this research report.

Acknowledgement

I wish to thank my undergraduate lecturers for moulding a life long learner, my supervisors and mentors Prof M. Altini and Prof MMR Bouckaert. I would like to acknowledge Mr. Riaz Hoosen for sparing his time in helping to collect the materials and data for the completion of this project as well as Miss Maritia Burger for her assistance with typing, as well as colleagues and friends who were motivational and encouraging during the course of this project.

Abstract

Aim: The aim of this retrospective study was to record the number and demographics of patients presenting with maxillofacial fractures at the Garankuwa Hospital, University of Limpopo, Medunsa Campus. In addition, the nature of these injuries and the aetiological factors involved were recorded and analysed.

Materials and methods: The approach to this study was collection of data from records of patients who were treated at the Maxillofacial and Oral Surgery Department for injuries (fractures) to facial bones. All the records for the period January 2002 to December 2005 were analysed.

Results: For the period (2002-2005) under review 4000 patient files were retrieved and analysed. These consisted of 1755 (43,88%) patients with mandibular or middle or upper third cranio-facial fractures who were included in this study and 2245 (56,13%) patients who had been treated as in or out patients for other oral and maxillo-facial procedures or pathology, who were excluded. The 1755 patients consisted of 232 (13.22%) females and 1519 (86.55%) males giving a male to female ratio of 6.55:1. Seventy percent of all the patients were in the age group 20-39 years with a peak frequency in the 3rd decade. The minimum age was two years and the maximum age was 88 years. A total of 2427 fractures were recorded. Of these 2077 (85.58%) occurred in the mandible where the most common sites were the angle (28.97%), the parasymphisis (17.43%) and the body (14.75%). Nearly 80% of the fractures were caused by personal assaults, 14.87% by motor vehicle accidents, 2.34% by gunshot wounds and 3.93 % by falls.

Conclusion: In conclusion this study has shown that in a South African population being studied, the leading cause of fractures to the maxillofacial skeleton were interpersonal violence (assaults and gunshots) followed by motor vehicle accidents.

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CHAPTER 1

1.1 Introduction

Patients presenting with maxillofacial injuries are common at most referral hospitals in South Africa. In order to develop effective treatment strategies (which includes budgetary and manpower allocations) and preventive programs it is necessary to conduct an audit of patients presenting with maxillo-facial injuries in the various hospitals. This is the first study of its kind to be carried out at the Medunsa Oral Health Centre, University of Limpopo and Garankuwa Hospital.

1.2. Setting

Doctor George Mukhari Hospital (previously Garankuwa) is a 1500 bed referral hospital located in Garankuwa, 32 km from the Pretoria central business district. It is affiliated to the University of Limpopo, Medunsa Campus. The hospital serves several neighbouring regions and is in a semi rural area. Personnel from the Oral Health Centre of the University provides clinical services to the hospital and to patients referred to the centre from Garankuwa Hospital.

CHAPTER 2

Aim

The aim of this retrospective study was to record the number and demographics of patients presenting with maxillofacial fractures at the Garankuwa Hospital, University of Limpopo, Medunsa Campus. In addition, the nature of these injuries and the aetiological factors involved were recorded and analysed.

CHAPTER 3

Literature Review

Retrospective studies such as this have been conducted in many different countries and in patients of different age groups. It is of interest to note the variability in the type of facial injuries depending on the patient demographics and etiological factors involved.

Several audits of maxillofacial injuries have been carried out in the Johannesburg area at various hospitals, which are serviced by the Division of Maxillofacial and Oral Surgery of the University of the Witwatersrand. The nature and type of maxillofacial injuries seen in South African children aged 18 years or less at six teaching hospitals affiliated to the University of the Witwatersrand have been studied by Bamjee et al (1996).[1] They found that 326 (8%) of the 4192 patients seen in his unit with maxillofacia1 injuries were patients within the age group of 18 years or younger. The male to female ratio was 2.3:1 and most of the injuries occurred in the age group of 13 – 18 due to assaults, fights and gunshot wounds, which accounted for 155 cases (48%). Mandibular injuries were the most common (64%) followed by maxillary fractures (25%). Violence was the most common cause of the injuries.

Using the same database Bamjee et al (1996) reported on paediatric maxillofacial trauma.[2] This study only included patients younger than twelve years of age. Of the 4192 facial trauma cases, 3% were children younger than twelve years. The study showed that the cause of injury varied with age. Accidental falls were the most frequent causes of facial injury in this age group. Violence was particularly common among the teenage

group. Motor vehicle accidents were less common among teenagers than younger children. It was found that the body of the mandible and dentoalveolar fractures were the most common sites of injury. He concluded that differences in the pattern of maxillofacial fractures between children and adults must be recognized to provide for appropriate diagnosis and treatment. Facial fractures in children may go unrecognised due to inadequate evaluation of the injury.

Snijman in 1963 reported on 1699 patients with facial skeleton fractures who were treated at The University of Pretoria.[3] It was shown that 83% occurred in black patients and 17% in white patients. The majority of the fractures occurred in the mandible and intentional violence was the major causative factor.

In 1979, 389 cases of facial fractures were reported (Beaumont et al 1985).[4] Seventy four percent occurred in blacks, 15% in whites and 11% in coloured and in Asian patients. This study was conducted in the Johannesburg group of teaching hospitals for the period 1 July 1979 to 31 December 1979. The youngest patient was a 5-year-old coloured child and the oldest was a 72-year-old black male. The mandible was the most common site of fracture. The commonest cause of injury among the black, coloured and Asian patients was assault, and in the whites it was found to be MVA's (motor vehicle accidents). This is in contrast to several international studies, where traffic accidents accounted for most of the mandibular fractures.[8, 10, 11, 13]

Low velocity handgun injuries also contribute to facial injuries. 40 such cases, which were seen in Johannesburg, were reviewed by Cohen, Shakenovsky and Smith (1995).[5] They found that the majority of the cases were due to assault by low velocity hand guns followed by accidental shooting and failed suicide attempts. Injuries ranged from soft tissue damage without fractures to severe comminuted fractures of the facial bones. These injuries were rarely life threatening. In 60% of the cases the bullet did not exit but was retained within the soft tissues. The floor of the mouth and the tongue were the soft tissues commonly injured. Mandibular fractures occurred in 58% of cases, followed in frequency by maxillary complex fractures. Twenty percent of the fractures involved the bones of the upper, middle and lower third of the facial skeleton.

Tsakiris, Cleaton Jones and Lownie (2002)[6] assessed the airway status in maxillofacial gunshot injuries in Johannesburg. An audit of 11 622 maxillofacial surgical cases was reviewed from January 1987 to December 1992. They found that 1.8% (211) of these cases were the result of gunshot wounds. They also reported an increase in the prevalence of gunshot injury cases within the total sample from 9% to 37% over the period 1987 to 1992. The sample showed a predominance of black male patients aged between 20 to 29 years and found that an abnormal airway is more likely to develop with high velocity injuries. The frequency of gunshot wounds to the maxillofacial area in Johannesburg was higher (211 in 6 years) compared with Cape Town (311 in 15 years.)

The latest of this series of studies emanating from the Johannesburg group of teaching hospitals consisted of an analysis of 95 condylar fractures, which occurred, in 84 patients,

mostly males (82%). Among the males assault (75.4%) was the most common cause of the fractures, as it was amongst the females (80%), followed in frequency by MVA, and falls. Most of the patients were in the 3rd to 5th decades.[7]

During a ten - year period (1993 to 2002), 521 patients with 681 mandibular fractures were treated at a medical centre in Portugal.[8] Motor vehicle accident (MVA) was the most common cause of the fractures (53.9%). Almost half of the patients (48.8%) were in the age group 16 to 18 years. The condyle of the mandible was involved in 31.0% of the fractures.

In a study involving 3385 patients younger than 15 years of age from Austria 6060 craniomaxillofacial injuries were sustained. Analysis of this group of patients showed that they sustained injuries due to play (58.2%), sport (31.8%), traffic accidents (5%), acts of violence (3.9%) and other causes (1.1%).[9]

In Tehran 400 (5%) patients, out of 8000 trauma patients, sustained facial injuries.[10]
The male to female ratio was 4.5:1 and 53% were aged between 11 to 30 years.
Traffic accidents were the commonest cause of injury. Motorcyclists who wore helmets sustained fewer facial fractures than those who did not. Soft tissue injuries and facial bone fractures comprised 43.3% and 40.8% of the injuries respectively. Seventy nine percent of soft tissue injuries were located extraorally. The mandible and nasal bones were the most commonly fractured facial bones. Victims of assault sustained more severe injuries compared to those involved in falls and traffic accidents.

Three studies from the University College in Ibadan Nigeria have reported on facial injuries in various age groups.[11-13] The first study reports the findings in the age group 16 years or less. A total of 1203 patients of all ages were treated for facial fractures. Ninety-three patients were within the age range of 16 years or less.[11] The male to female ratio was 2.6:1 and 53.8% were within the age group of 11-16 years. The mandible was more commonly fractured than the middle third of the facial skeleton. Road traffic accidents (51.6%) were the most common cause of the facial fractures.

The second study consisted of 103 patients with middle third fractures of the facial skeleton that were seen and managed over a five-year period in Ibadan.[12] The male to female ratio was 7.6:1. Most of the fractures occurred in the 21-30 year age group. Road traffic accidents were responsible for the majority of the fractures (78.7%). The zygomatic complex was the most frequently involved area, which was treated by open reduction with transosseous wiring of the fracture lines.

The third study analysed 1689 patients of all ages with facial injuries over a 15 year period.[13] Patients of 60 years and older accounted for 53 (3.1%) of the total. The male to female ratio was 1.1:1. Road traffic accidents were the most common cause of the fractures (58.5%). The mandible was involved in 91% of the cases. It was concluded that attention be paid to updating driving courses and home safety instructions in order to reduce the incidence of maxillofacial injuries in the elderly.

An analysis of patients 65 years and older treated for dental and maxillofacial trauma in New Zealand revealed an increase in the rate and absolute number of injuries among older people. [14] The dental trauma rate was highest among males and the facial fracture rate was highest among older females. There was a general increase in the contribution of falls to the occurrence of trauma.

During a period of ten years (1991- 2000) 9,543 patients with craniomaxillofacial trauma were admitted to the Department of Oral and Maxillofacial Surgery, University of Innsbruck.[15] Five major mechanisms of injury existed in which 3,613 (38%) were activities of daily life, 2991 (31%) sports, 1170 (12%) violence, 1116 (12%) traffic accidents, 504 (5%) work accidents, and 149 (2%) other causes. A total of 3,578 patients had facial bone fractures and 5,968 had soft tissue injuries. The male to female ratio was 2:1. The mean age was 25.8 +/- 19.9 years. The conclusions of this study was that older persons were more prone to bone fracture (increase of 4.4% per year of age) and soft tissue injuries (increase of 2% per year of age) while younger persons were more susceptible to dentoalveolar trauma.

From Tehran a study reported on 173 mandibular, 33 maxillary, 32 zygomatic, 57 zygomatico- orbital, 5 cranial, 5 nasal and 4 frontal bone fractures.[16] Of the maxillofacial injuries 73 were caused by car accidents, 55 by motorcycle accidents, 23 by altercations, 15 in sports events and 23 caused by warfare confirming the view that the causes and incidence of maxillofacial injuries vary from one country to another.

The Department of Maxillofacial and Oral Surgery at Tawam Hospital United Arab Emirates reported on 144 patients with maxillofacial injuries seen between January 1998 and December 31 2001.[17] The most frequently injured patients belonged to the age group of 16 to 20 years. The male predilection was 83% and road traffic accidents were the most common causative factor (59%) followed by falls, which was 21.5%. Assault accounted for 4.1%, work 4.8%, sport related injuries 4.8% and accidents where camels were involved accounted for 5.5%. A total of 53.4% sustained mandibular fractures, 32.6% had midface fractures and 13.8% had combined midface and mandibular fractures. The final report found an increase in maxillofacial injuries from 28.3% (1990-1995) to 36% (1998 – 2001) on an annual average. The study concluded that the seat belt laws were being ignored in that country.

A descriptive study to determine the etiology and pattern of maxillofacial injuries in the armed forces of Pakistan was undertaken by Khan et al (2007).[18] The most frequent bone fractured was the mandible (53%), followed in frequency by the zygomatic complex (17%). The most common cause of the fractures was MVA's (56%) followed by accidental falls (23%), gunshot injuries (9%), and sports related injuries (5%). Interpersonal violence accounted for only 4% of the fractures.

A study by Brasileiro and Passeri[19] evaluated 1024 patients presenting with 1399 maxillofacial fractures. The mean age was 28 +/- 16.4 years with a range from 0 to 88 years. The ratio of male to female was 4:1. Most of the fractures were caused by traffic accidents (45%), followed by assaults (22.6%) and falls (17.9%). Most fractures involved

the mandible (44.2%), followed by the zygomatic complex (32.5%) and nasal bones (16.2%).

A second study from Brazil by Martini et al[20] evaluated 91 mandibular fractures collected over a period of 1 year. Motorcycle accidents were the major cause of the mandibular fractures followed by assaults and falls. The body, symphysis and condyle were the mandibular sites most commonly fractured. The patients consisted mainly of males in the 21 to 30 year age group.

Patrocinio et al[21] analysed 293 patients with mandibular fractures and reported an increase in frequency. Males were affected more frequently than females (4:1) and they were mostly in the third decade of their lives. The most common cause of the fractures was traffic accidents and the symphysis and condyles were the sites most frequently involved.

In contrast, a study in Germany by Depprich et al[22] reported that over a 10 year period the rate of mandibular fractures had remained constant. There was no change in the male to female ratio of 2.3:1 and the mean age of 33.3 years remained constant. The most common fracture site was the condyle (47%) followed by the angle (29.4%). The major causes of the fractures were assaults (38.6%) followed by accidental fall (27.3%).

A survey conducted in Pretoria by Roode et al [23] revealed mandibular fractures as being more common in males in the age range of 21 to 40 years. Interpersonal violence was the

major cause of these fractures. Majority of the fractures occurred in the body region of the mandible. The other common etiological factors were found to be road traffic accidents and falls.

CHAPTER 4

4.1. Materials and methods

Ethical clearance (research number M060821) for this retrospective study was granted by the Committee for Research on Human Subjects (Medical), of the University of Witwatersrand, and the Research and Ethics Committee of Medunsa where the study was conducted.

Patients with maxillofacial fractures who presented to the Department of Maxillofacial and Oral Surgery over a four-year period (ranging from January 2002 to December 2005) were included in the study. Data was collected from patient records including radiographs.

Data was recorded on a separate data collection sheet under various categories, as shown below.

Table 4.1 An example of the data collection table used to record the information

Date of injury	**Cause/etiology Of injury**	**Site of injury: Mandible/Middle third Orbit/Zygoma/ left or right and upper third Frontal bones/other bones of the skull**	**Gender**	**Age**	**Associated injuries**	**Type of treatment done**	**Abuse in children or women**

Patients were excluded from the study if their records were incomplete or ambiguous or if the fracture occurred secondary to a pathological lesion. Patients presenting for retreatment of previous injuries were also excluded.

Fractures involving the mandible were anatomically recorded. In order to maintain a standardised format the symphysis was defined as the region between the distal aspects of the 32 (lower left lateral incisor) up to the distal aspect of the 42 (lower right lateral incisor). The parasymphyseal region was identified as that area from the mesial aspect of the 33 up to the mesial aspect of the 36 (lower first molar) on the left side. The right side extended over a similar tooth distribution that extended from the 43 up to the mesial aspect of the 46 (lower first molar). Other anatomical sites of the mandible consisted of the body, ramus, angle, condylar head and neck and the coronoid process. Associated soft tissue injuries were not recorded.

Fractures of the middle one third (midface) of the facial skeleton were anatomically recorded as: dentoalveolar fractures of the maxilla, maxillary fractures (Le Fort I, II and III), naso-orbito-ethmoid (NOE) fractures, orbital fractures, nasal bone fractures, zygoma and zygomatic arch fractures. The upper one third of the facial skeleton involved the frontal bone.

4.2. Statistics

All the data collected was transferred to an electronic database. The frequency of maxillofacial injuries seen at the hospital was calculated by expressing the number as a percentage of the total number of patients seen at the hospital during this period. Descriptive statistics was used and statistical significance was tested for using the Student t test, Chi square test with Yates correction and Fishers exact test. A logistic regression analysis was conducted to assess the significance of possible causative factors to various facial bone fractures. All statistical procedures were performed on SAS®, run under Microsoft®,Windows®.

CHAPTER 5

RESULTS

5.1 Frequency

For the period under review, 4000 patient records were retrieved and analyzed. Of these 1755 patients (43, 88%) presented with maxillofacial fractures and were therefore included in this study.

5.2 Gender

The 1755 patients consisted of 232 (13.22%) females and 1519 (86.55%) males giving a male to female ratio of 6.5:1. The gender of the patients was not stated in four cases (Table 5.1, Fig 5.1).

Table 5.1 Number of male and female patients admitted for treatment of facial fractures

Total number Of patients	*MALES*	*FEMALES*	*MISSING*	*M: F*
1755	1519 (86.55%)	232 (13.22%)	4 (0.23%)	6.55: 1

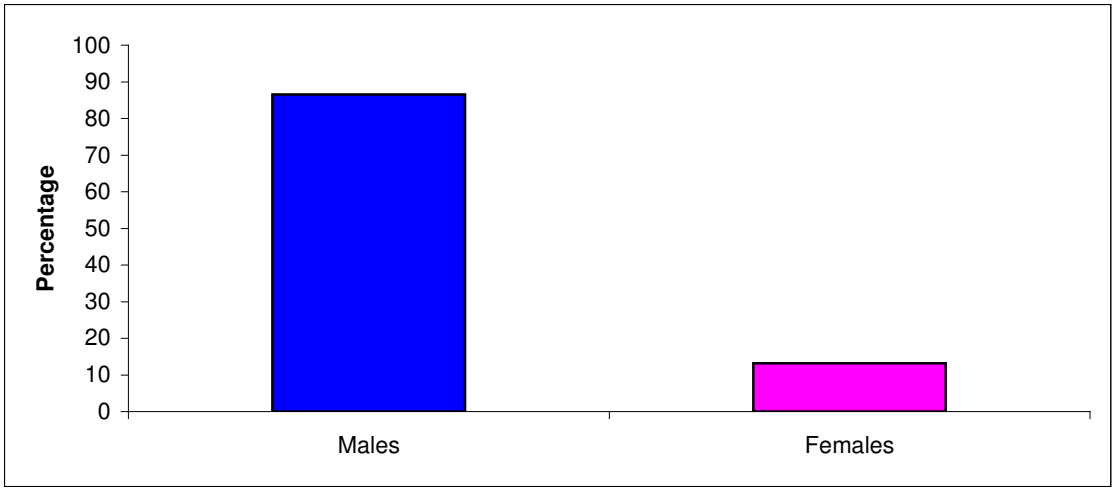


Figure 5.1 Gender distribution of patients admitted for treatment of maxillofacial fractures.

5.3. Race

All patients in this study were black.

5.4 Age

The age distribution of the patients is shown in Figure 5.2 and Table 5.2.

In both males (71.2%) and females (63.4%), the majority of the patients were in the age group of 20-39 years with a peak frequency in the 3rd decade. The minimum age was two years and the maximum age was 88 years.

Table 5.2 Age distribution of 1755 males and females with maxillofacial fractures

n	*Mean age (Yrs)*	*Standard deviation*	*Minimum age (Yrs)*	*Maximum age (Yrs)*
1755	31.80	11.76	2	88

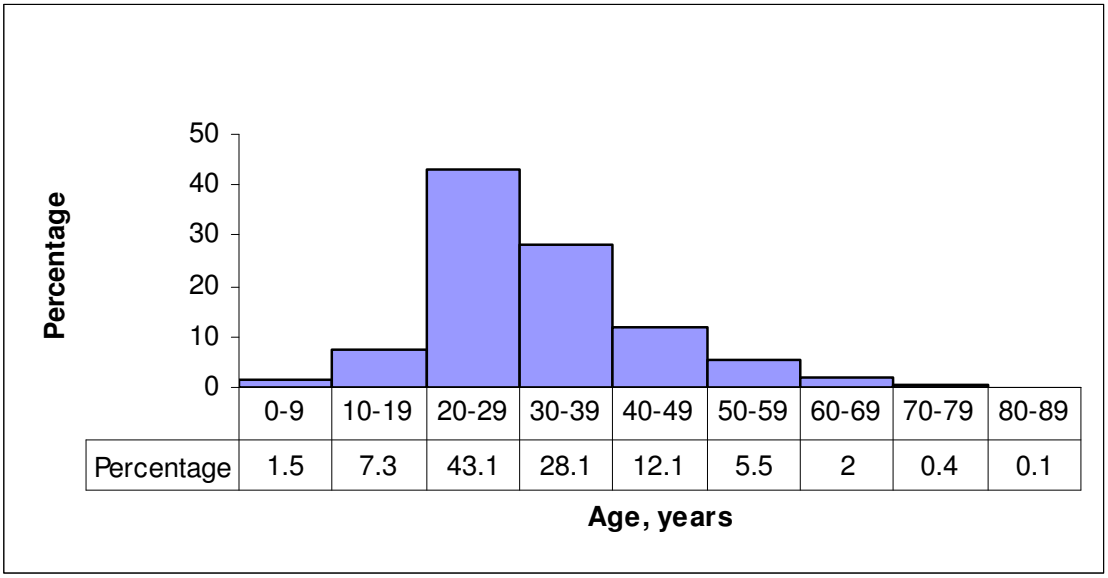


Fig 5.2 Histogram showing age distribution of males with maxillofacial fractures

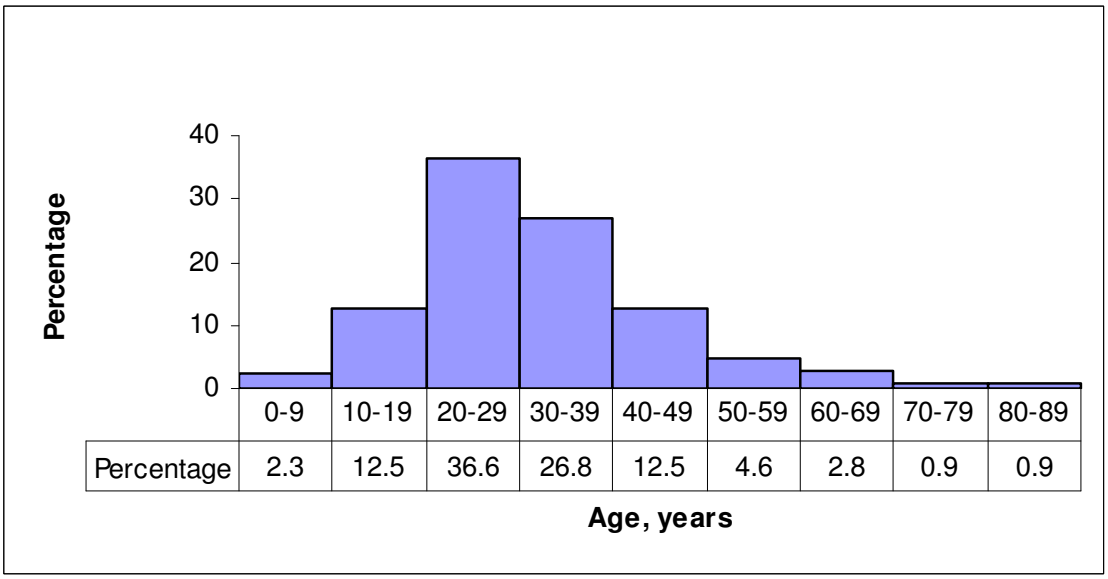


Fig 5.3 Histogram showing age distribution of females with maxillofacial fractures

Comparison of the mean ages of the males and females showed no significant difference (Student t test $p = 0.59$).

5.5 Site

The site of the fractures was recorded according to the anatomical location. Many patients had more than one fracture; in such cases each fracture was recorded as a separate entity (Table 5.3; Fig 5.4). A total of 2427 fractures were recorded. 1975 (81.38%) occurred in the mandible, where the most common sites were the angle (28.97%), the parasymphysis (17.43%) and the body (14.75%).

Four hundred and fifty two fractures (18.62%) occurred in the middle and upper third of the facial skeleton. Most fractures in the middle third occurred in the zygoma and zygomatic arches (7.79%), dentoalveolar (4.49%) and orbits (2.88%).

Table 5.3 Site frequency distribution of 2427 maxillofacial fractures

SITE	**Total**	**%**
Mandible		
Angle	703	28.97%
Body	358	14.75%
Condyle	168	6.92%
Coronoid	16	0.66%
Parasymphysis	423	17.43%
Ramus	60	2.47%
Symphysis	247	10.18%
Sub-total	1975	81.38%
Middle Third		
Maxilla	61	2.5%
Nasal-bones	13	0.54%
Orbit	70	2.88%
Dento-alveolar	109	4.49%
Zygoma /Zygomatic arch	189	7.79%
Upper Third		
Frontal bone	10	0.41%
Sub-total	452	18.62%
Total	2427	100%

The sites of injury were recorded separately according to the anatomical distribution of the facial skeleton. Although patients may have had combination fractures, each fracture was recorded as a separate entity. The results of which were as follows:

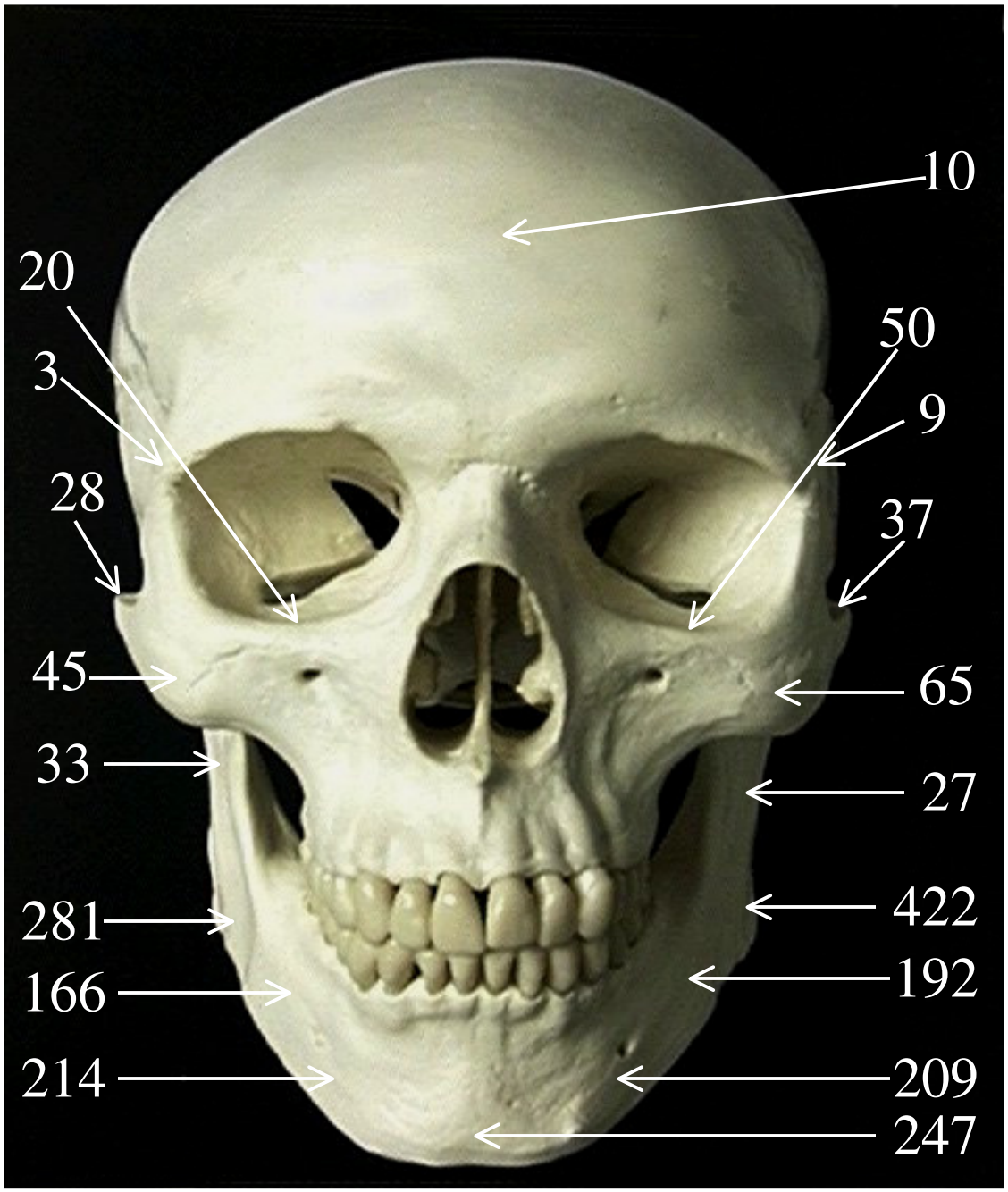


Figure 5.4 Anatomical locations of maxillofacial fractures

5.6 Aetiology

The aetiological agents responsible for the fractures are summarized in Table 5.4. Analysis of this data shows that 77.32% of the fractures were caused by personal assaults, 14.87% by motor vehicle accidents (MVA's), 2.34% by gunshot wounds and 4.33% by falls (Table 5.4, Fig 5.5). Only these four major aetiological groups will be analysed, as the numbers in the other categories are too small to warrant further consideration.

Table 5.4 Causes of maxillofacial fractures

Assault	1357	77.32%
Sports injuries	10	0.57%
Falls	76	4.33%
Gunshot wounds	41	2.34%
Injury on Duty	2	0.11%
MVA (motor vehicle accidents)	263	14.99%
Unknown	6	0.34%
Total	1755	100%

If the number of males and females in each of the four major aetiological categories is compared with the number of males and females in the other three etiological categories in absolute terms there are naturally many more males than females affected in all of the categories given the huge preponderance of males in the sample as a whole. However, in relative terms males are at greater risk of developing a fracture due to assault than females whereas females are at greater risk of developing fractures due to MVA's, gunshots and falls than males. This difference was highly statistically significant (Chi square test for independence, p = 0,0001) (Table 5.5)

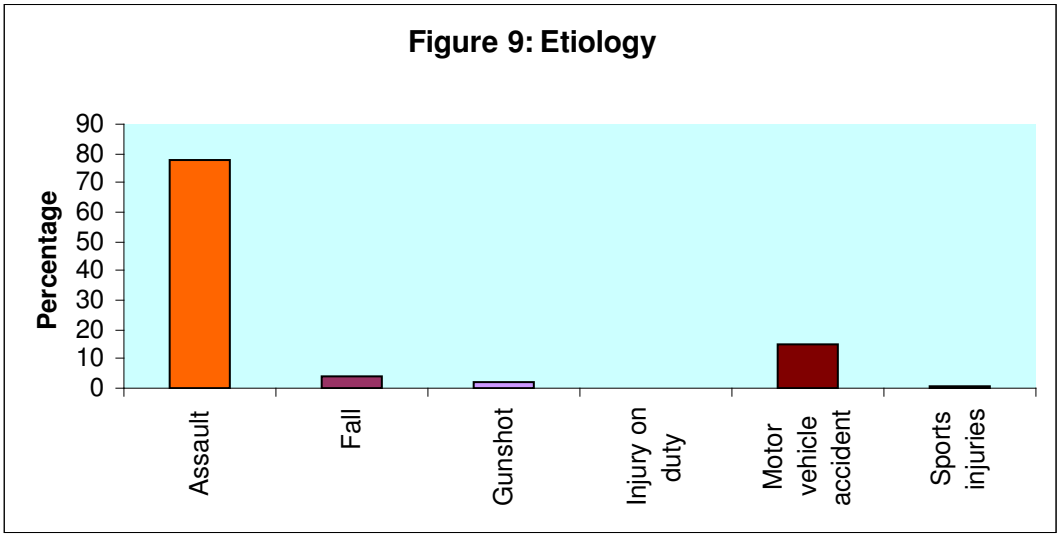


Figure 5.5 Percentages of patients that sustained maxillofacial fracture due to various causes

Table 5.5 Four main causes of maxillofacial fractures in males and females

	Males	**Females**	**Total**	**Ratio**
Assault	1201	156	1357	7,7:1
Motor vehicle accidents	206	55	261	3,8:1
Gunshots	33	8	41	4,1:1
Falls	63	13	76	4,9:1
Total	1503	232	1735	6,5:1

If the mean ages of the patients in the four main categories of cause of injury are compared it is found that for females the mean age of those injured due to gunshots was significantly older than the mean age of the patients in the other three major aetiological categories, whereas for the males the mean age of the patients who were assaulted and those involved in MVA's was significantly older than those who suffered injury due to gunshots (student t test $p < 0.05$).

5.6.1 Assault

One thousand two hundred and one (88.5%) males and 156 (11.5%) females suffered a fracture as a result of a personal assault. The male to female ratio of 7.7: 1 is higher than the ratio for the sample as a whole. Chi square test with Yates correction showed this difference not to be statistically significant (p = 0.1527) (Table 5.6).

Table 5.6 Comparison of number of males and females who suffered fractures due to assault with the male to female distribution for the entire sample.

	Males	*Females*	*Total*	*Ratio*
Assault	1201	156	1357	7,7:1
All	1519	232	1751	6,55:1

Chi Square test with Yates correction p = 0, 1527

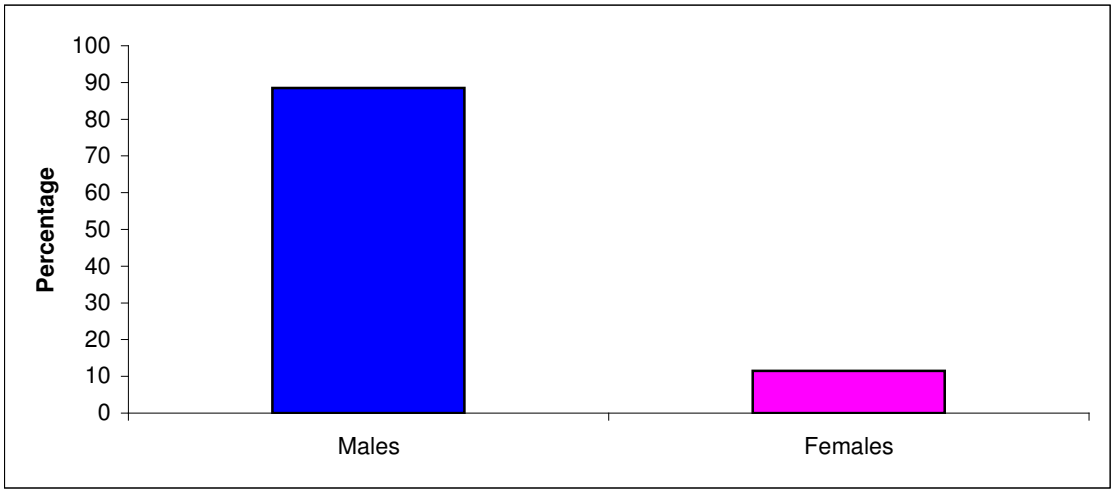


Figure 5.6 Percentage of males and females who suffered maxillofacial fracture due to assault

Table 5.7 Age distribution for the entire sample of assault patients

n	*Mean age (yrs)*	*Standard deviation*	*Minimum age (yrs)*	*Maximum age (yrs)*
1357	32.19	11.04	2	86

The mean age of assault victims was found to be 32.19 years.

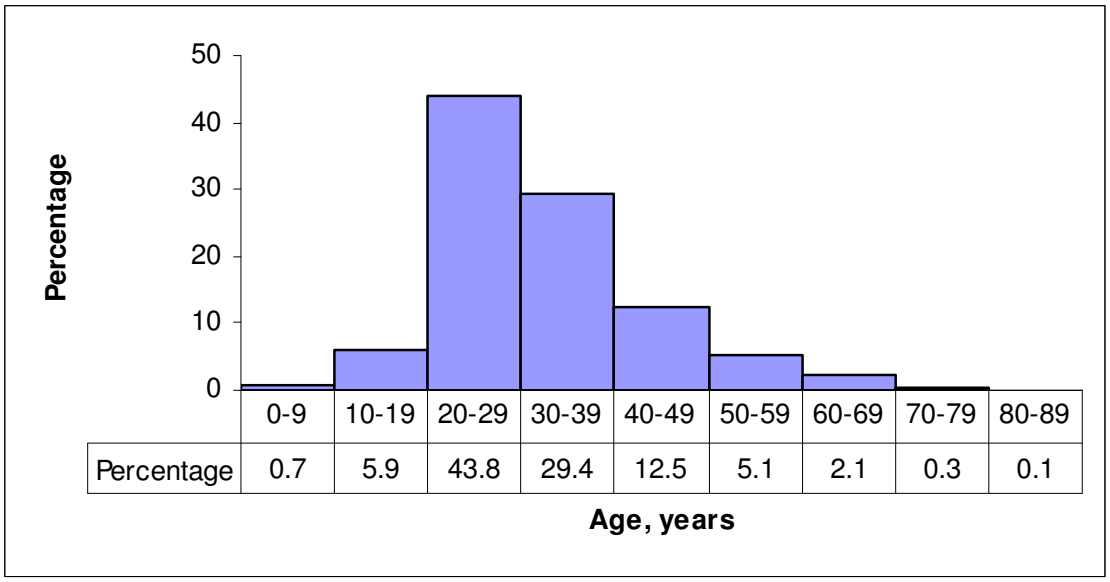


Figure 5.7 Age distribution of male patients who were assaulted.

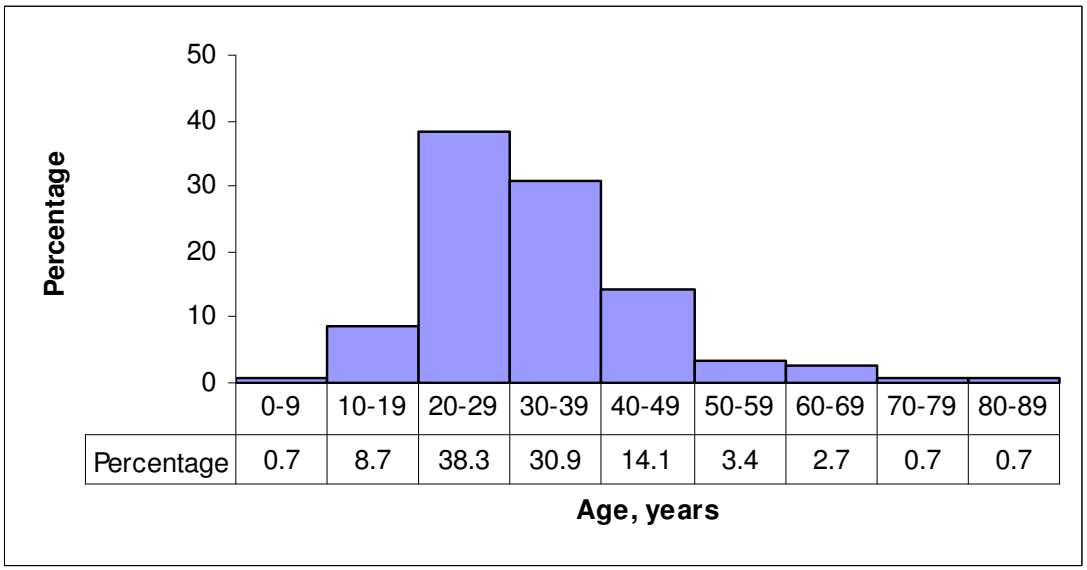


Figure 5.8 Age distribution of female patients who were assaulted.

If the mean ages of the males in this aetiological category are compared with the mean ages of the females there is no significant difference (student t test p = 0.48). The site distribution of those fractures caused as a result of an assault is shown in Table 5.8 separately for the males and females.

Table 5.8 Site distribution of maxillofacial fractures in males and females due to assault

	Males %	**Females %**
Mandible		
Angle	32.82	28.37
Body	15.13	17.67
Parasymphisis	18.24	16.74
Symphisis	9.58	7.44
Condyle	5.37	5.12
Ramus	2.56	0.47
Coronoid	0.85	0
Middle Third		
Dento-alveolar	3.72	7.44
Maxilla	1.16	7.44
Orbit	2.50	3.72
Zygoma + Zygomatic arch	7.13	5.58
Nasal Bones	0.61	0
Upper Third		
Frontal bone	0.31	0

	100%	100%

Analysis of this data (Table 5.8) shows that for both males and females the most common sites of fracture in the mandible were the angles followed by the parasymphysis and body. In the middle third the most common sites of fracture were the zygoma, dento-alveolar and orbit in the males, and dento-alveolar, middle third, zygoma and orbit in the females. There was no significant difference in the site distribution between males and females in this etiological category ($p > 0.05$).

5.6.2 Motor Vehicle Accidents

Two hundred and sixty one patients were involved in MVA'S of whom 206 were males (78.93%) and 55 were females (21.07%) (M: F = 3.8: 1) (Table 5.9, Fig 5.9).

If the numbers of males and females in this category are compared with the numbers of males and females in the overall sample it can be seen that relatively more females than males were involved and that this difference was statistically significant. (Chi square test with Yates correction p =0.0011)

Table 5.9 Comparison of numbers of males and females who suffered fractures as a result of an MVA with the total number of males and females in the sample.

	Males	*Females*	*Total*	*Ratio*
All	1519	232	1751	6,55:1
MVA's	206	55	261	3,75:1

Chi Square with Yates correction p =0.0011

If the mean ages of the males are compared with the mean ages of the females in this aetiological category there is no significant difference (p = 0.24) (Fig 5.10, Fig 5.11).

Table 5.10 Age distribution of patients involved in MVA - motor vehicle accidents

n	*Mean age (yrs)*	*Standard deviation*	*Minimum age (yrs)*	*Maximum age (yrs)*
261	30.72	14.08	3	80

The mean age was found to be 30.72 years for patients involved in MVA.

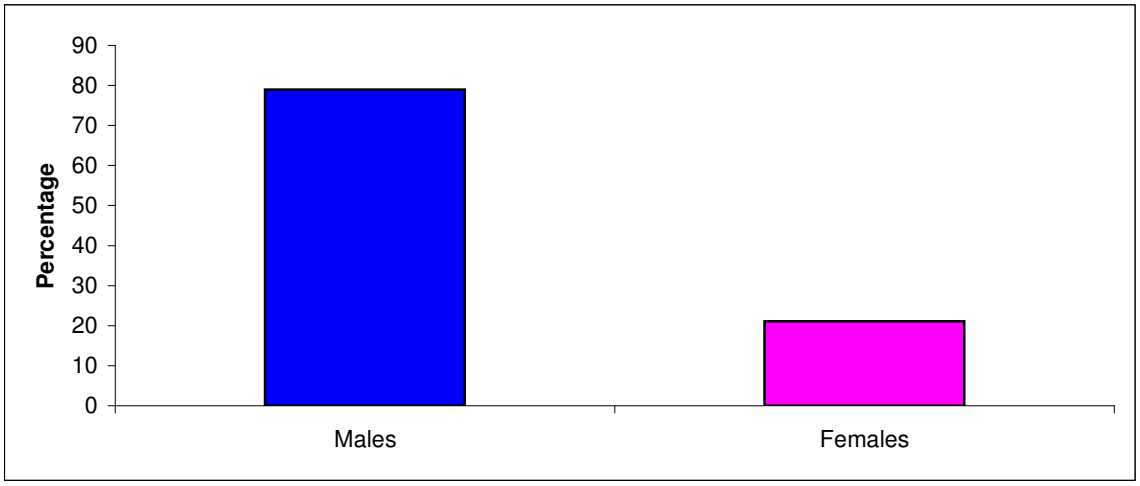


Figure 5.9 Gender distributions of patients involved in MVA

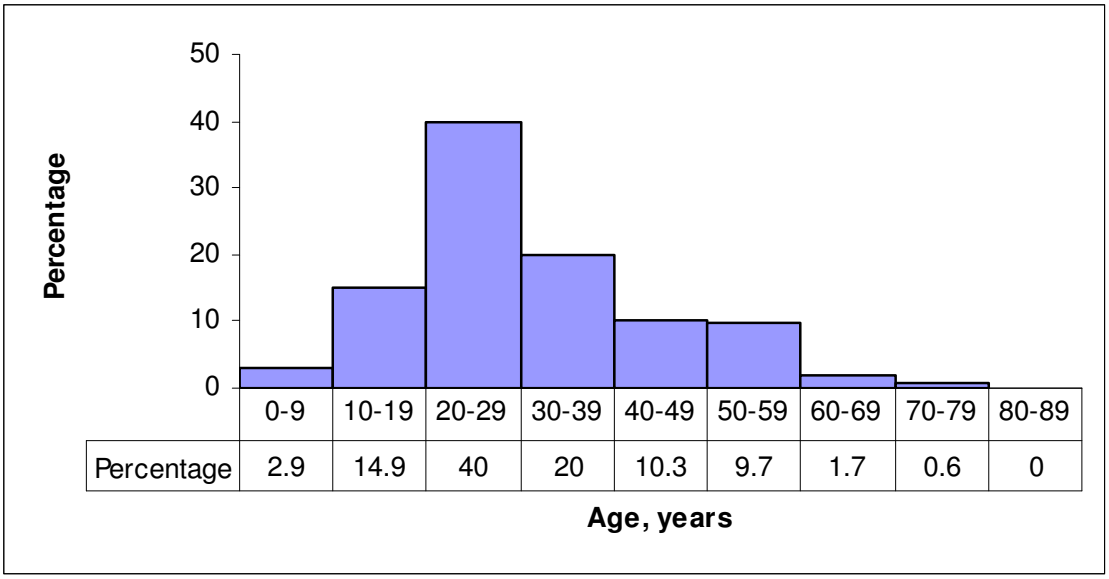


Figure 5.10 Age distribution of male patients involved in MVA.

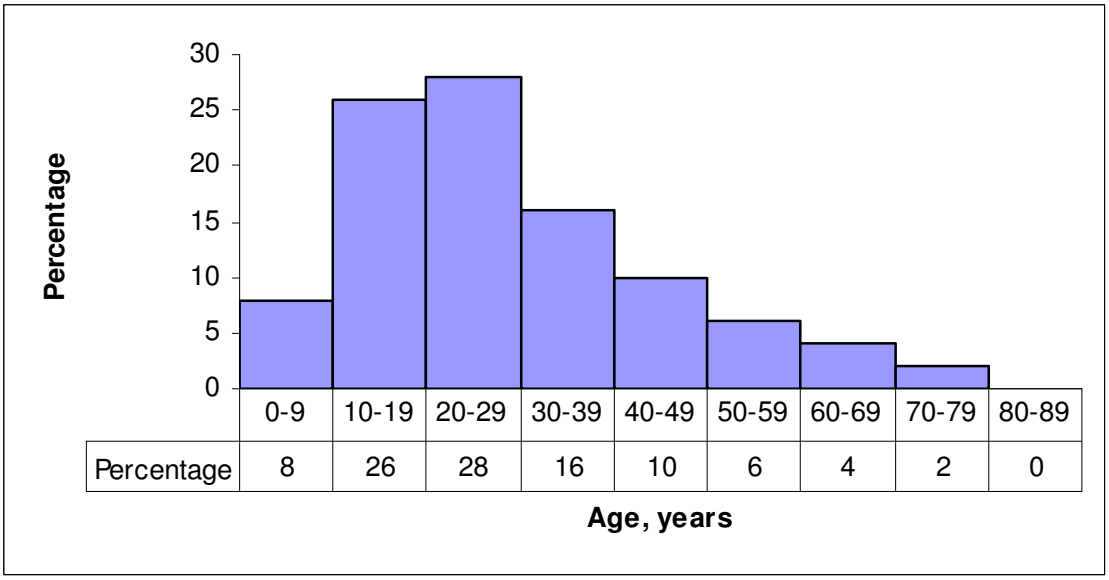


Figure 5.11 Age distribution of female patients involved in MVA.

The site distribution of fractures caused by MVA's is given in Table 5.11 separately for males and females.

Table 5.11 Site distribution of fractures in males and females which occurred as a result of an MVA.

	Males %	**Females %**
Mandible		
Parasymphysis	14.75	15.12
Angle	17.05	12.79
Body	9.51	11.63
Symphysis	16.39	8.14
Condyle	14.43	6.98
Ramus	1.97	2.33
Middle Third		
Zygoma	6.56	16.27
Dento-alveolar	6.23	8.14
Maxilla	4.92	8.14
Orbit	3.61	4.65

Zygomatic arch	2.62	4.65
Nasal bones	0.98	0.0
Upper Third		
Frontal bone	0.98	1.16
	100%	100%

Analysis of this table shows that amongst the males, the most commonly affected sites in the mandible were the symphysis, angle, parasymphysis and condyle, whereas amongst the females the most common sites involved were the parasymphysis, angle and body.

For both males and females the zygoma and dento-alveolar fractures were the most common in the middle third. There was no significant difference in site distribution between males and females in this category (Student t test p = 0.23).

5.6.3 Gunshot wounds

Forty-one patients (2.34%) sustained injuries due to gunshot wounds. These patients consisted of 33 males (80%) and 8 females (20%) (M: F = 4.1:1) (Fig 5.12).

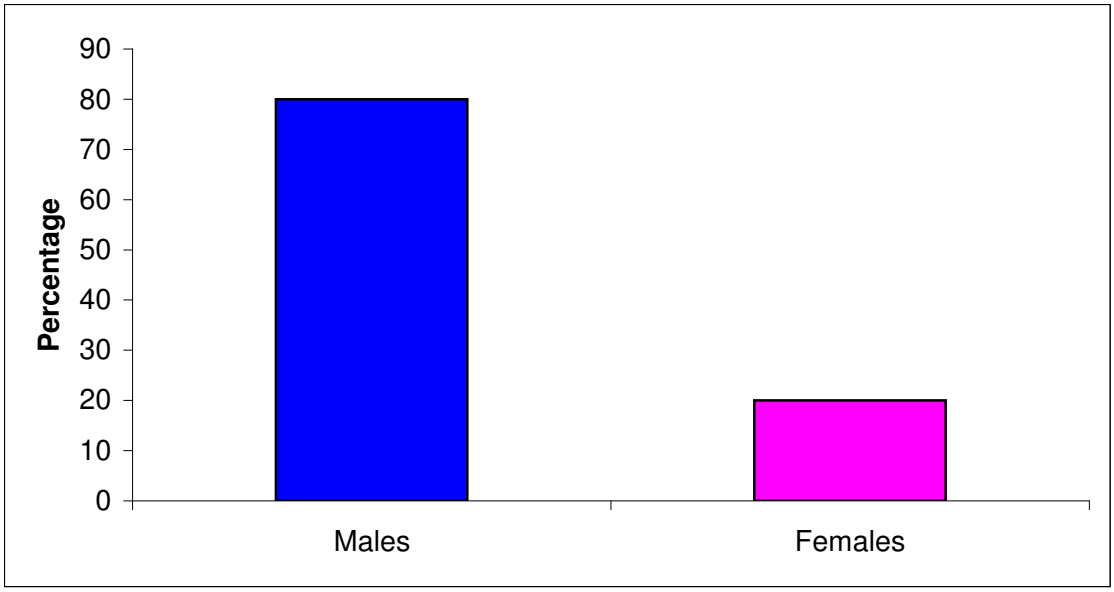


Figure 5.12 Percentage of males and females who suffered gunshot injuries, which resulted in fractures of maxillofacial skeleton

If the number of males and females in this aetiological category are compared with the number of males and females in the entire sample it can be seen that there were more males with fractures due to gunshot injuries than in the sample as a whole but that this difference was not statistically significant (Fishers exact test p =0,2456) (Table 5.12).

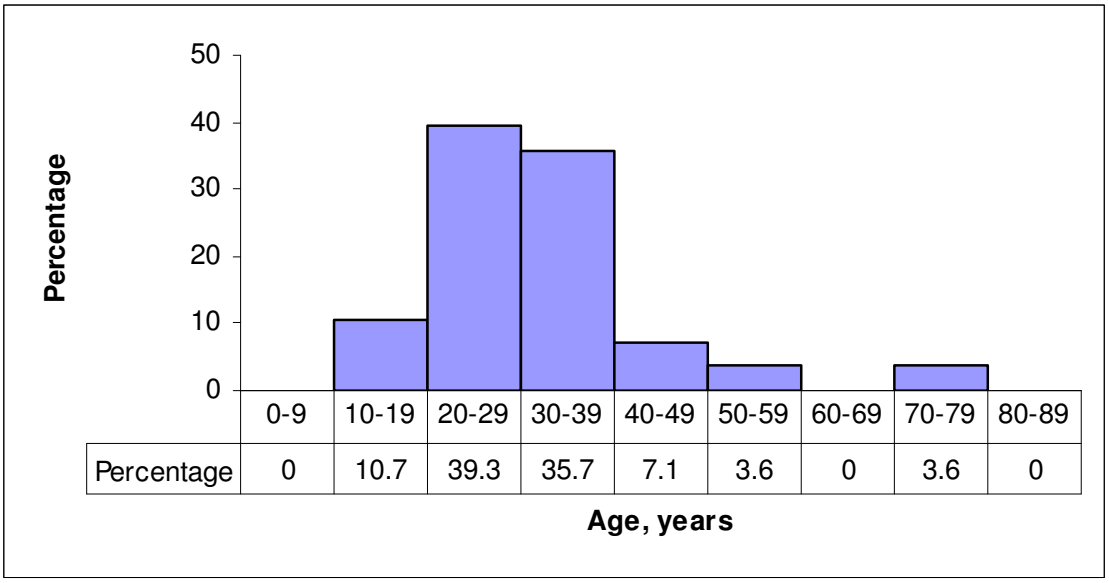
Table 5.12 Comparison of number of males and females who suffered fractures due to gunshot wounds with number of males and females in the entire sample

	Males	*Females*	*Total*	*Ratio*
All	1519	232	1751	6,55:1
Gunshots	33	8	41	4,1:1

Fishers exact test p = 0.2456

Comparison of the mean ages of the males and females in this aetiological category showed no significant difference (student t test p = 0.95) (Fig 5.13).

The site distribution of the fractures caused by gunshot wounds is shown in Table 5. 13 separately for males and females.



	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89
Percentage	0	10.7	39.3	35.7	7.1	3.6	0	3.6	0

Figure 5.13 Age distribution of male patients that sustained gunshot injuries.

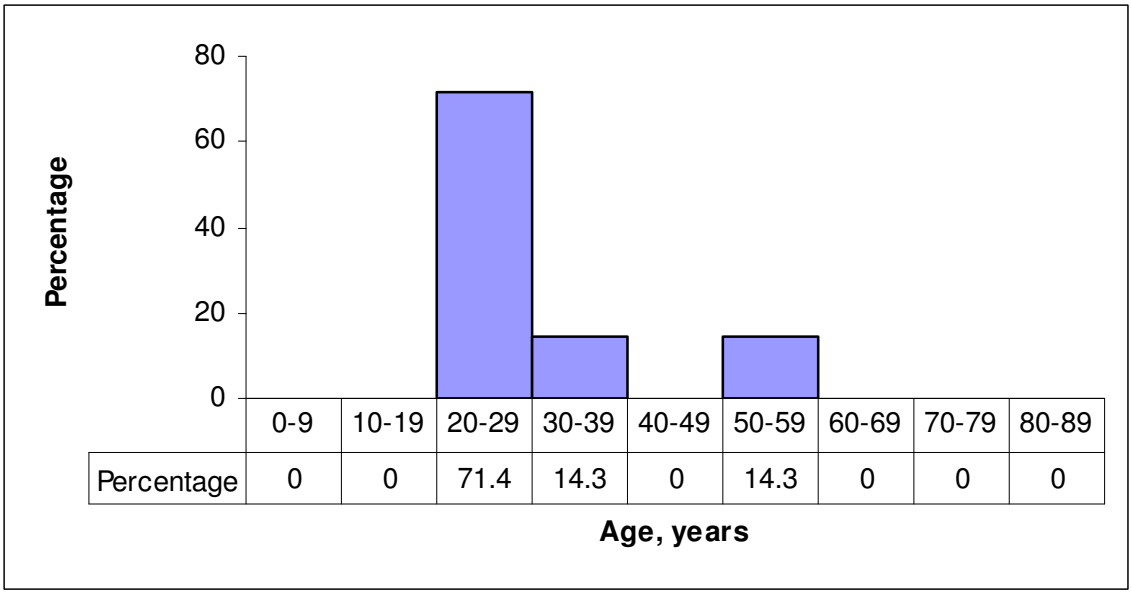


Figure 5.14 Age distribution of female patients that sustained gunshot injuries

Table 5.13 Site distribution of 41 fractures caused by gunshots in males and females

	Males %	**Females %**
Mandible		
Body	25.58	45.45
Angle	13.95	36.36
Ramus	11.63	9.09
Symphysis	11.63	0.0
Condyle	9.3	0.0
Parasymphysis	9.3	0.0
Coronoid	4.65	0.0
Middle Third		
Zygoma	4.65	0.0
Zygomatic arch	4.65	0.0
Maxilla	2.33	9.09
Orbit	2.33	0.0
Total	100%	100%

For both the males and females the most frequent site of injury in this category were the body and the angle of the mandible. This difference was not statistically significant ($p > 0.05$).

5.6.4 Falls

Seventy-six patients (4.34%) sustained fractures due to falls. This group consisted of 63 males (82.89%) and 13 females (17.11%) giving a M: F ratio of 4.9:1. Of these, seven patients (0.4%) fell as a result of an epileptic seizure.

If the number of males and females who sustained a fracture due to a fall is compared with the number of males and females in the overall sample, no significant difference is found (Fishers exact test p = 0.4754) (Table 5.14).

Table 5.14 Comparison of the number of males and females who suffered fractures due to a fall with the number of males and females in the entire sample.

	Males	*Females*	*Total*	*Ratio*
All	1519	232	1751	6,55:1
Fall	63	13	76	4,9:1

Fishers exact test p = 0.4754

Comparison of the mean ages of the males and females in this aetiological category showed them to be significantly different (Student t test p =0.002).

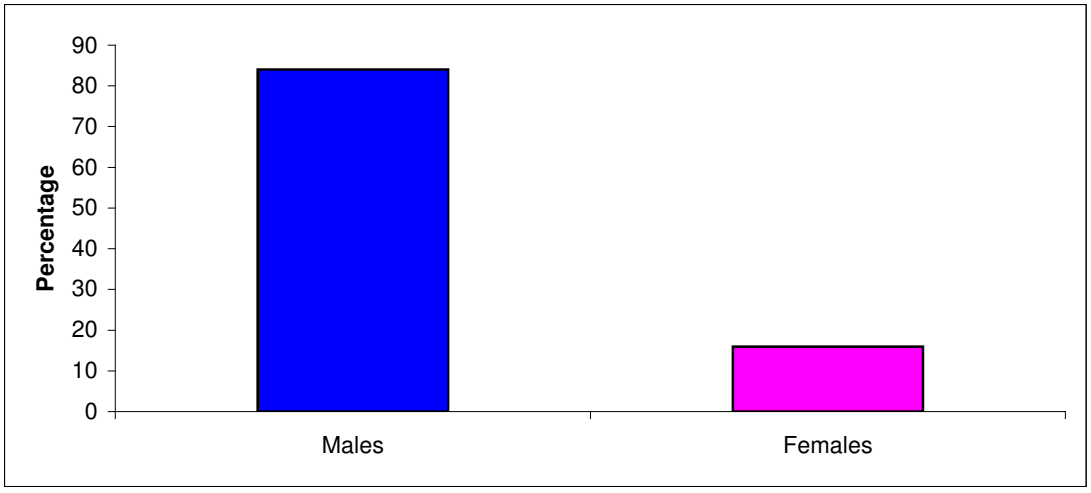


Figure 5.15 Gender percentages of males and females who suffered maxillofacial fracture due to fall

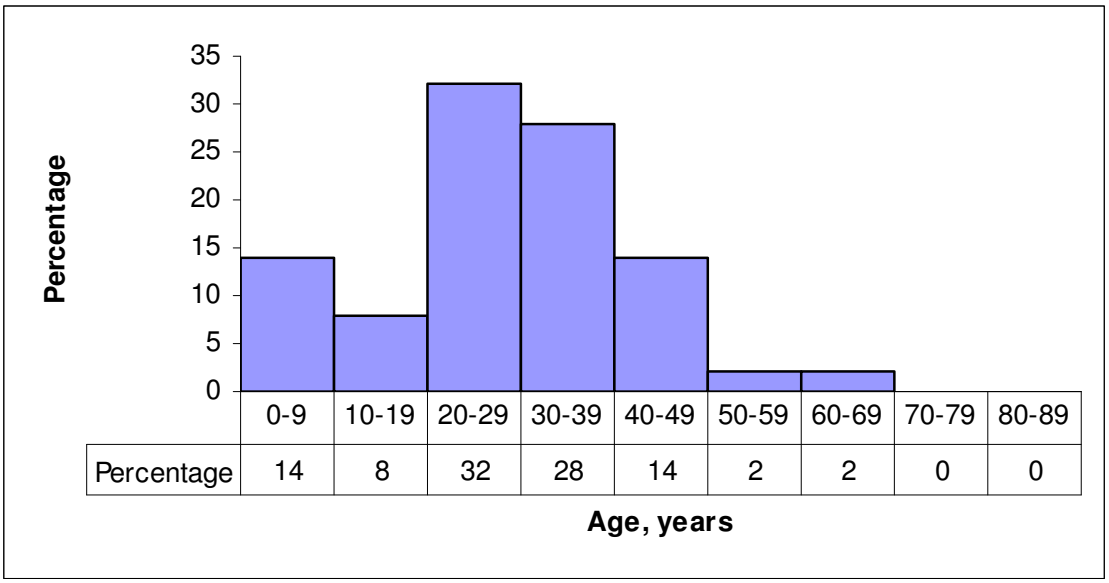


Figure 5.16 The age distribution of male patients that suffered a fracture due to fall



Figure 5.17 The age distribution of female patients that suffered a fracture due to fall

The site distribution of the fractures caused by falls is shown in Table 5.15 separately for males and females. For the males the most common sites of injury in this category were angle, parasymphysis and body, whereas for the females it was the angle parasymphysis and condyle. These differences were not significant (Chi square test $p > 0.05$).

Table 5.15 Site distribution in males and females of 76 fractures which occurred as a result of a fall.

	Males %	**Female %**
Mandible		
Angle	22.62	25
Parasymphysis	16.66	25
Body	13.10	20
Condyle	11.90	5
Symphysis	10.72	5
Ramus	2.38	5
Middle Third		
Dento-alveolar	5.95	5
Orbit	4.76	5
Zygoma	5.96	0.0
Maxilla	2.38	5
Zygomatic arch	2.38	0.0
Upper Third		
Frontal Bone	1.19	0.0
	100%	100%

For the remaining categories of aetiological agents the number of cases are too few to warrant statistical analysis and comparisons. The results are therefore presented in a descriptive format only.

5.6.6 Sports injuries

Only 10 patients (0.57%) sustained injury due to sport. They were all males with a mean age of 25.2 years and an age range of 17 to 42 years.

5.6.7 Injury on duty

Two males (0.11%) sustained an injury while on duty. They were both security guards whose ages were 28 and 29 years respectively.

Chapter 6

Discussion

The results of audits such as the one undertaken in this study are of importance both to the communities being studied and to health authorities responsible for providing medical services. For the community, the results of the audit will highlight socio-economic and behavioural determinants of illness and disease, while health authorities will be able to plan better and more efficient health services directing a greater portion of their budgets and staff resources towards the areas where the need is greatest. In addition all will have a responsibility to address the causes of the illness or disease and to institute appropriate preventative and behavioural modification programmes. The resolution to many health problems in our country does not lie in an ever-burgeoning health budget but in socio-economic upliftment and a change in community attitudes and behaviour.

The most important result of this study was the finding that 79.6% of all fractures of the maxillofacial skeleton occurred as a result of interpersonal violence (assaults and gunshots). This confirms the results of previous studies from Johannesburg and Pretoria; in similar audits interpersonal violence was also identified as by far the most common cause of fractures to this area.[1, 3, 4, 7, 23] Thus in South Africa the vast majority of fractures to the maxillofacial skeleton are entirely preventable and avoidable.

In contrast, audits from other parts of the world including Austria, United Arab Emirates, Portugal, Iran, Pakistan and Brazil have shown interpersonal violence to be very low on their lists of causes of fractures, the frequencies varying from 3%-12%.[8-10, 17-19] Even from other African countries such as Nigeria violence was not the major cause of

fractures of the maxillofacial skeleton, with road traffic accidents being the most common cause, accounting for 78.7% of fractures in the 21-30 year age group, and 58.5% of the cause of fractures in all age groups.[11-13] In one international study from Germany [22] assault was also identified as the major cause of fractures, however that accounted for only 38.6% of the fractures unlike the overwhelming number found in this study.

Interestingly a study from Brazil identified motorcycle accidents as being most responsible for fractures of the mandible. [20]

During the period under review patients with fractures to the maxillofacial skeleton accounted for just under half of all patients treated in the maxillofacial unit at Dr. George Mukhari Hospital. It is extremely disturbing to consider the percentage of the hospital budget and the number of staff that had to be allocated to treat these avoidable injuries. Scant resources have to be taken away from other areas where they are desperately needed such as in the prevention and treatment of HIV/AIDS and tuberculosis.

Anecdotal evidence suggests that poor socioeconomic factors such as poverty, unemployment and overcrowding are major predisposing factors to interpersonal violence. Alcohol abuse appears to be the single largest contributor to violence in our country.[24] Violence towards others is endemic in South Africa and while a decrease in the level of poverty, unemployment and overcrowded living conditions will go some way towards bringing down the levels of interpersonal violence, a change in community attitudes must first take place before this issue will be resolved.

Other significant results to emerge from the audit are that the males are more likely to suffer a fracture due to an assault, whereas in females MVA's, falls or gunshots were more likely to cause a fracture rather than assault. Less than 10% of the patients were younger than 20 years of age. In addition it was found that amongst females those injured due to gunshots were significantly older than those in the other three major etiological categories. As for males, those who were assaulted and involved in MVA's were much older than those who suffered injury due to gunshots.

The fact that all patients were black can be readily explained by the location and history of the hospital where the study took place. It was created during the apartheid era to provide medical services exclusively to the population of Garankuwa. To a large extent the hospital, because of its geographic location, has maintained this function even in the post-apartheid period.

In this study the male preponderance may be a reflection of the fact that the community at risk has a high proportion of male migrant labourers who work in the platinum mines in the area and in the industrial area of Rosslyn. They frequently live in male dominated hostels where boredom, alcohol abuse and crowded living conditions are a recipe for interpersonal violence. However this is speculation and the proportion of males and females in the population at risk is not really known.

The gender distribution of those patients whose fractures were caused by assaults was even more marked in favour of the males whereas fractures due to MVA's, falls and gunshot wounds were more evenly distributed amongst the females. This difference was

statistically significant and it is interesting to speculate that factors such as alcohol and the migrant labour system maybe key elements in this circle of violence.

Most studies of maxillofacial injuries consistently reveal a predominance of males over females in varying ratios.[6, 7, 10, 11-13, 21, 23, 25] Bamjee[1] et al showed that in Johannesburg in patients younger than 18 years, the male to female ratio was 2.3:1, in Pretoria it was 3:1[23] while in Nigeria it was 1.1:1.[11-13] Interestingly a study from New Zealand[14] on persons older than 65 years of age showed a higher rate of fractures amongst females, but falls played a significant role in the causes of the fractures, whilst a study from the United Arab Emirates by Gustav and Kovacs[17] showed that 83% of the patients were males, which is probably a reflection of the dominant position of males in that society where females are more homebound, do not travel to work and thus are far less exposed to road traffic accidents. Thus the gender distribution is influenced by factors such as the age of the population groups being studied, the cause of the fractures, the degree of urbanization and the role of women in the society.

The effect of age on the site and gender distribution of facial fractures was shown in a study from Austria[15] where an increase in the frequency of fractures in females of 4% per year of age was demonstrated. The effect of age on the cause of the fracture has been commented on in several studies. Bamjee[2] showed that accidental falls was the most common cause of facial fractures in children under 12 years of age. In a study from Portugal[8] almost half of the patients were younger than 16 years and the most common cause was motor vehicle accidents, whereas from New Zealand[14] most of the patients were over 65 years of age and the most common cause was due to a fall.

The older the population at risk, the more likely they are to be involved in assaults, gunshots, MVA's and falls and even in sports related injuries. It was very interesting to observe that in a country such as Austria where sporting activity is dominated by skating, skiing, ice hockey and other similar related activities facial fractures due to sports related injuries and play accorded for in excess of 90% of the total number of fractures.[9] Clearly participants in these types of sports need to consider wearing helmets with bars in order to protect themselves.

In our study the mean ages of females who suffered fractures due to gunshots was older than that of females where the cause of the fracture was due to any other cause, whereas in males those who suffered gunshot wounds were significantly younger than the males in any of the other etiological categories.

As far as site was concerned the vulnerability of the mandible to facial trauma due to any cause was again confirmed with 85.58% of fractures involving this bone. Multiple fractures were also a feature with 2427 fractures occurring in 1755 patients. There was no significant difference in the sites of the fractures between males and females in the entire sample nor were there any difference when the site distributions for males and females within each etiological category were compared.

All reported studies have identified the mandible as the site most frequently affected by facial bone fractures. However most have concluded that the symphyseal and parasymphyseal areas of the mandible were most at risk. This might well be due to the different aetiological agents responsible for causing the fractures in different studies from

all over the world. Clearly if the main cause of the fractures is violence then the body or angle will be most at risk, whereas if the main cause of the fractures is motor vehicle accidents the symphyseal area would be most at risk. In this regard special mention should be made of the condyle. Several authors have identified the condyle as the most at risk.

Condylar fractures are fractures most commonly missed. The proportion of condyle fractures amongst all mandibular fractures is 17.5% to 52%. Most are not caused by direct trauma but follow indirect forces transmitted to the condyle from a blow elsewhere. The displacement will be determined by the direction, degree, magnitude and precise point of application of the force as well as the state of the dentition and the occlusal position. With adequate molar support and the teeth in occlusion little or no displacement is likely to be sustained, while with the mouth wide open the full force is transmitted to the condyles. Direct impact leads to a unilateral fracture as the weak condylar neck breaks easily and there is no intracranial displacement, thus the condyle protects the brain in mandibular fractures. A laceration or contusion of the chin should raise suspicion of a condylar fracture. [25]

The limitations of this study centered mainly on the poor quality of the records. Missing, poorly and inadequately completed files made the gathering of the data extremely time consuming and many cases had to be excluded from this study because of poor records. It would have been of great interest to analyze the number of days these patients occupied hospital beds, the percentage of theatre time and staff time spent on these patients and the proportion of the hospital budget devoted to treating them, but the data was not available.

CHAPTER 7

Conclusion

In conclusion this study has shown that in the population being studied 80% of fractures of the maxillofacial skeleton were the result of interpersonal violence, namely, assaults and gunshots. This is the highest in the world confirming the violent nature of our society and the very high crime rate. A significant proportion of the hospital budget and human resources have to be diverted to treating these avoidable injuries thus depriving other critical areas of much needed resources.

Males are very much more commonly affected than females in all aetiological categories, but especially when the cause of the fracture is an assault. Alcohol, the migrant labour system and unemployment presumably play a major role in the causes of these assaults, but in particular it is possibly the mindset of this population that sees violence rather than dialogue as the means of resolving conflicts. The lack of respect for human life is fundamental in this mindset. This problem must be tackled on many fronts, socio-economic upliftment, eradication of poverty, education, provision of adequate housing, decrease in the frequency of alcohol abuse, but most important of all must be a change in the mindset to one that denigrates the use of violence rather than seeing it as the first option in resolving conflicts or in gaining retribution.

The age group most commonly affected is the 3rd to 5th decade especially when the cause of the fracture was assault, and the most common site was the angle of the mandible as

opposed to when the cause is an MVA where the site affected is likely to be the symphysis and parasymphysis of the mandible.

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