The Prevalence and Distribution of Combination Fractures in the Mandible

Researcher: **Dr. AS Singh**

[redacted] [redacted]

Supervisor: **Prof. MMR Bouckaert**

Co Supervisors: **Dr. C Masureik**

Dr. A Mohamed

DECLARATION

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

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Dr. A.S. Singh

10th day of June 2010

Dedication

I dedicate this research report to my loving wife Jerusha, son Rohit, daughter Kritika, parents and family for their sacrifices, time and motivation in helping me complete this research report.

Acknowledgements

I wish to thank my undergraduate lecturers for molding a life long learner, my supervisors and mentors Prof MMR Bouckaert, Dr. A. Mohamed, Dr. C Masureik and Dr J. Mchenga. 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 colleagues and friends who were motivational and encouraging during the course of this project. I would also like to extend my appreciation and sincere thanks to Prof. Schoeman and Salome for their help in compiling and completing the statistical data necessary for this research. Thanks to Dr. Lekhubu for her motivation and encouragement through tough times. Last but not least I would like to thank my fellow registrars, Dr. JP White, Dr. C Anagnostopoulos, Dr. T. Ragadu,, Dr. CJ Perumal and Dr. Mabusela for their help and team work in allowing this research to materialize.

Abstract

Introduction-Craniofacial reconstruction following trauma is different for each individual as it highly depends on the nature and location of the patient's injuries. The mandible is a unique bone, which has a complex role in both esthetics of the face and functional occlusion. Due to the prominent position of the lower jaw, mandibular fractures are the most common fracture of the facial skeleton

Aim- The aim of this study is to assess the prevalence and distribution of combination fractures in the mandible among patients presenting at the University of Limpopo, Medunsa Campus, department of Maxillofacial and Oral surgery. The nature and site of injuries occurring in the mandible will be recorded, and correlated with the cause of injury. The data should establish a preoperative idea of fractures that can be expected in the mandible when associated with a particular type of injury, especially of the combination type.

Materials and methods- The patient's records and radiographs at the University of Limpopo Medunsa Campus, Department of Maxillofacial and Oral Surgery (MFOS) were accessed. Patients with mandibular fractures who presented to the department over a four-year period (ranging from January 2002 to December 2005) were included in this study.

Results- There were 1755 patients treated for maxillofacial injuries during the period 2002 to 2005 (4 years). A total of 1222 (69.63%) patients sustained fractures to the mandible. However 505 (41.33%) patients sustained combination fractures of the mandible. This evidence statistically proves that there is a 41.33% chance of another fracture occurring in a patient who has been diagnosed with a single fracture to the mandible. Various etiological factors contributed to these mandibular fractures. Interestingly the major contributing factor was found to be assault. This study confirms the results that males are affected more than females. This study found the average male to female ratio to be 8.18:1. The age distribution ranged from 2 years to 86 years. The mean age was found to be 31.07 years with a standard deviation of 12.06 years. The highest frequency was recorded between 20 to 29 years (42.77%) followed by 30 to 39

years (24.36%). The sites of fractures varied with different combinations. The highest number of fractures was recorded in the left angle (159) followed by the right parasymphysis region (142). In the combination category however the left angle right parasymphysis combination (70) showed the highest incidence of combination fractures followed by left parasymphysis and right angle combination (47), right angle and left body combination (37) and left angle and right body (36) combination fractures. The incidence of sustaining a left angle and right parasymphysis combination fracture is 13.86%. A total of 92 (18.22%) condyles sustained fractures with various combinations. Fifty fractures occurred on the left side while 42 occurred on the right side.

Conclusion- In conclusion this study has shown that there is a 41.33% chance of a combination fracture occurring in a fractured mandible. These results are statistically high given the fact that the mandible is a commonly injured bone. Therefore careful evaluation of diagnostic radiographs is necessary since some fractures are not diagnosed clinically. This can help improve treatment outcomes and reduce possible postoperative complications.

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IOD	-	Injury on duty
MVA	-	Motor vehicle accident
GSW	-	Gunshot wounds
Ass	-	Assault
L	-	Left
R	-	Right

CHAPTER 1

Introduction

Craniofacial reconstruction following trauma is different for each individual as it depends on the nature and location of the patient's injuries. The mandible is a unique bone, which has a complex role in both esthetics of the face and functional occlusion. Because of the prominent position of the lower jaw, mandibular fractures are the most common fracture of the facial skeleton.

Patients presenting with injuries to the maxillofacial region are common at most referral hospitals in South Africa. Motor vehicle accidents, assaults, sports injuries and injury on duty are some of the common causes of facial injuries. Many patients who present with mandibular fractures have fractures at two or more sites in the mandible. These fractures usually correlate to a particular cause of injury due to a resultant force and vector. This retrospective study will attempt to review the causes of injury and correlate it with the types of combination fractures occurring in the mandible. This study is the first of its kind to be carried out at the Medunsa Oral Health Centre Medunsa Campus, University of Limpopo.

Setting

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

CHAPTER 2

Aim

The aim of this study is to assess the prevalence and distribution of combination fractures in the mandible in patients presenting at the Department of Maxillofacial and Oral Surgery, University of Limpopo, Medunsa Campus. The nature and site of injuries occurring in the mandible will be recorded, and correlated with the cause of injury. The data should establish a preoperative idea of fractures that can be expected in the mandible when associated with a particular type of injury, especially of the combination type.

Objective

The objective of this study is to be able to predict the combination of fractures occurring in the mandible depending on the types of injures.

CHAPTER 3

Literature Review

A predominant consequence of facial injury is mandibular fractures, which contribute a substantial portion of the surgical caseload at trauma centres. Fractured mandibles usually present with malocclusion, pain at the fracture site, internal bruising, or laceration with bleeding between teeth at the fracture site. Management of this common injury varies greatly and the treatment is still driven by expert opinion or empirical data. Scientific studies of mandible fractures and their treatment have been hampered because of the lack of injury cataloging systems. Conventional classification systems for mandibular fractures have been accepted and widely used without critique (Shetty *et al*, 2007). The current climate of evidence-based practice and extramural audit of quality of care and cost effectiveness imposes an urgency to develop more precise metrics for cataloguing mandible fractures and establishing a severity score to facilitate trauma care research. A good mandible fracture classification and scoring system must, at a minimum, be easy to use with clear definitions, allow reproducible measurements across assessors, have good face validity, and reflect the range of injuries (Shetty *et al*, 2007).

In a study conducted in Denmark by Jensen *et al* in 2006, it was found that mandibular condylar fractures represented 20% to 52% of all mandibular fractures, and are thus among the most common facial fractures. There were 105 patients with isolated mandibular condylar fractures, of which 81 were unilateral and 24 bilateral in this study.

A retrospective survey was carried out on 724 patients presenting with fractures of the mandible over a ten-year period in Germany, where the rate of mandibular fractures remained constant. There were no changes in the age groups. Males had a higher prevalence than females. The major causes of fractures were assaults and accidental falls. The most common fracture site was the condylar region (49%) followed by the angle (29.4%) of the mandible. Etiological factors showed no significant change in mandibular injuries over the ten-year period, 1994 to 2003 (Depprich *et al*, 2007).

A five-year retrospective statistical analysis of maxillofacial injuries in patients admitted and treated at two hospitals in Mysore City revealed road traffic accidents as a common cause for maxillofacial injuries (Shekar and Reddy, 2008). Five hundred and fourty six patients with maxillofacial injuries presented at the two hospitals between 1998 and 2002. The injuries were mostly sustained in the age group of 11 – 40 years, constituting about 78% of all injuries. Influence of alcohol was found in 58% of patients with maxillofacial injuries. Males were affected more than females. Mandibular fractures were the most common injury. Subcondylar fractures were the most common among the mandibular fractures while nasal bone fractures were more common among the middle third fractures.

At the University Hospital of Malmö, Sweden, standardized trauma charts were used for registration of all jaw fractures from 1972 to 1976 (Anderson *et al,* 2007). Forty-nine patients with unilateral mandibular condylar fractures were treated non-surgically in 1972 to 1976. Condylar fractures accounted for 25% to 35% of all mandibular fractures. Thirty-seven were men and 12 were women with a mean age of 32.4 years.

In Pakistan patients from the armed forces with maxillofacial injuries were included in a descriptive study to evaluate etiology and pattern of maxillofacial injuries (Khan *et al*, 2007). The most frequent bone fractured was the mandible (53%). The most common cause was road traffic accidents.

Martini *et al*, (2006), reviewed 450 cases of facial bone fractures in the city of São Paulo (Brazil), which revealed the main cause of facial bone fractures to be road traffic accidents. The survey found that out of 550 cases of facial fractures 29.2% occurred in the mandible. Since the use of seat belts and motorcycle helmets, this scenario has changed. In this report mandibular fractures most often resulted from aggression or car accidents. The most commonly affected anatomical sites were the mandibular body (30.9%), symphysis (27.5%), condylar process (16.1%), and the coronoid process (2%).

Subhashraj *et al,* (2007), reviewed the records of 2748 patients treated for maxillofacial injuries at Sri Ramachandra Medical and Dental College Hospital between January 1999 and December 2005. Five hundred and twelve (16%), sustained mandibular fractures. The male to female ratio was 3.7:1. The parasymphysis (31%) was the most common site of the mandible to be fractured followed by the condyle (19%), angle (12%), dentoalveolar (11%), symphysis (11%), body (8%), ramus (5%) and coronoid process (4%).

Brasilairo and Passeri, (2006), analysed a total of 1024 patients, presenting with 1399 maxillofacial injuries in the Department of Maxillofacial and Oral Surgery at the

Piracicaba Dental School from 1999 to 2004. Maxillofacial fractures were more prevalent in mandibles. Traffic accidents are the main cause of fractures of the mandible, predominantly involving the condylar region of the mandible.

Zachariades, *et al*, (2006), found the incidence of condylar fractures to be high among mandibular fractures. When violence is the cause, the angle and body regions of the mandible are more commonly involved. Condylar fractures among all mandibular fractures are between 17.5% and 52%. The most common unilateral fracture is of the condyle and the most common bilateral fracture is of the condylar heads. These are the most controversial fractures regarding diagnosis and management. Most are not caused by direct trauma, but follow indirect forces transmitted to the condyle from a blow elsewhere in the mandible. Consequently condylar fractures are the most widely missed fractures in the mandible from a diagnostic point of view. Direct impact leads to fracture of the condylar neck so that there is no intracranial displacement, thus the condyles protect the brain in mandibular fractures. A laceration of the chin should raise suspicion of mandibular condyle fractures. Paediatric condylar fractures can be easily missed during diagnosis in children because physicians are not properly trained to diagnose these types of fractures. If these fractures are missed it could result in growth disturbances and asymmetry at multiple facial levels including the orbits, cheeks, maxilla and the mandible. Condylar fractures can be extracapsular (condylar neck or subcondylar) or intracapsular, undisplaced, deviated, displaced or dislocated. Treatment depends on the age of the patient, the co existence of other mandibular or maxillary fractures or whether the condylar fractures are unilateral or bilateral.

Four hundred and sixty six fractures were recorded at the Oral and Maxillofacial Surgery Department, KAT, General District Hospital of Attica Kifissia, Athens Greece. Road traffic accidents were the main cause. The male to female ratio was 3.5:1. One hundred and twenty four condylar fractures were not associated with other mandibular fractures. There were 46 on the right side and 36 on the left side and 21 bilateral. The other 342 condylar fractures were associated with other mandibular fractures (Zachariades *et al*; 2006).

During a period of ten years (1991-2000), 9543 patients were admitted to the Department of Oral and Maxillofacial Surgery, University Hospital of Innsbruck with craniomaxillofacial trauma (Gassner *et al*; 2002). Three thousand six hundred and thirteen patients sustained facial trauma. The major contributing factors were activity of daily life, in which sport (31%) was the major contributor followed by violence (12%), traffic accidents (12%) and other causes (2%) respectively. Males were predominantly affected by facial bone injuries while females had a higher prevalence of dentoalveolar fractures. When compared with other causes, the probability of suffering soft tissue injuries (12%) and dental trauma (16%), with no facial bone fractures is higher in sports related accidents. It was concluded that older patients were more prone to bone fractures and soft tissue injuries while younger persons were more susceptible to dentoalveolar trauma.

Olasoji *et al*, (2002), conducted a prospective study in Northern Nigeria to assess whether the socioeconomic changes over the last 20-30 years have affected etiology, gender, age and type of facial fractures among patients presenting at the University of Maiduguri

Teaching Hospital. The period assessed was 1996 to 1999, in which 306 patients were treated for facial fractures. Most of the patients were in an age range of 21-30 years with a male to female ratio of 2.19: 1. The main causes were assault (48%) and road traffic accidents (36%). Other etiological factors such as falls and sports injuries accounted for the remaining cases. The assault cases occurred mainly due to armed robbery and interpersonal violence on the farms. The mandible was the most common site of fracture (89%), with most of the mandibular fractures occurring in the body of the mandible followed by the symphysis.

There are considerable differences in the reported worldwide patterns of maxillofacial fractures, (Adebayo *et al*, 2003). In the developed countries of Europe, violence followed by road accidents are the predominant causes, while in the developing world, the causative factors are reversed, with most being a result of road crashes. Interestingly, a male to female ratio of 3:1 is seen worldwide. Between 1991 and 2000, 443 cases of maxillofacial fractures were seen at the Ahmadu Bello University Teaching Hospital, Kaduna, Nigeria. Road crashes were responsible for 56% of the cases followed by falls (24%). Previously 241 fractures were seen each year, as compared to 44 fractures seen per year presently. This is due to an increase in the number of centres for the treatment of such injuries in Nigeria. There is also an increase in females with facial fractures, which reflects their greater exposure during the past 20 years. There were more patients with mandibular fractures than middle third fractures. The majority of the patients with middle third fractures died. This shows a lack of enforcement of legislation on the use of seat belts, drunken driving and inadequate emergency medical care which ultimately contribute to mortality and morbidity.

Mandibular fractures are the second most common facial fracture and there has been a significant increase in the number of cases on the last few years (Patrocinio *et al*, 2005). Two hundred and ninety three cases of reduction of mandibular fractures were retrospectively analysed, which occurred between the periods 1974 to 2002. There has been an increase in the number of mandibular fractures over the years. A male to female ratio of 4:1 was reported, with a peak in the 20-29 year age group. The principle causes were traffic accidents and violence. The most injured sites were the symphysis, condyle, angle, body, ramus and coronoid process in a decreasing order of frequency. Majority of the patients were treated with open reduction.

Fractures of the lower jaw are the most common facial traumatic injuries and their therapy dominates the treatment activities of oral and maxillofacial surgeons (Atanasov, 2003). Three thousand three hundred and twenty six mandibular fractures occurred in 2252 patients that were treated in Bulgaria. The ages of these patients ranged from 26 months to 80 years, with a gender distribution of 1876 males and 376 females. Mandibular fractures affected all ages and occurred five times more often in males than in females and predominated young patients aged between 20 to 29 years. The major contributing factor was assault and alcohol abuse (68.07%). The angle of the mandible was most affected (34.15%), followed by the body (25.77%) and symphysis (19.57%).

An epidemiological survey of mandibular fractures at the Oral and Dental hospital in Pretoria between 1999 and 2003 revealed 501 patients that sustained mandibular fractures, (Roode et al, 2007). Assault (72.5%) was the most common cause followed by

road traffic accidents (14.2%) and falls (8.8%). Of the 501 patients 41.3% occurred bilaterally, 32.7% on the left side and 26% on the right side. The majority of the fractures occurred in the body of the mandible (41%), followed by the symphysis and parasymphysis (21.3%). Males were affected more than females.

One hundred and sixty two patients presented at the Khalili Hospital, Southern Iran with facial bone injuries, (Eghtedari and Khezri, 2003). Fifty-one of these patients had sustained 77 independent lines of fractures in the mandible. The greatest number of fractures occurred between 11 and 30 years. Motor vehicle accident was the leading etiological factor (39.1%), followed by falls (33.3%) and violence 21.5%. Fractures of the condyle were the most frequent type of fracture, followed by fractures of the body, angle, symphysis, parasymphysis, alveolar region, coronoid process and ramus respectively.

Rikhotso, (2008), conducted a 6 month prospective study on condylar fractures at the Chris Hani Baragwanath Hospital. He found 84 patients with 95 condylar fractures. More males (82%) than females (18%) were affected. Interpersonal violence was the major cause of injury followed by road traffic accidents and falls. Eighty seven percent (87%) had unilateral fractures while 13% sustained bilateral condylar fractures. There were 16 medially dislocated condylar fractures in 13 patients. He concluded that road traffic accidents and falls result in an increase in bilateral and dislocated fractures of the condyles.

The inadequate alignment of healed bony segments results in malocclusion (Mortellaro *et al*, 2006). This results in a change of the original neuromuscular system such that the compensatory mechanism begins to change. Patients present with mandibular cross bite, asymmetry of the face and extensive alteration of muscular, articular, and postural function. Timing of surgical treatment and adequate fixation and immobilization of fracture segments are very important to avoid complications such as infections, delayed union, nonunion, malunion, skeletal discrepancies, nerve injury, and rarely ankylosis. The surgical approach should be to restore the original bone shape and right occlusal relations as soon as possible.

According to Villagra *et al,* (2006), fractures of the lower jaw are the second most frequently fractured sites as compared to all other bony fractures, with the condylar region being the most frequent. Most surgeons now prefer the open reduction, rigid fixation for treating displaced fractures of the subcondylar region (Villagra *et al,* 2006).

CHAPTER 4

Materials and Methods

Ethical clearance (DP 06/07) to conduct this study was obtained from the Medunsa Research Ethics and Publications Committee of the University of Limpopo.

The patient's records and radiographs at the University of Limpopo Medunsa Campus, Department of Maxillofacial and Oral Surgery (MFOS) were accessed.

Patients with mandibular fractures who presented to the department over a four-year period ranging from January 2002 to December 2005 were included in this study. Data was recorded on a separate data collection sheet under various categories as shown below.

Table 4.1 Data collection table used to record the information.

Date of injury	**Cause of injury**	**Age**	**Gender**	**Site of injury on mandible**	**Associated injuries**	**Type of treatment**

Patients were excluded from the study if their records were incomplete.

Fractures involving the mandible were anatomically recorded. In order to maintain a standardized 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 42 (lower right lateral incisor) teeth regions.

The parasymphyseal region was identified as from the mesial aspect of 33 up to the mesial aspect of 36 (lower first molar) on the left side. The right side extended over a similar tooth distribution that extended from the tooth 43 up to the mesial aspect of tooth 46 (lower first molar). The body of the mandible extended from the mesial aspect of the first molar up to the distal aspect of the last molar of the mandible bilaterally. The area distal to the last molar formed the angle of the mandible. The ramus of the mandible including the condyles was recorded as either left or right sides, depending on which side the injury occurred.

Statistics

All data collected was transferred to an electronic database.

The frequency of combination fractures of the mandible during the four year period was estimated by expressing the number as a percentage of the total number of patients with mandibular fractures seen at the hospital during this period. Descriptive statistics was used and statistical significance was tested for using the student t-test. A logistic regression analysis was conducted to assess the significance of possible contributory factors to various mandibular fractures. Probability levels of less than 5% were regarded as significant. All statistical procedures were performed on SAS®, and run under Microsoft® Windows®.

CHAPTER 5

RESULTS

5.1 Frequency

For the period under review 1755 patients had been treated for maxillofacial fractures. One thousand two hundred and twenty two sustained fractures to the mandible. Five hundred and five patients sustained combination fractures to the mandible. Various causes were attributed to the cause of these injuries.

Table 5.1 Cause and frequency of injuries

CAUSE	FREQUENCY	PERCENTAGE
Assault	387	76.63
Fall	22	4.35
GSW	11	2.18
IOD	1	0.20
MVA	82	16.24
Sport Injuries	2	0.40
Total	505	100

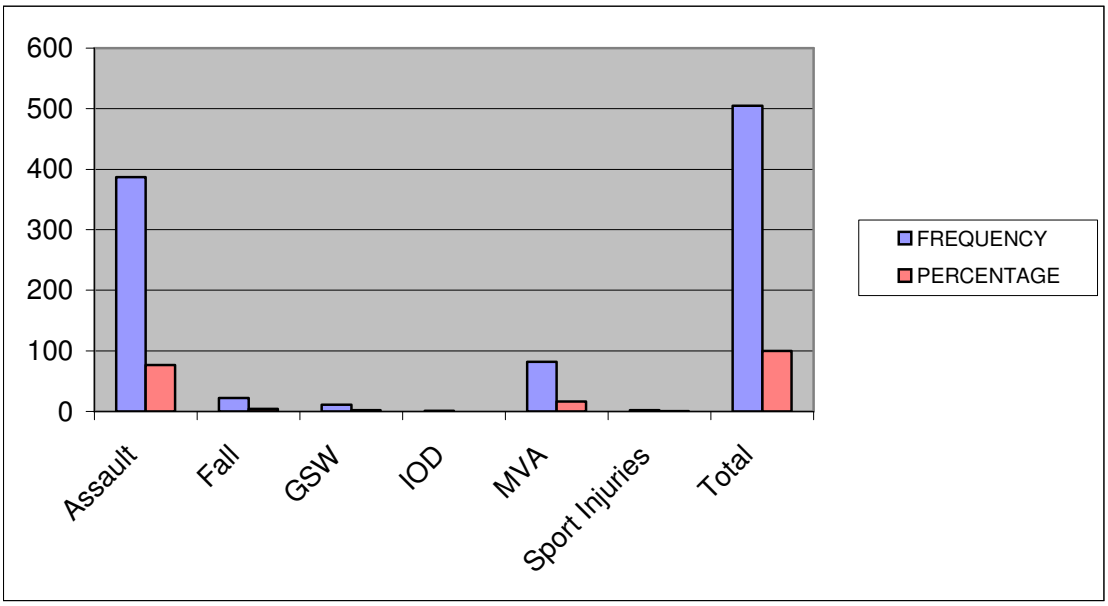

Figure 5.1 Frequency and percentage distribution of causes of injury

5.2 Gender

The 505 patients consisted of 450 (89.11%) males and 55 (10.89%) females. The male to female ratio was found to be 8.2:1.

Table 5.2 Number of male and female patients with combination fractures

GENDER	FREQUENCY	PERCENTAGE
Males	450	89.11
Females	55	10.89
Total	505	100

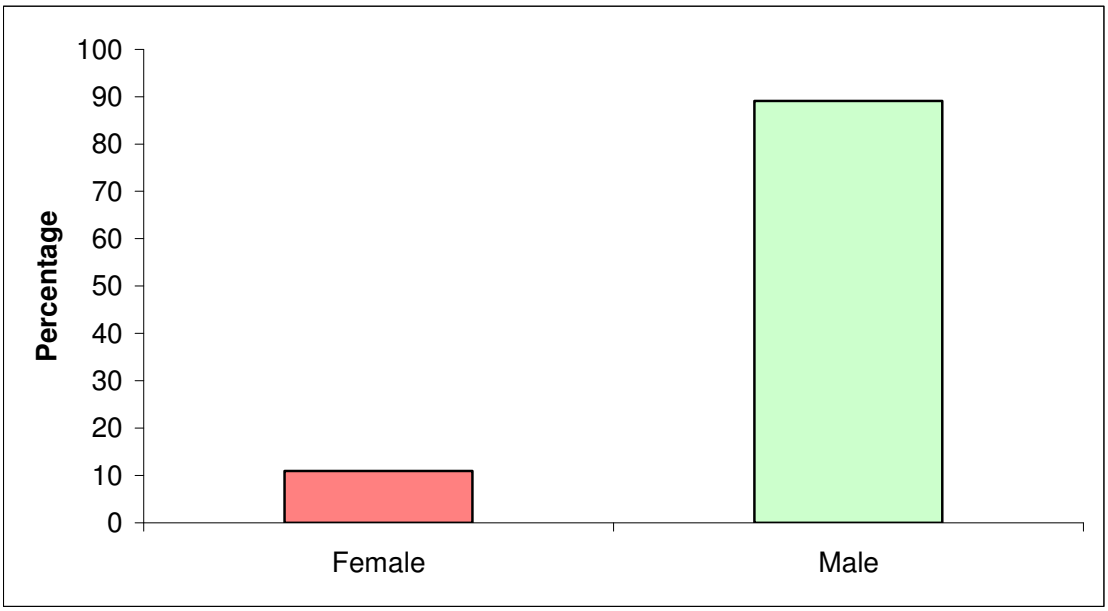

Figure 5.2 Gender distributions of patients with combination fractures

Table 5.3 Gender distribution for cause of injury

CAUSE	MALES	FEMALES
ASS	347	40
FALL	18	4
GSW	9	2
IOD	1	0
MVA	73	9
SPORTS INJURY	2	0
TOTAL	450	55

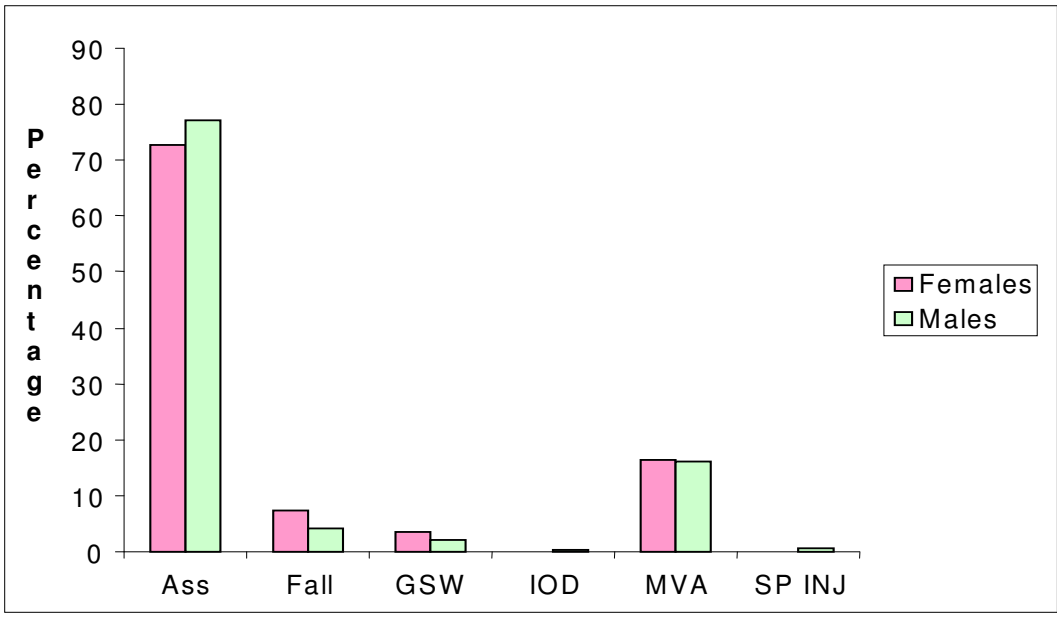

Figure 5.3 Gender distribution for various causes of injuries

5.3 AGE

Age distribution of the entire sample is shown in table 5.4 and figure 5.4. The incidence was found to be higher among the 20 to 29 year age group. The minimum age is 2 years and maximum age is 86 years, with a standard deviation of 12.06 and mean of 31.70 years.

Table 5.4 Age distribution for entire sample

AGE	FREQUENCY	PERCENTAGE
0 - 9	5	0.99
10 - 19	44	8.71
20 - 29	216	42.77
30 - 39	123	24.36
40 - 49	73	14.46
50 - 59	26	5.15
60 - 69	13	2.57
70 - 79	3	0.59
80 - 89	2	0.40

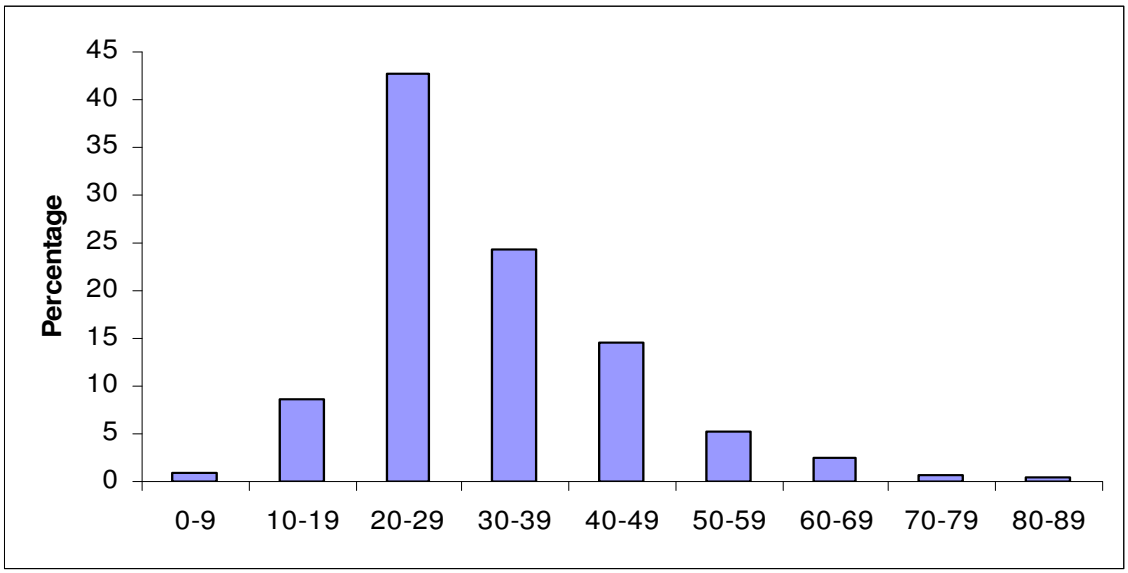

Figure 5.4 Histogram for entire sample

For females the minimum age is 7 years and maximum age is 67 years (table 5.5 and figure 5.5) with a standard deviation of 13.56. The mean age is 31.15 years.

Table 5.5 Age distribution for females

AGE	FREQUENCY	PERCENTAGE
0 – 9	1	1.54
10 – 19	9	13.85
20 – 29	30	46.15
30 – 39	11	16.92
40 – 49	6	9.23
50 – 59	4	6.15
60 – 69	4	6.15

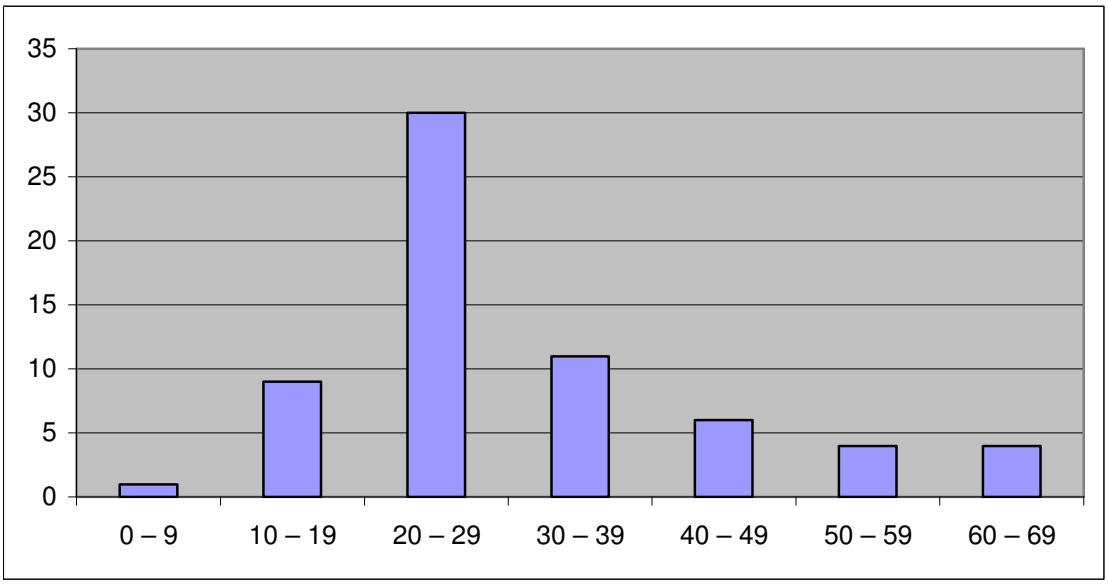

Figure 5.5 Histogram for females

For males the minimum age is 2, maximum age is 86 years (table 5.6 and figure 5.6) with a standard deviation of 13.56. The mean age is 31.15.

Table 5.6 Age distribution for males

AGE	FREQUENCY	PERCENTAGE
0 – 9	6	1.13
10 – 19	37	6.94
20 – 29	230	43.15
30 – 39	138	25.89
40 – 49	77	14.45
50 – 59	29	5.44
60 – 69	11	2.06
70 – 79	3	0.56
80 – 89	2	0.38

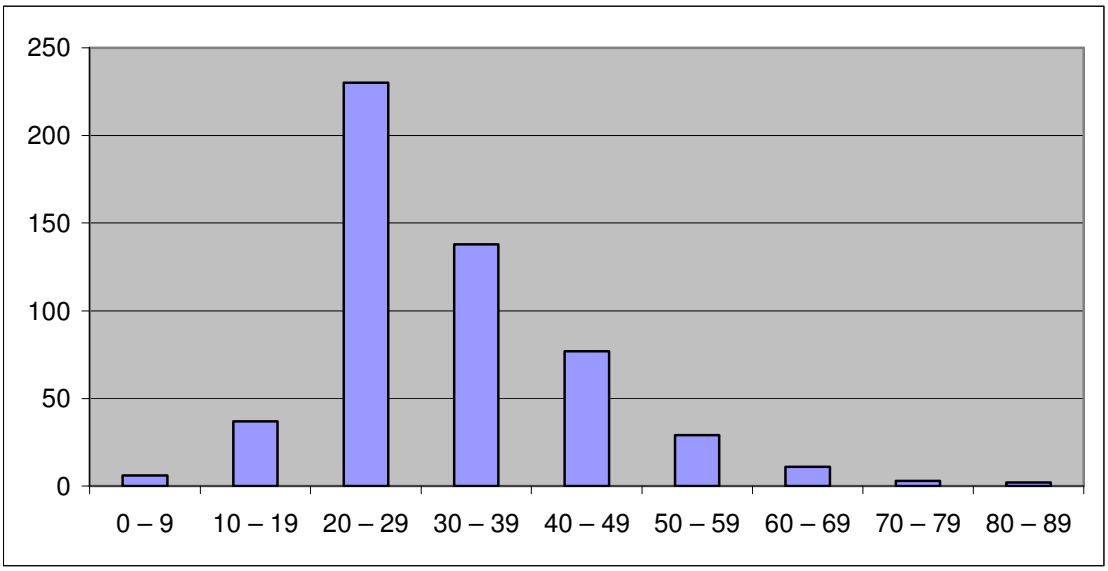

Figure 5.6 Histogram for males

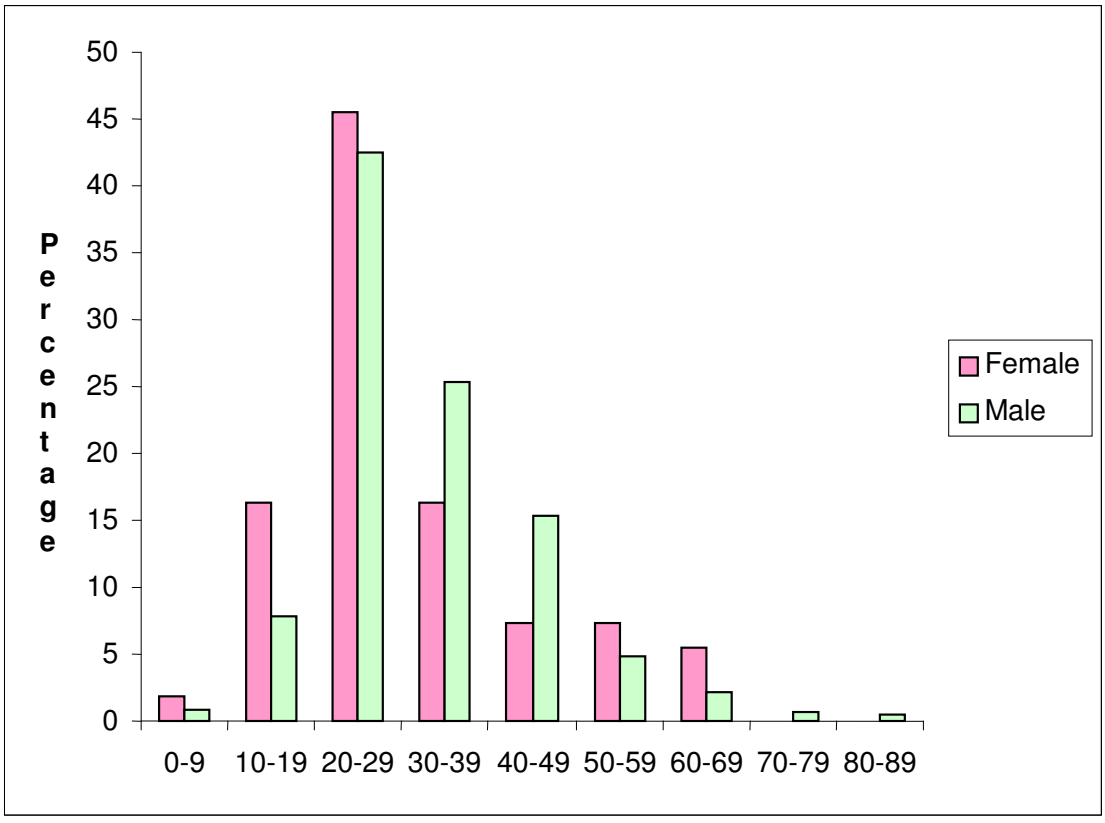

Figure 5.7 Histogram for males and females combined

5.4 SITE

The sites of the fractures were recorded as separate entities according to their anatomical locations, and subsequently the combination fractures were recorded in the combination in which they occurred.

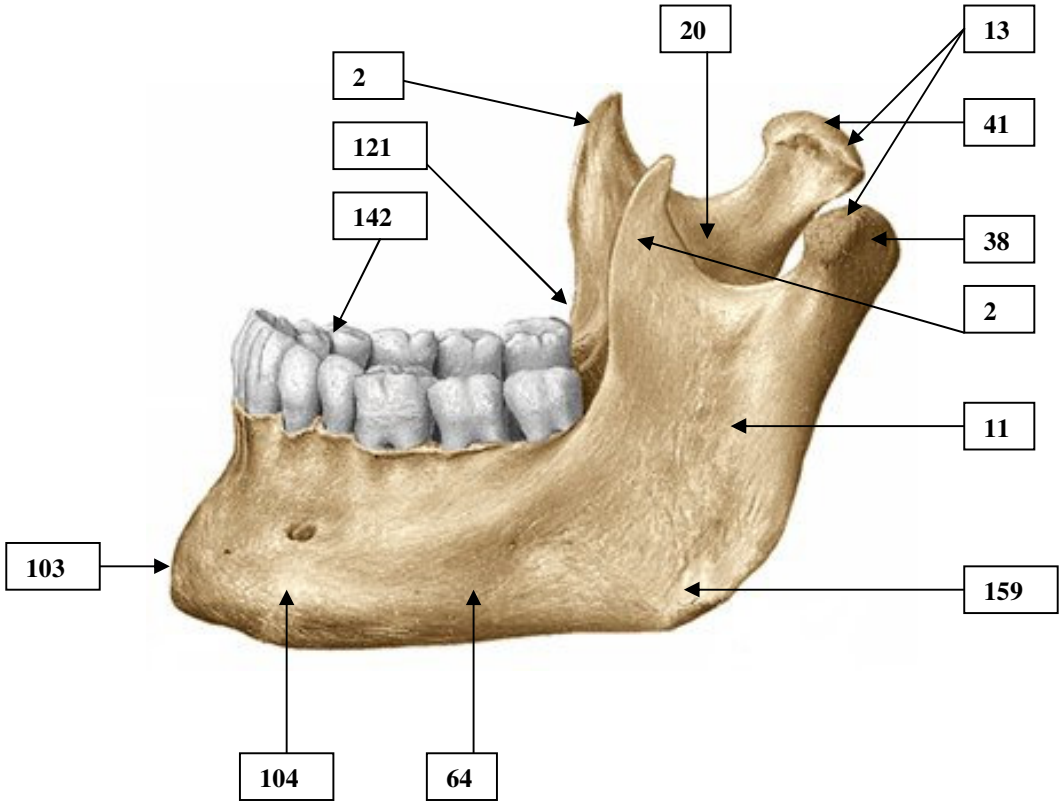

Figure 5.8 Anatomical sites for distribution of mandibular fractures

Table 5.7 Various combinations of fractures of the mandible

Site	Total
L angle + R body	36
R body + symphysis	3
R angle + symphysis	21
R body + L body	17
L angle + R parasymphysis	70
L angle + symphysis	29
L angle + R angle	28
L parasymphysis + R parasymphysis	17
R angle + R body	4
R angle + L body	37
R body + R parasymphysis	2
L body + R parasymphysis	18
L parasymphysis + R angle	47
R parasymphysis + symphysis	3
R body + L parasymphysis	11
R angle + R parasymphysis	12
L body + symphysis	6
L angle + L parasymphysis	10
L parasymphysis + symphysis	6
L angle + L body	3
R angle + R parasymphysis	2
R ramus combinations	20
L ramus combinations	11
Total	413

Condylar combination fractures

Table 5.8 Various combinations of condylar fractures of the mandible

Site	Total
L & R condyles	5
L & R condyles + symphysis	8
L condyle + symphysis	13
L condyle + R parasymphysis	10
L condyle + R body	4
L condyle + R angle	4
L condyle + L parasymphysis	4
L condyle + L angle	1
L condyle + L body	1
R condyle + symphysis	14
R condyle + R parasymphysis	8
R condyle + L parasymphysis	9
R condyle + R body	2
R condyle + L body	6
R condyle + R angle	1
Condyle + ramus	2
Total	92

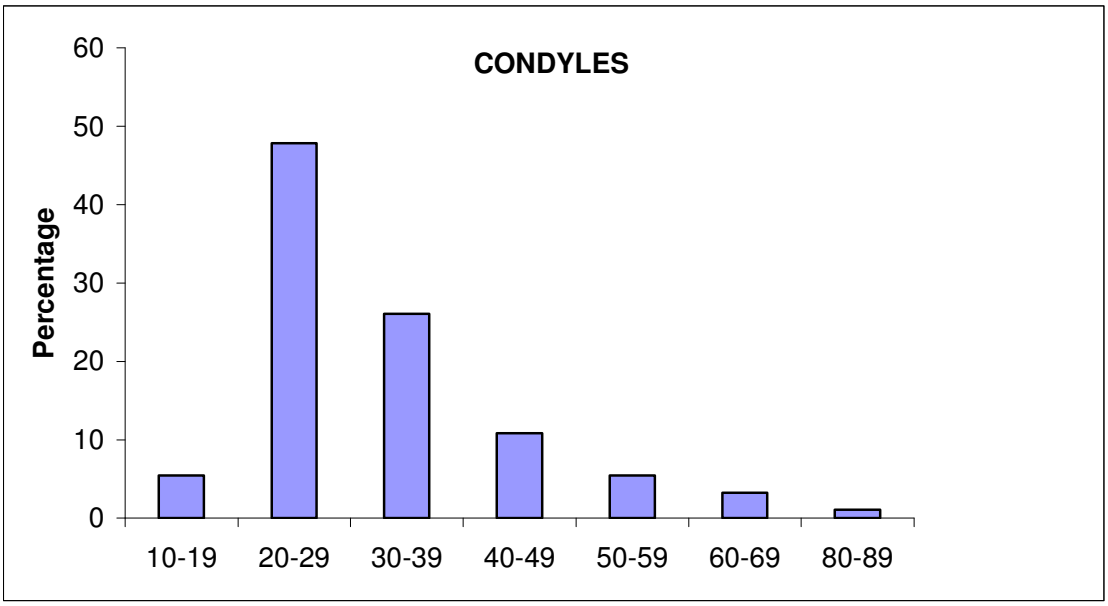

Figure 5.9 Histogram for patients with condylar combination fractures

Table 5.9 Age distribution for condylar combination fractures

N	Mean	Std Deviation	Minimum	Maximum
92	32.33	12.06	13.00	86.00

There were 92 condylar combination fractures recorded. The mean age was found to be 32.33 years with the minimum age being 13 years and the maximum being 86 years.

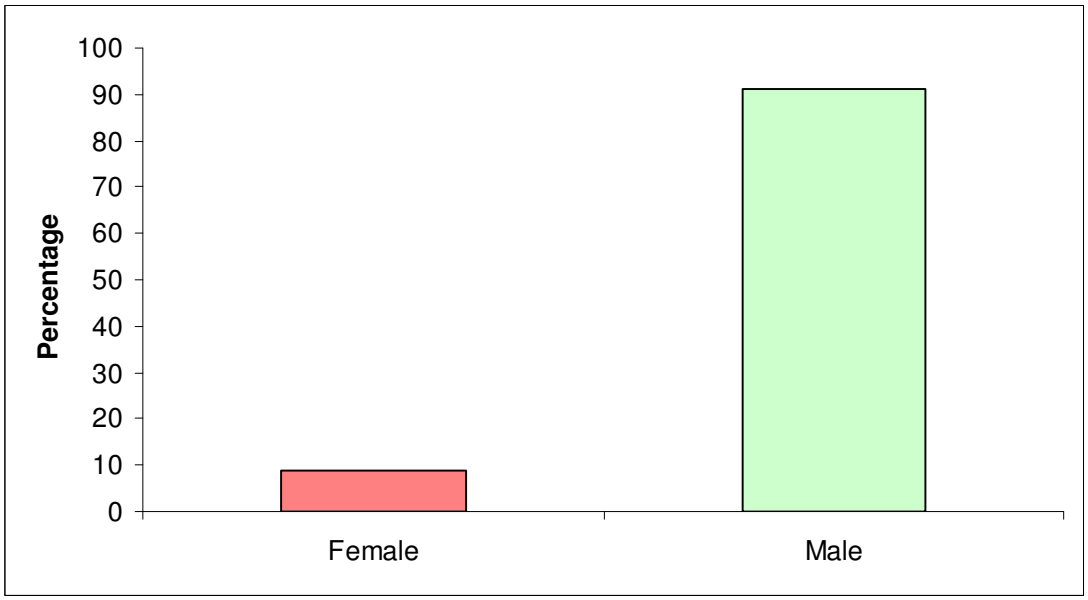

Figure 5.10 Gender distributions for patients with condylar combination fractures

There were 8.70% females and 91.30% males that sustained condylar combination fractures.

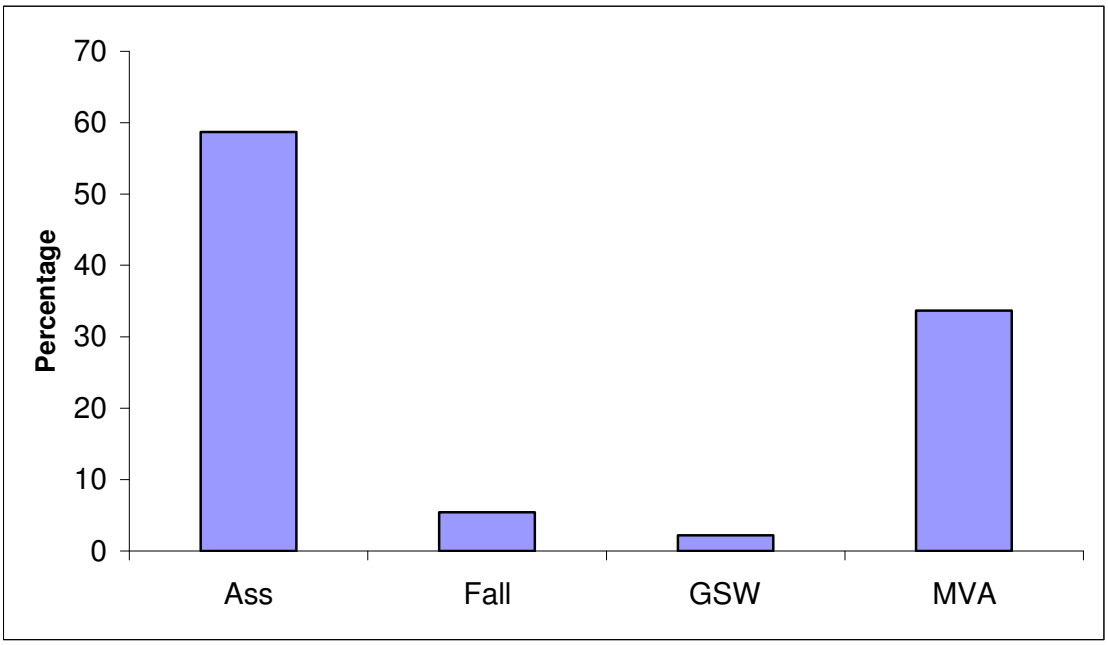

Figure 5.11 Etiological factors responsible for condylar combination fractures

Etiology for condylar fractures was as follows: assault 58.7%, MVA 33.7%, Fall 5.43% and GSW 2.17%.

Left angle and Right body combination fractures

Table 5.10 Age distribution for left angle and right body combination fractures

N	Mean	Std Deviation	Minimum	Maximum
36	32.47	11.69	15.00	69.00

Thirty-six patients sustained left angle right body combination fractures. The mean age was found to be 32.47 years with the minimum being 15 years and the maximum 69 years.

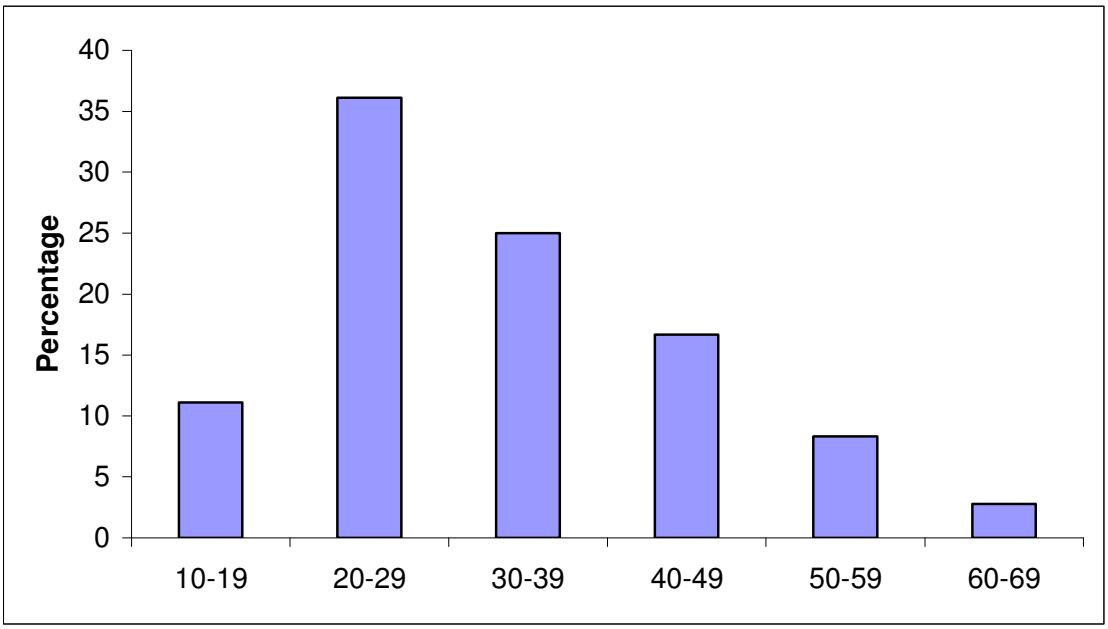

Figure 5.12 Histogram for left angle and right body combination fractures

Majority of the injuries occurred in the age range of 20 to 29 years.

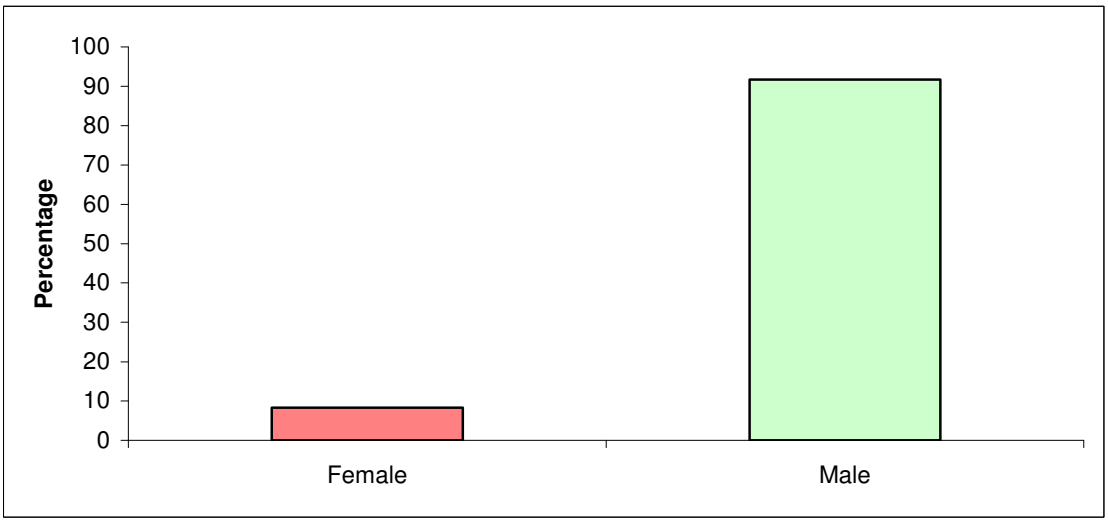

Figure 5.13 Gender distributions for left angle and right body combination fractures

Three (8.33%) females and 33 (91.67%) males sustained left angle and right body combination fractures.

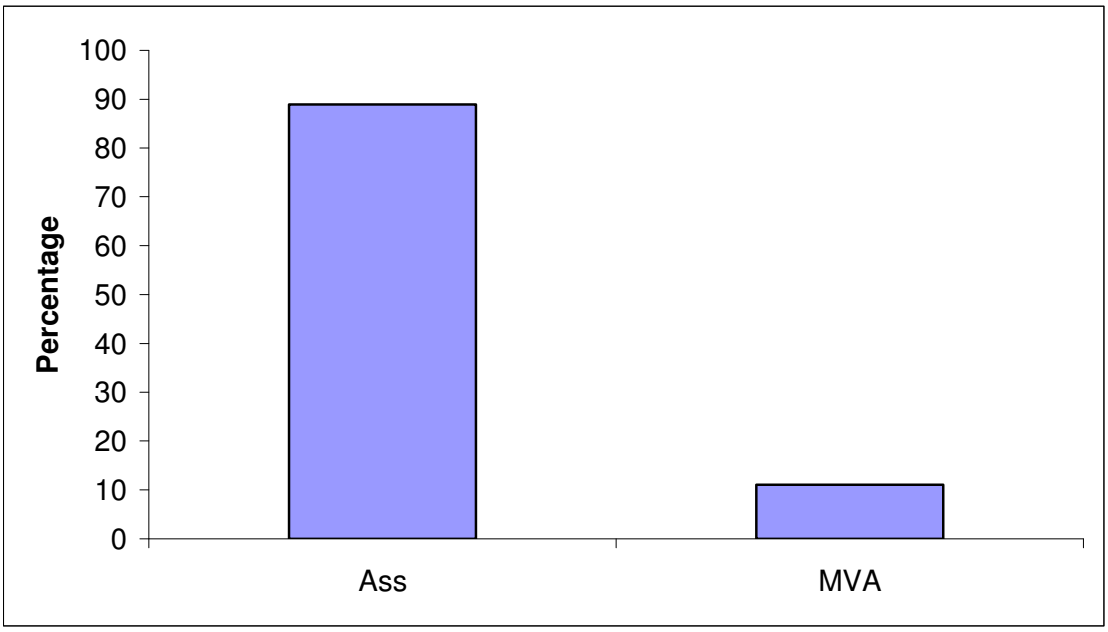

Figure 5.14 Etiology for left angle and right body combination fractures

Assault contributed for 88.89% while MVA contributed for 11.11% of left angle and right body combination fractures.

Right body and Left body combination fractures

Table 5.11 Age distribution for right body and left body combination fractures

N	Mean	Std Deviation	Minimum	Maximum
17	38.24	16.53	20.00	72.00

The minimum age was found to be 20 years while the maximum being 72 years with a mean age of 38.24 years.

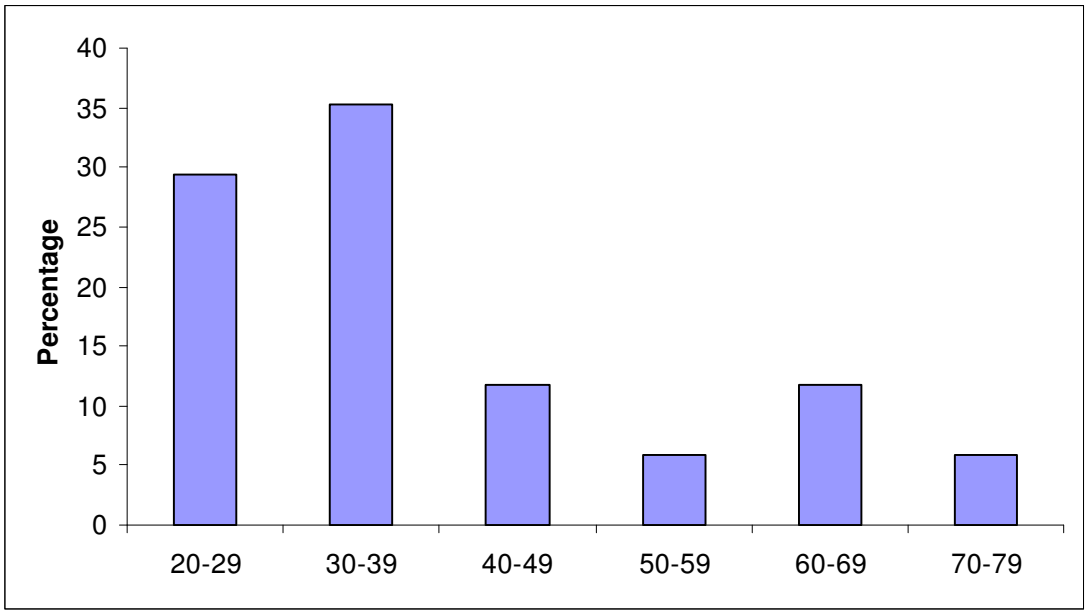

Figure 5.15 Histogram for right body and left body combination fractures

These injuries occurred more frequently in the 30 to 39 year age group followed by the 20 to 29 year age group.

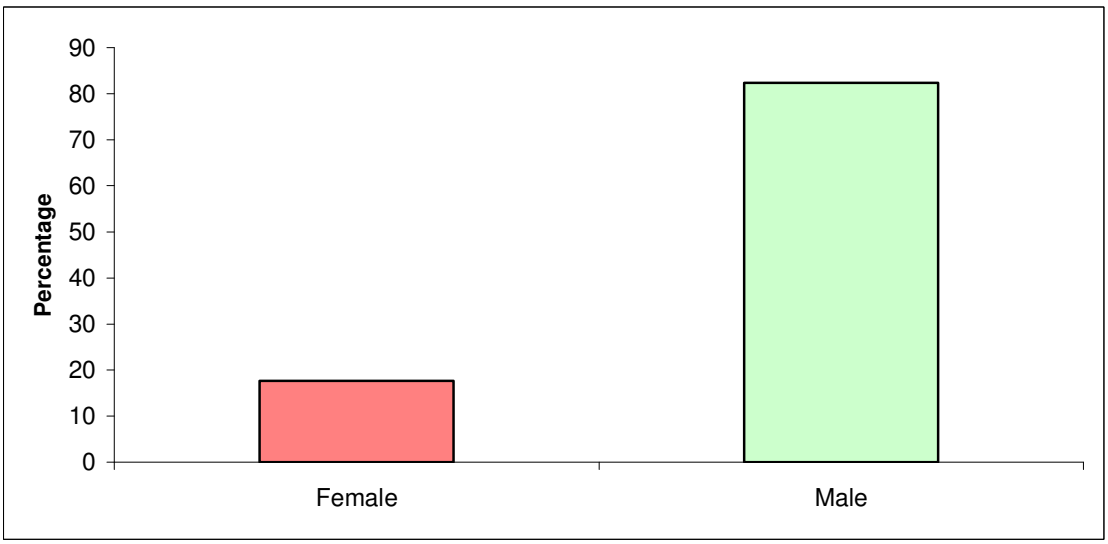

Figure 5.16 Gender distributions for right body and left body combination fractures

There were 17.65% females and 82.35% males with right angle left angle combination fractures.

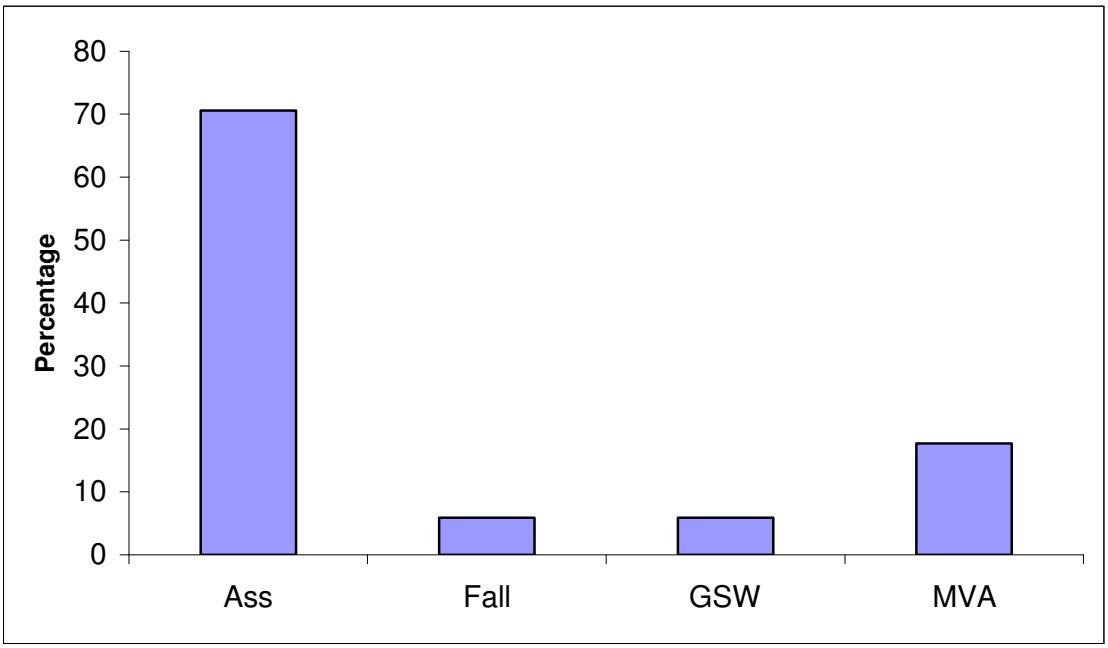

Figure 5.17 Etiology for right body and left body combination fractures

The major etiological factor for right angle left angle combination fractures was assault (70.59%) followed by MVA (17.65%), Fall (5,88%) and GSW (5.88%).

Right angle and Left angle combination fractures

Table 5.12 Age distribution for right angle and left angle combination fractures

N	Mean	Std Deviation	Minimum	Maximum
28	30.71	10.07	13.00	55.00

The mean age for right angle and left angle combination fractures was found to be 30.71 years with a minimum of 13 years and a maximum of 55 years.

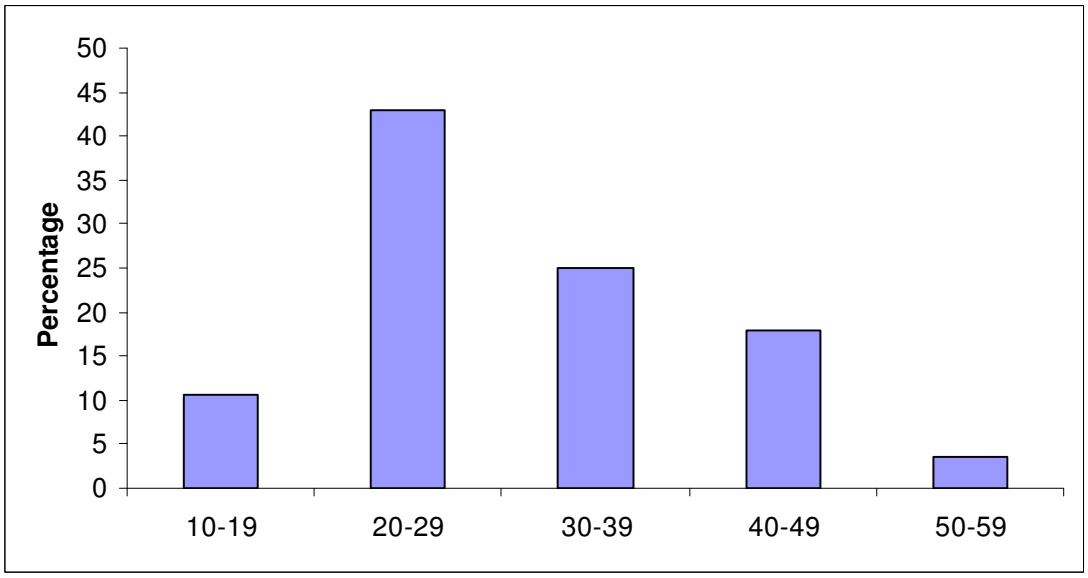

Figure 5.18 Histogram of entire sample for right angle and left angle combination fractures

The most affected age range was between 29 to 29 years.

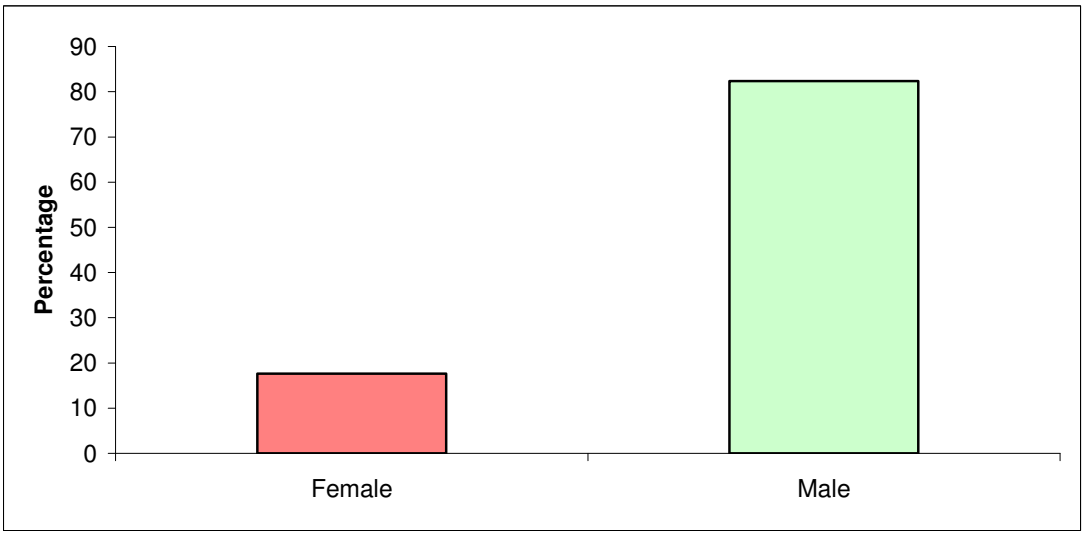

Figure 5.19 Gender distributions for right angle and left angle combination fractures

There were 14 (82.34%) males and 3 (17.65%) females affected.

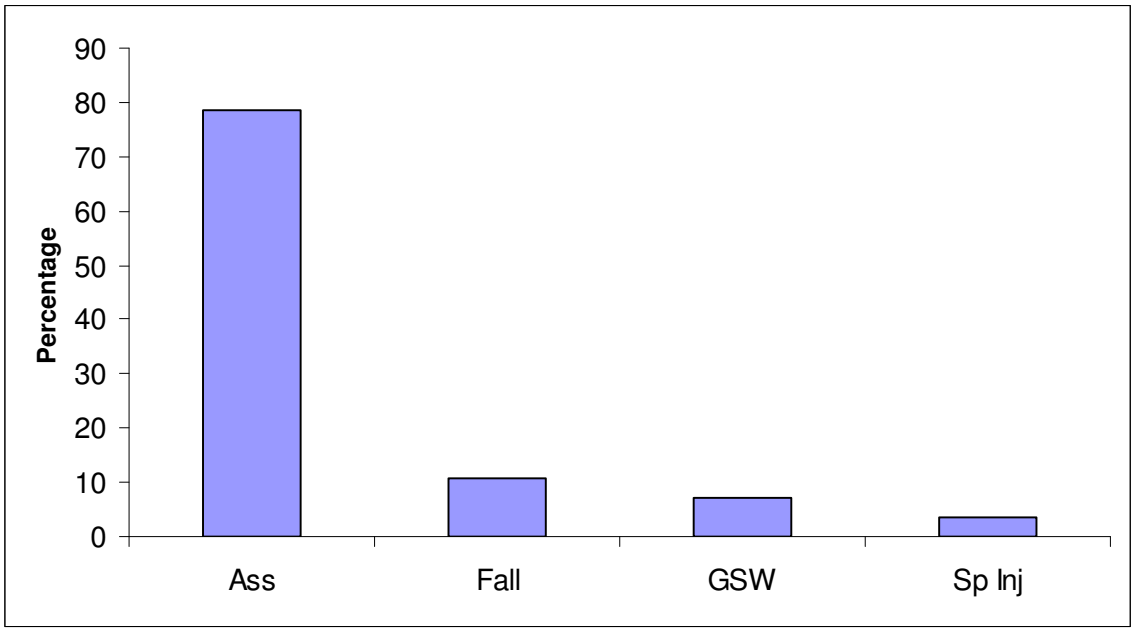

Figure 5.20 Etiology for right angle and left angle combination fractures

The etiological factors were assault 78.57%, Fall 10.71%, MVA 7.14% and sports injury 3.57%.

Right parasymphysis and Left parasymphysis combination fractures

Table 5.13 Age distribution for right parasymphysis and left parasymphysis combination fractures

N	Mean	Std Deviation	Minimum	Maximum
17	30.71	12.06	7.00	52.00

The minimum age was 7 years and the maximum was 52 years with a mean of 30.17 years.

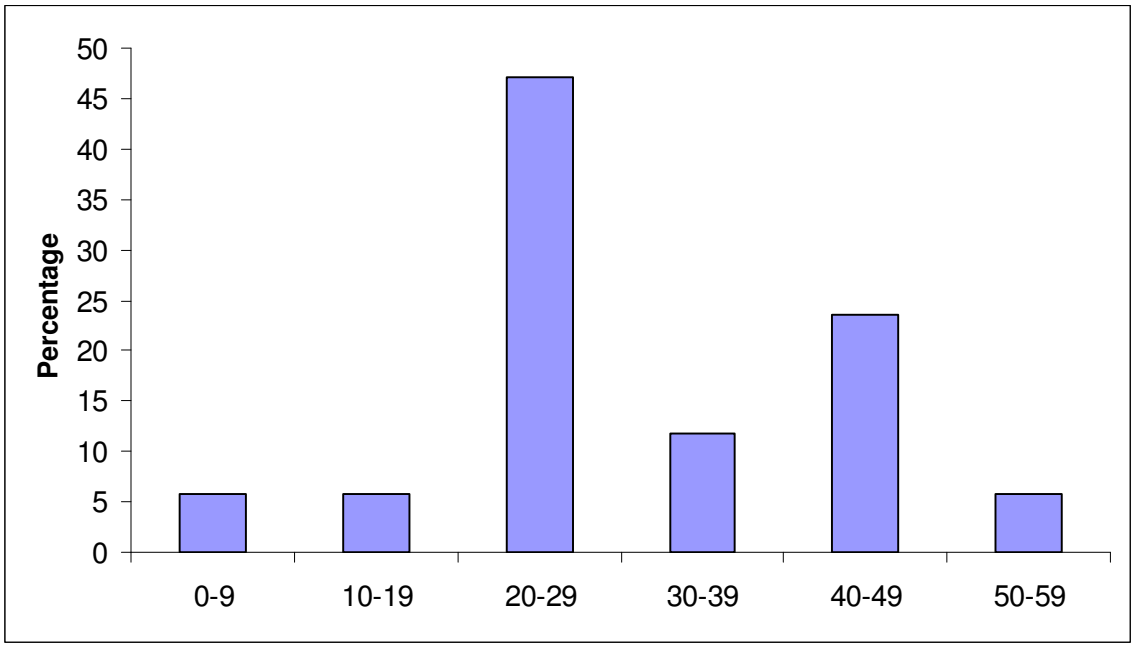

Figure 5.21 Histogram for right parasymphysis and left parasymphysis combination fractures

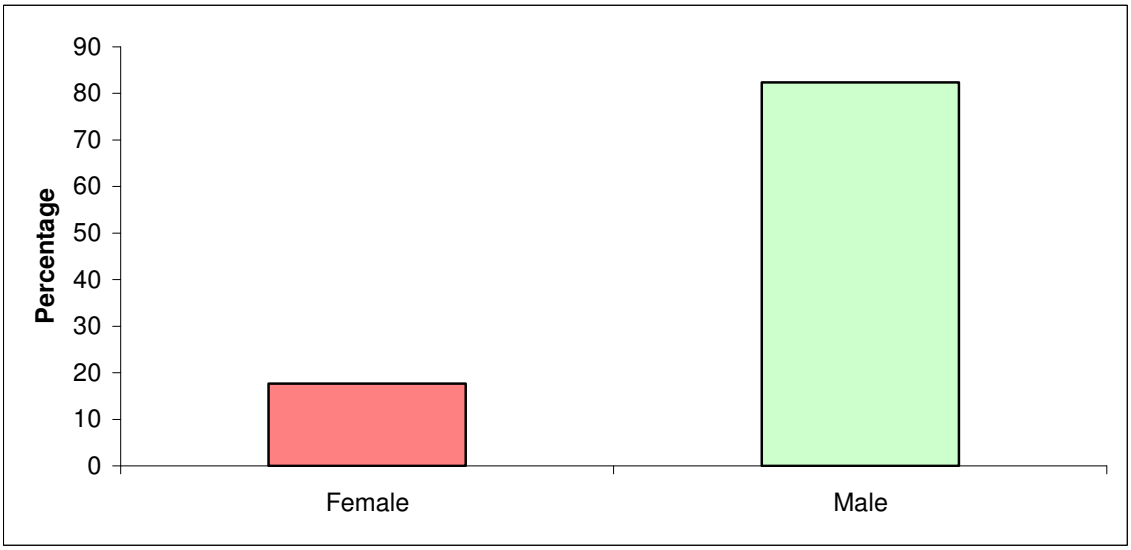

Figure 5.22 Gender distributions for right parasymphysis and left parasymphysis combination fractures

Three (17.65%) females and 14 (82.35%) males' sustained right parasymphysis left parasymphysis combination fractures

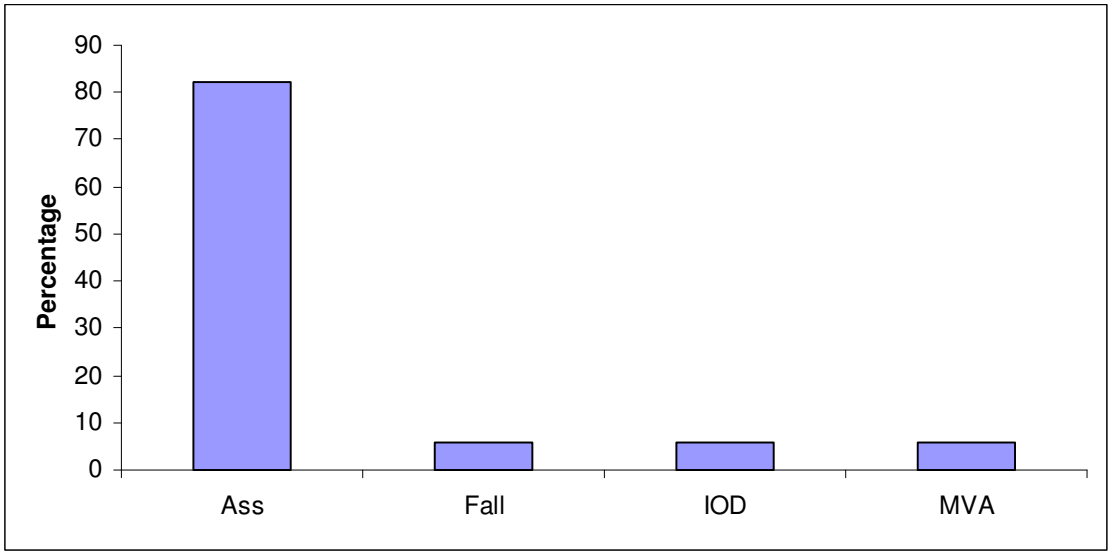

Figure 5.23 Etiology for right parasymphysis and left parasymphysis combination fractures

The etiological factors were assault 82.35%, Fall 5.88%, IOD 5.88% and MVA 5.88%.

Right angle and Right parasymphysis

Table 5.14 Age distribution for right angle and right parasymphysis combination fractures

N	Mean	Std Deviation	Minimum	Maximum
12	29.25	10.33	19.00	53.00

There were 12 patients with a minimum of 19 years and a maximum of 53 years. The mean age was 29.25 years.

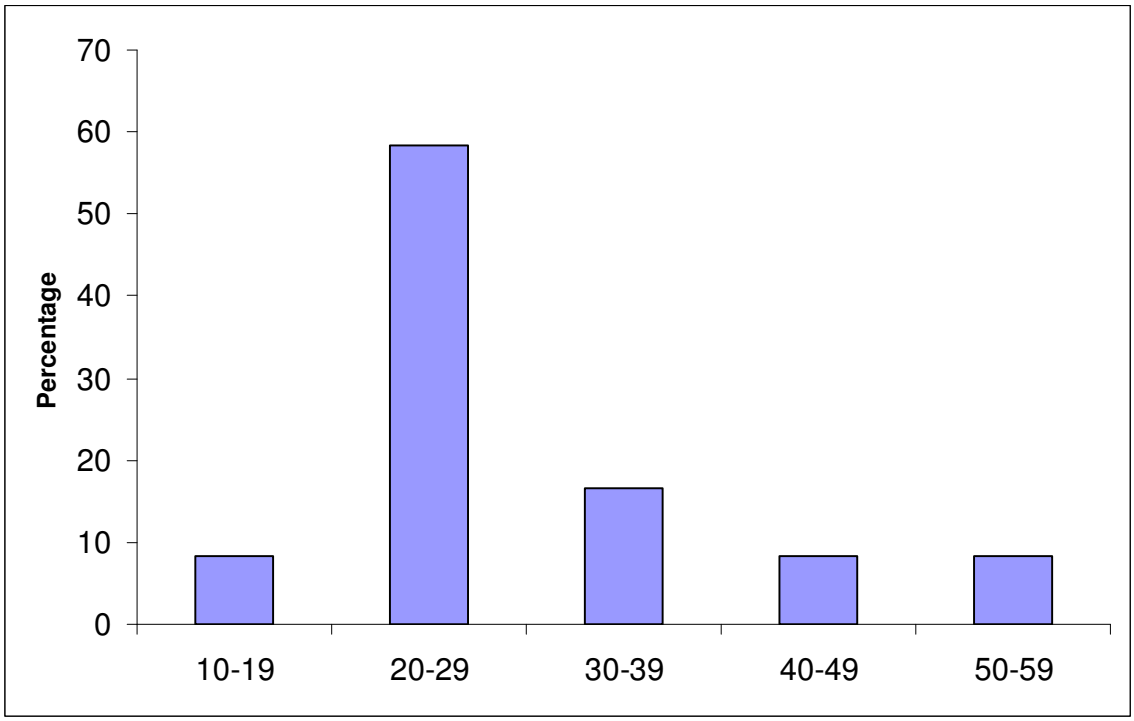

Figure 5.24 Histogram for right angle and right parasymphysis combination fractures

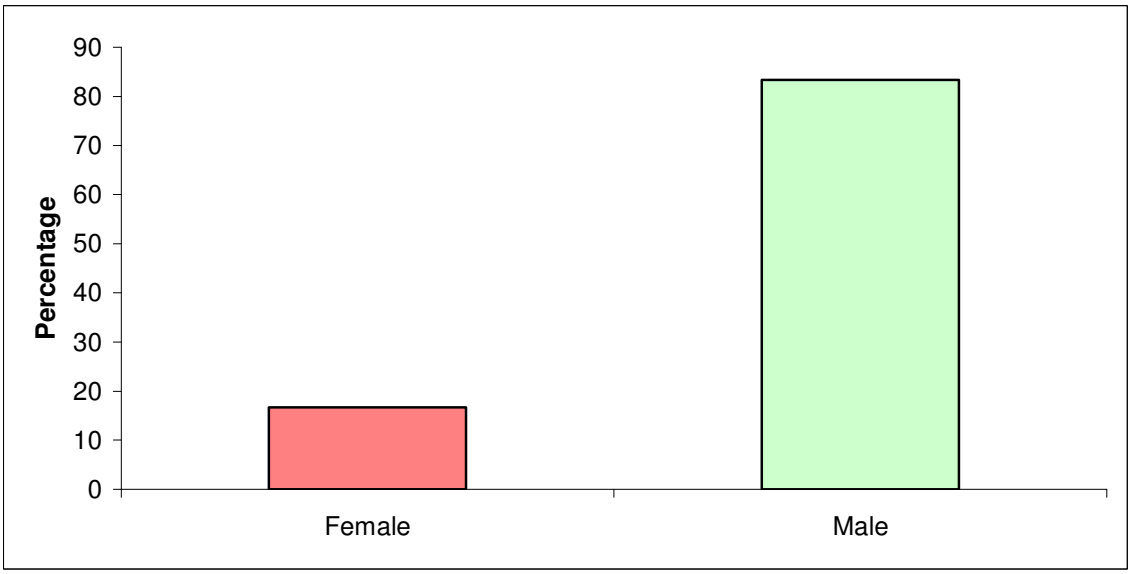

Figure 5.25 Gender distributions for right angle and right parasymphysis combination fractures

There were 2 (16.67%) females and 10 (83.33%) males with right angle and right parasymphysis combination fractures.

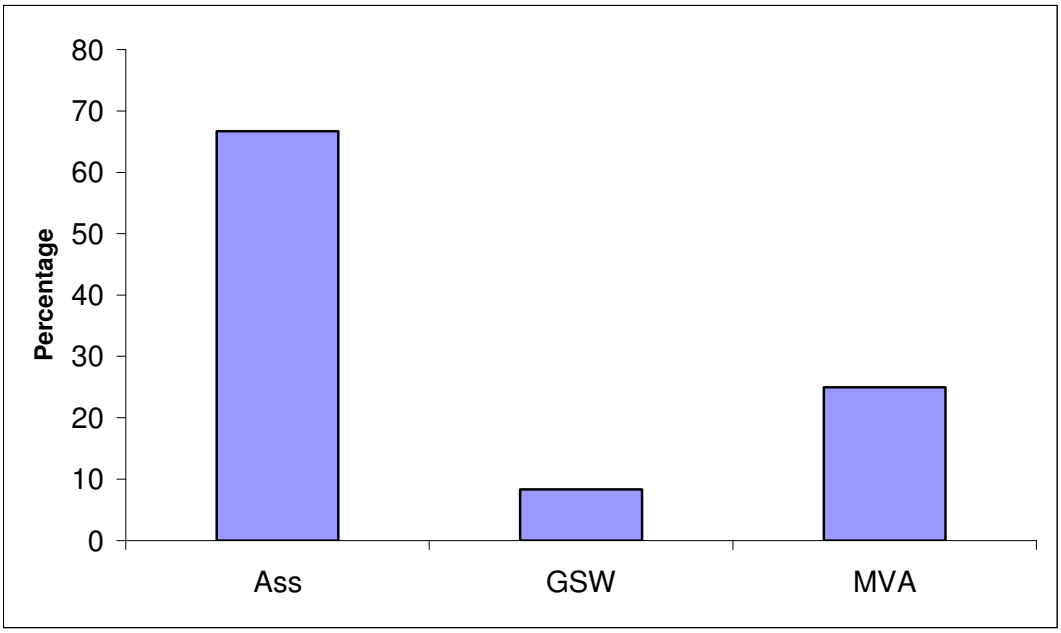

Figure 5.26 Gender distribution for right angle and right parasymphysis combination fractures

Etiological factors were assault 66.67%, GSW 8.33% and MVA 25%.

Left parasymphysis and Symphysis combination fractures

Table 5.15 Age distribution for left parasymphysis and symphysis combination fractures

N	Mean	Std Deviation	Minimum	Maximum
6	25.83	14.59	8.00	50.00

A total of 6 patients with a mean age of 25.83 years sustained left parasymphysis

symphysis combination fractures.

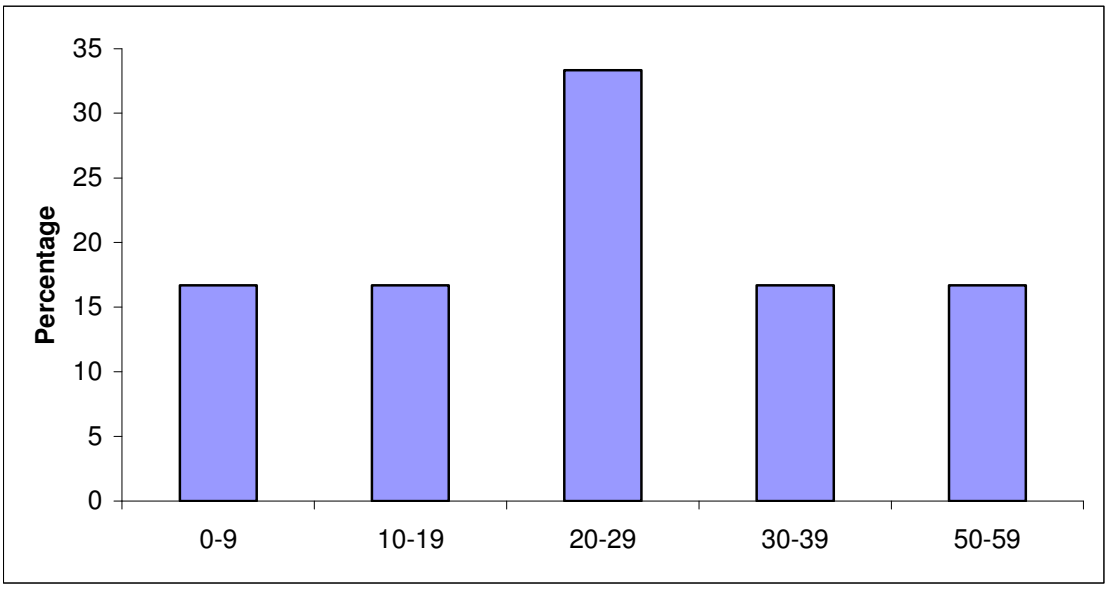

Figure 5.27 Histogram for left parasymphysis and symphysis combination fractures

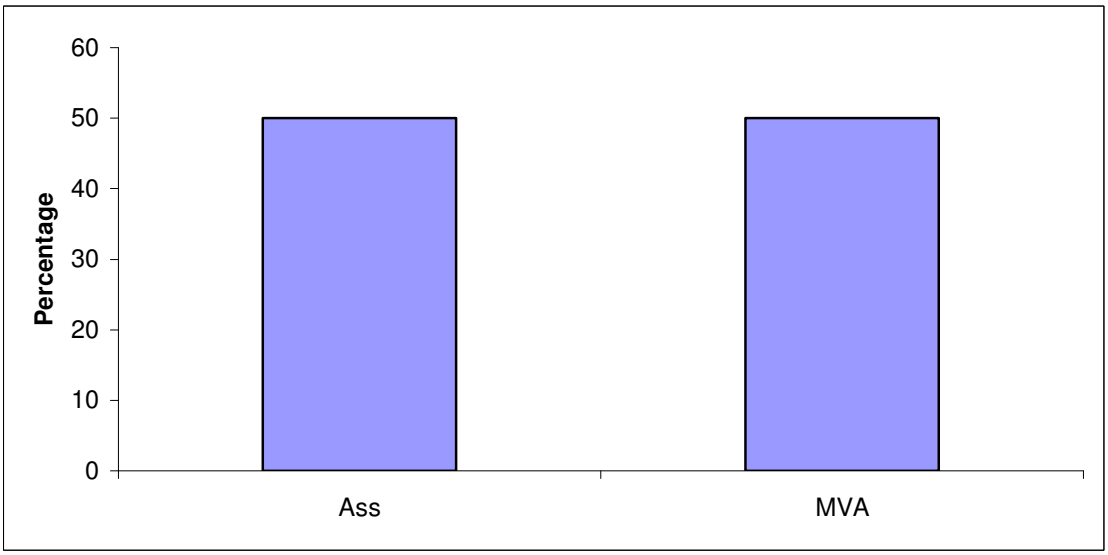

Figure 5.28 Etiology for left parasymphysis and symphysis combination fractures

Assault (50%) and MVA (50%) were the only etiological factors.

All patients were males.

Right angle and Left body combination fractures

Table 5.16 Age distribution for right angle and left body combination fractures

N	Mean	Std Deviation	Minimum	Maximum
37	30.92	13.72	10.00	79.00

A total of 32 patients with a maximum age of 79 years and a minimum of 10 years with a standard deviation of 30.92 years.

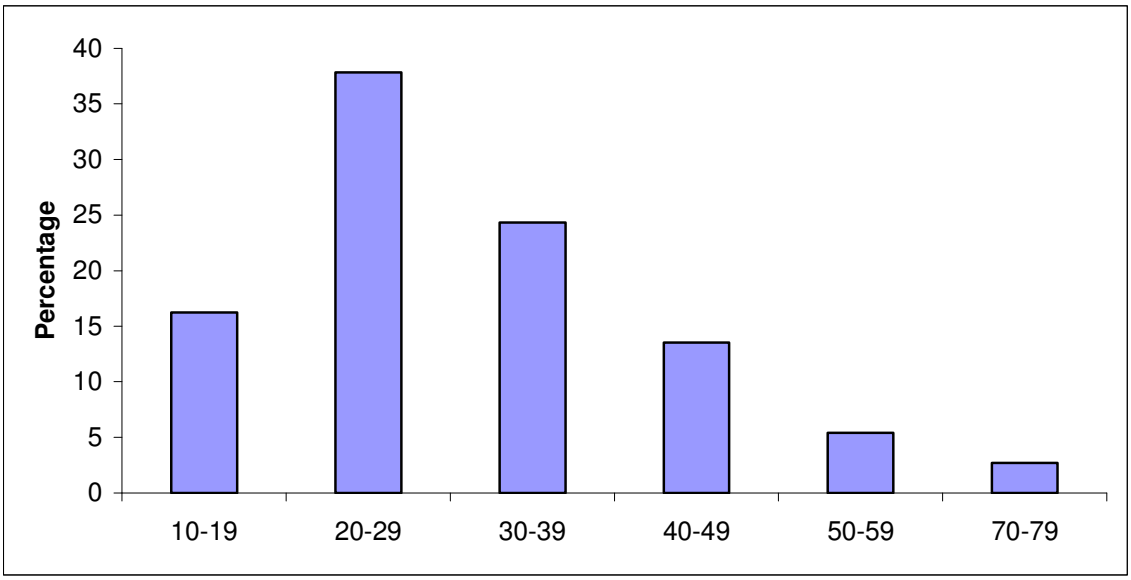

Figure 5.29 Histogram for right angle and left body combination fractures

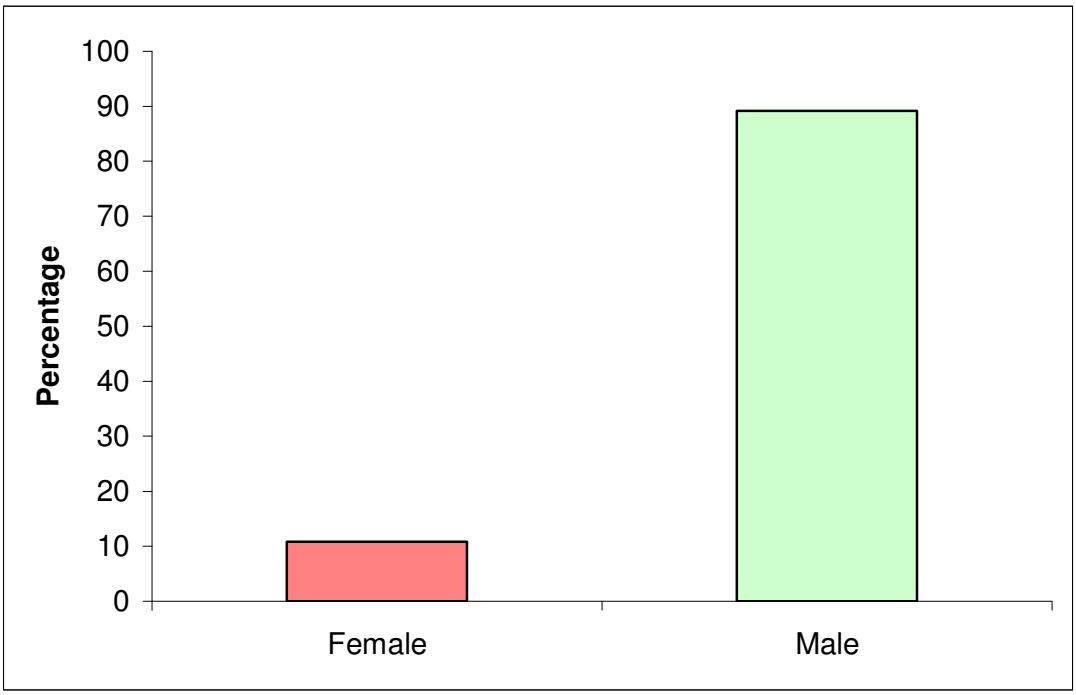

Figure 5.30 Gender distributions for right angle and left body combination fractures

Females accounted for 10.81% and males 89.19%.

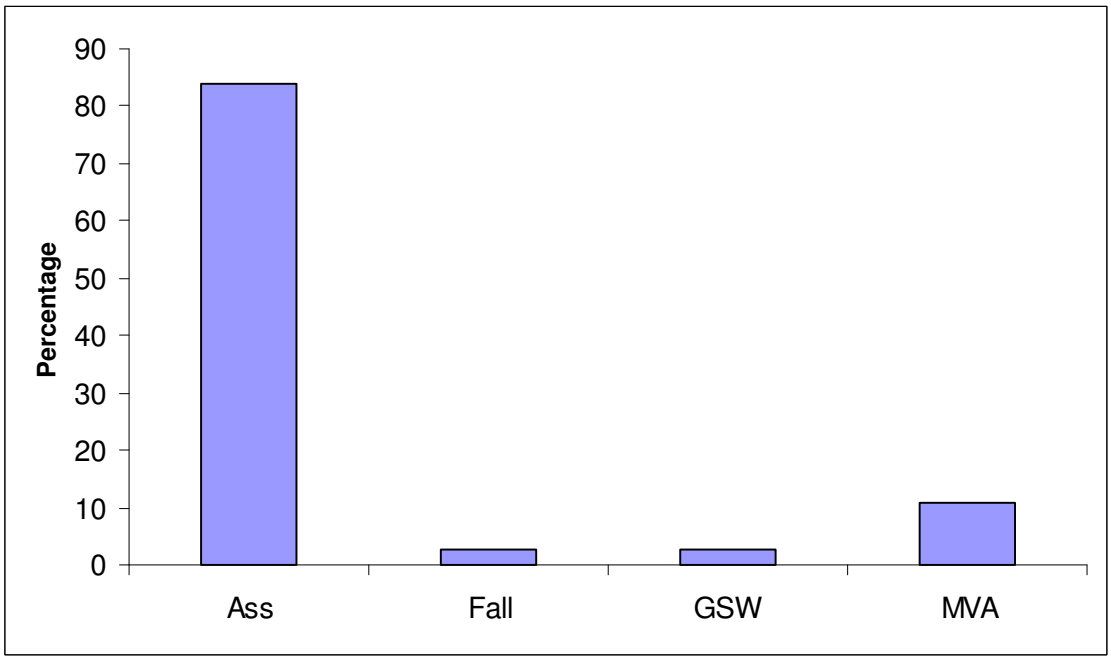

Figure 5.31 Etiology for right angle and left body combination fractures

Etiological factors were assault 83.78% MVA 18.81%, Fall 2.70% and GSW 2.70%.

Right angle and Symphysis combination fractures

Table 5.17 Age distribution for right angle and symphysis combination fracture

N	Mean	Std Deviation	Minimum	Maximum
21	29.57	13.84	15.00	80.00

A total of 21 patients with a minimum age of 15 years and a maximum age of 80 years with a mean of 29.57 years.

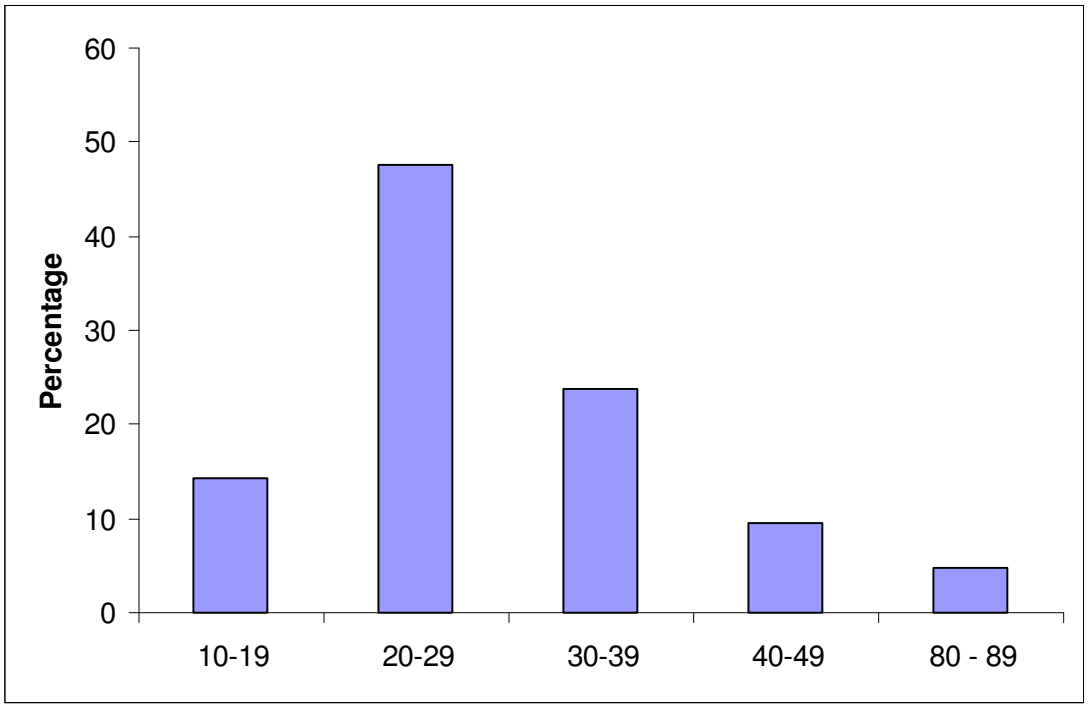

Figure 5.32 Histogram for right angle and symphysis combination fracture

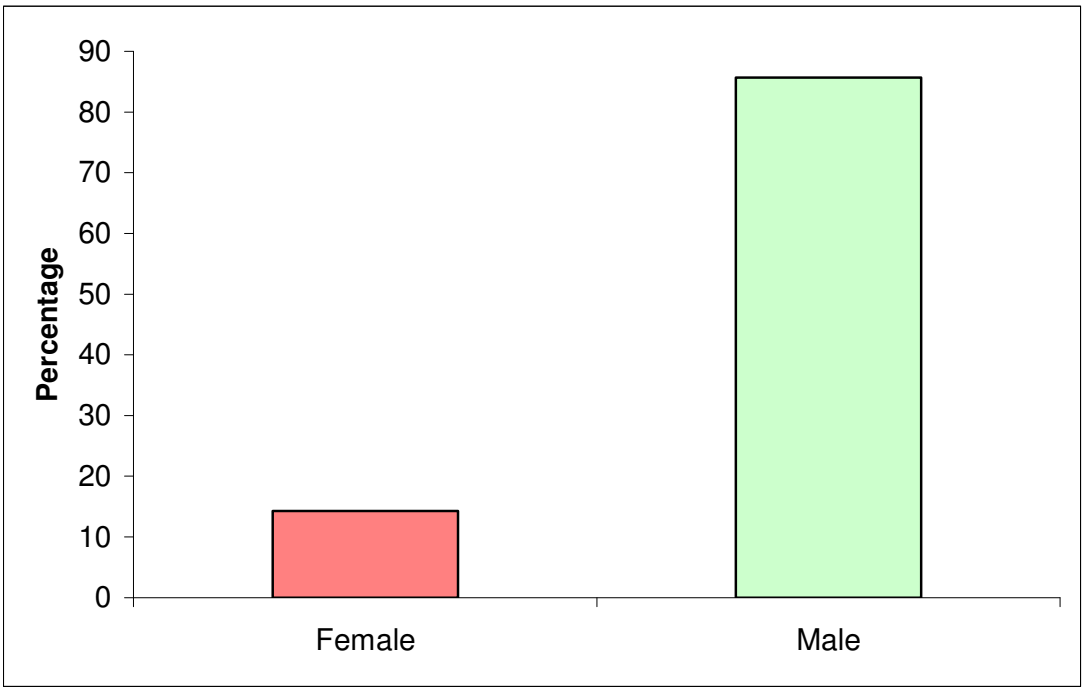

Figure 5.33 Gender distributions for right angle and symphysis combination fracture

There were 14.29% females and 85.71% males.

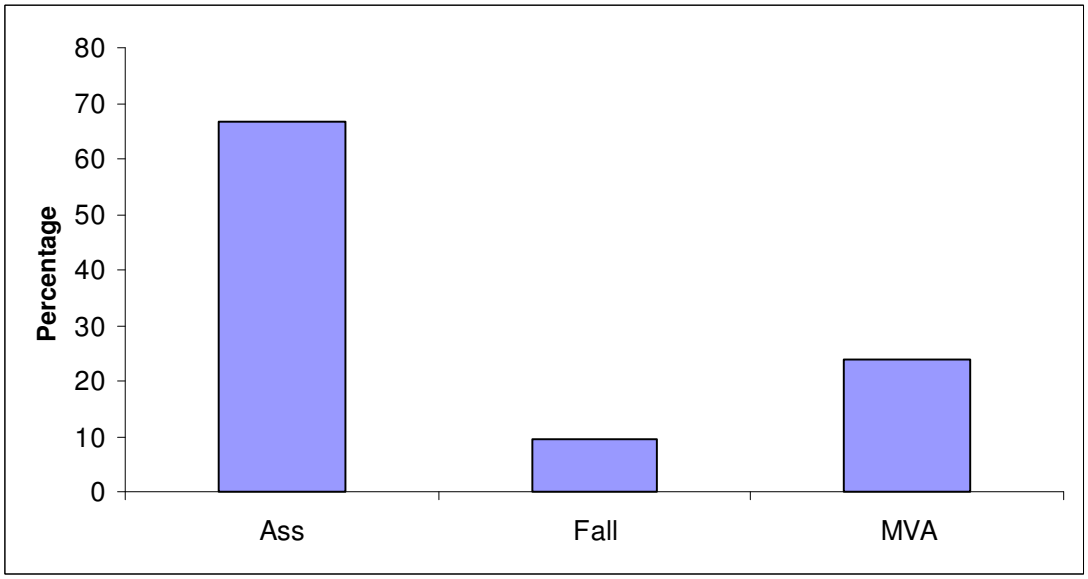

Figure 5.34 Etiology for right angle and symphysis combination fracture

Etiological factors were assault 66.67%, MVA 23.81% and Fall 9.52%.

Right angle and Left parasymphysis combination fractures

Table 5.18 Age distribution for right angle and left parasymphysis combination fracture

N	Mean	Std Deviation	Minimum	Maximum
47	27.85	9.02	10.00	56.00

A total of 47 patients with a minimum age of 10 years, a maximum age of 56 years with and the mean being 27.85 years.

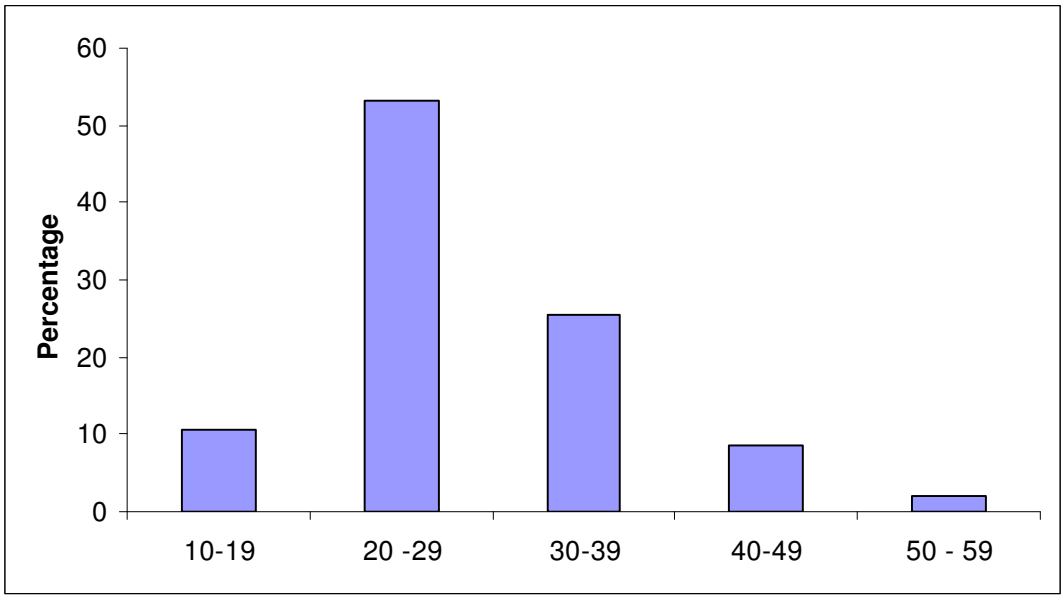

Figure 5.35 Histogram for right angle and left parasymphysis combination fractures

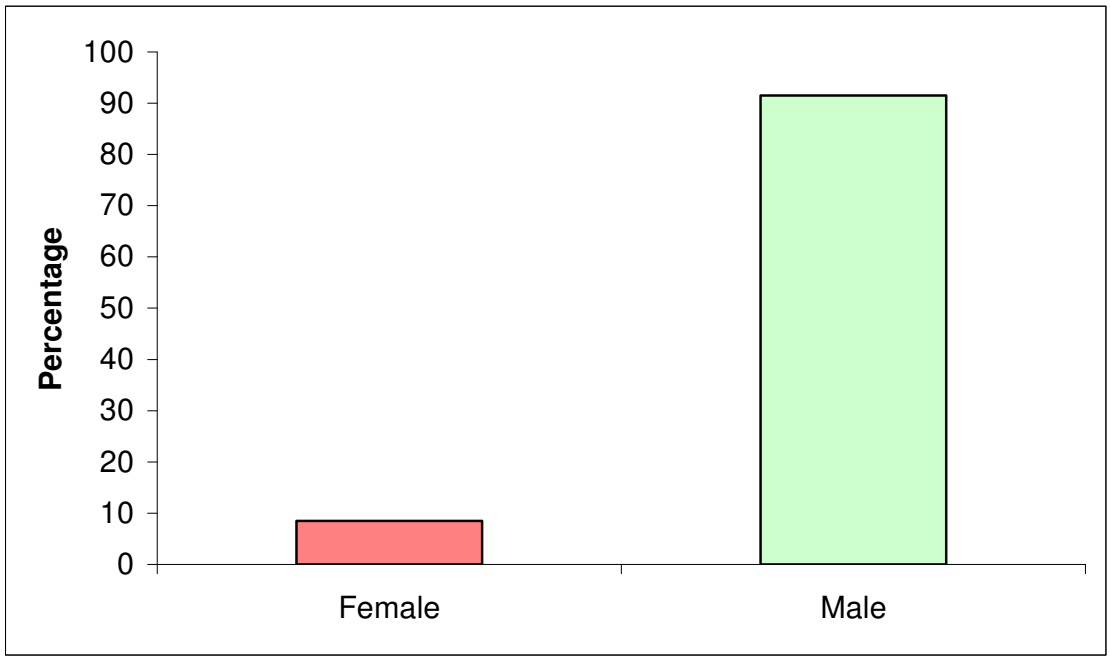

Figure 5.36 Gender distributions for right angle and left parasymphysis combination fractures

There were 8.51% females and 91.49% males.

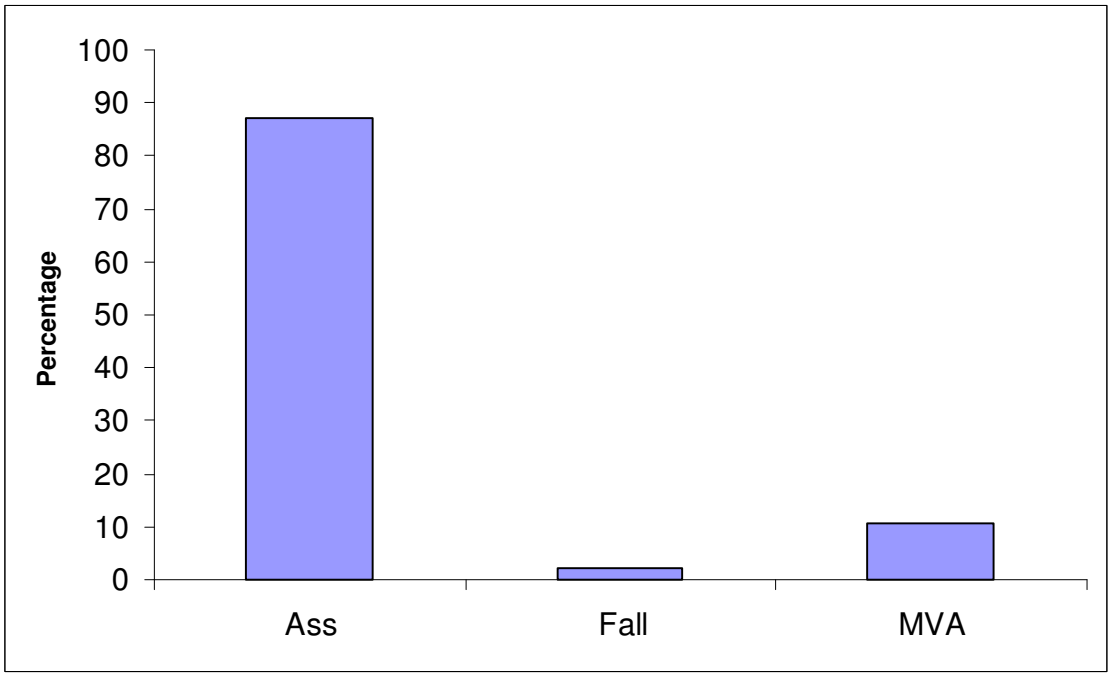

Figure 5.37 Etiology for right angle and left parasymphysis combination fractures

Etiological factors were assault 87.23%, MVA 10.64% and Fall 2.13%.

Left body and Right parasymphysis combination fractures

Table 5.19 Age distribution for left body and right parasymphysis combination fractures

N	Mean	Std Deviation	Minimum	Maximum
18	31.50	8.81	20.00	47.00

The minimum age was 20 years while the maximum was 47 years with a mean of 31.50 years.

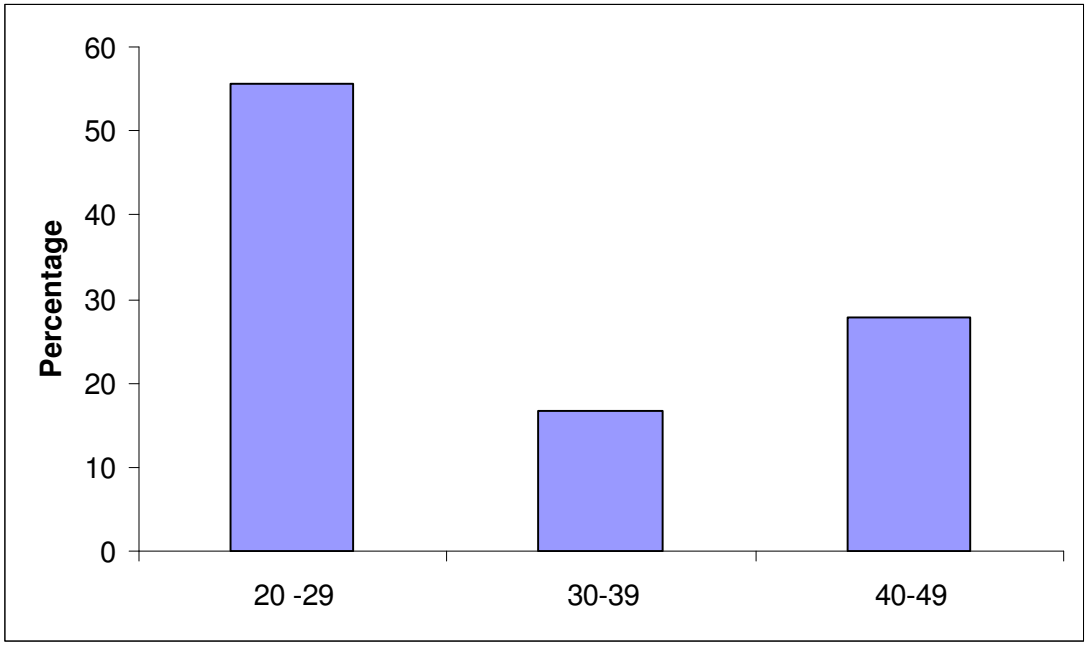

Figure 5.38 Histogram for left body and right parasymphysis combination fractures

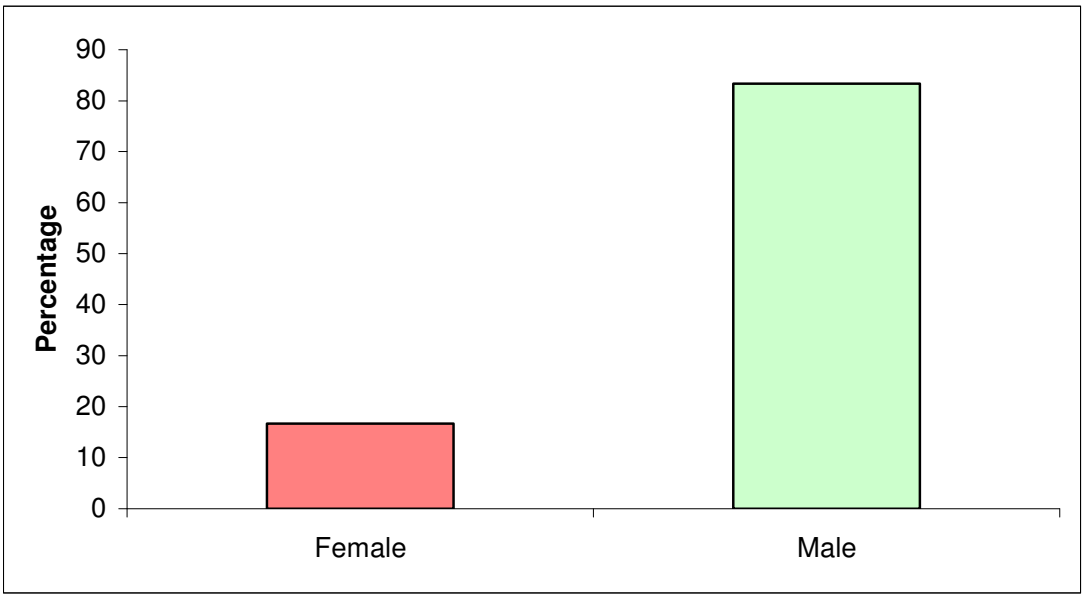

Figure 5.39 Gender distributions for left body and right parasymphysis combination fractures

There were 16.67% females and 83.33% males who sustained left body right

parasymphysis combination fractures

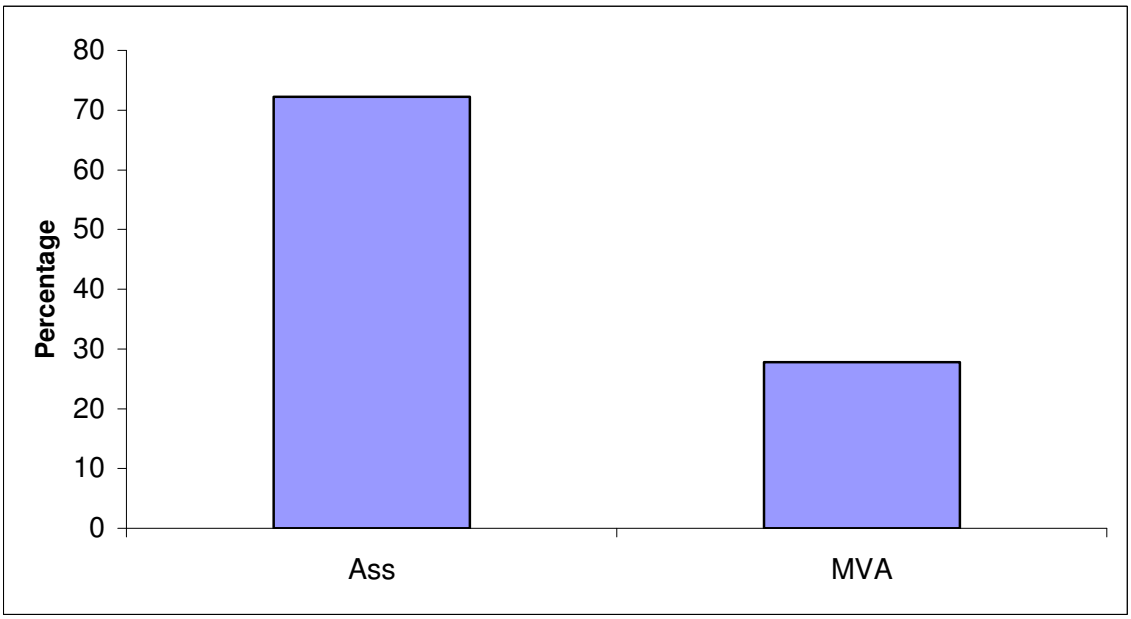

Figure 5.40 Etiology for left body and right parasymphysis combination fractures

Etiology was found to be assault 72.22% and MVA 27.78%.

Right body and Left parasymphysis combination fractures

Table 5.20 Age distribution for right body and left parasymphysis combination fractures

N	Mean	Std Deviation	Minimum	Maximum
11	37.73	17.57	19.00	77.00

The minimum age was found to be 19 years and the maximum 77 years with a mean of 31.73%.

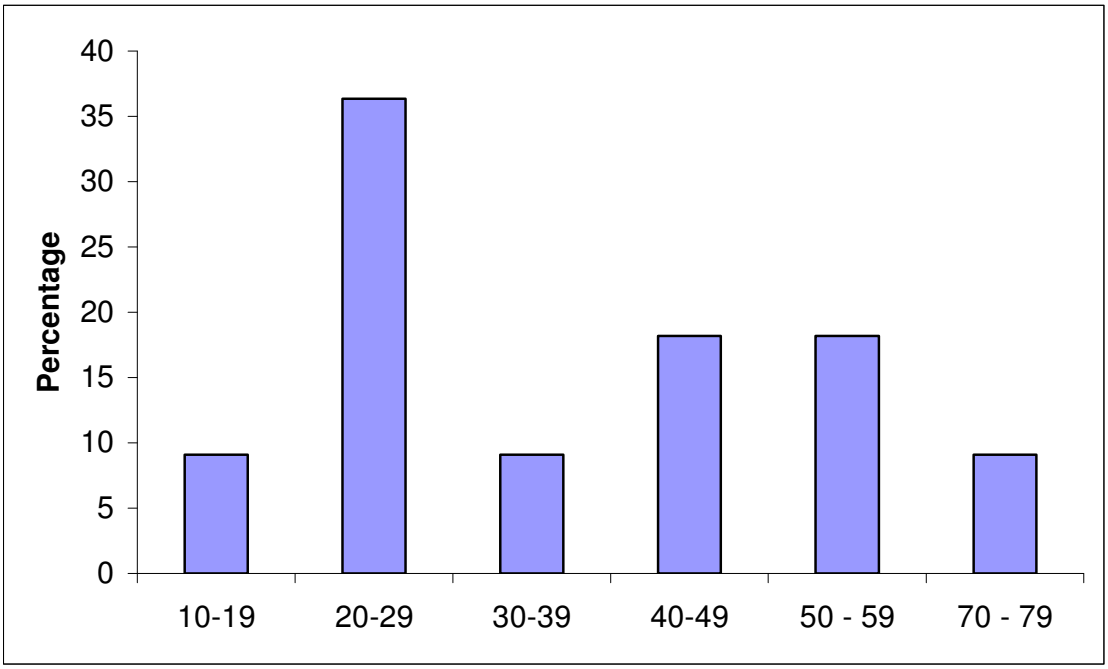

Figure 5.41 Histogram for right body and left parasymphysis combination fractures

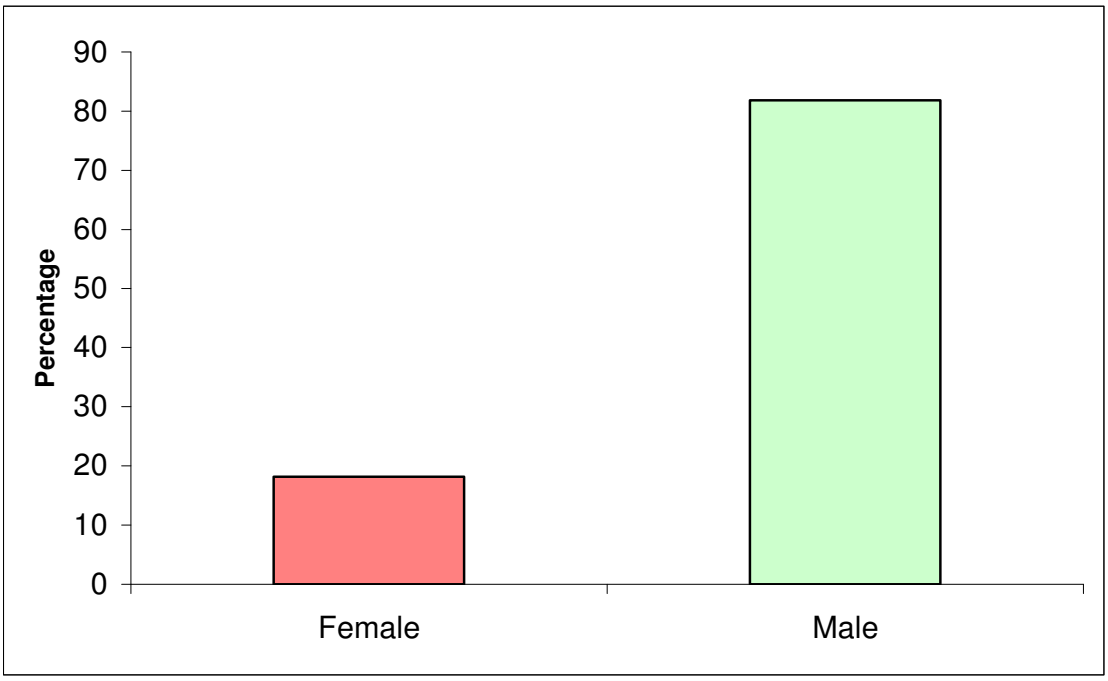

Figure 5.42 Gender distributions for right body and left parasymphysis combination fractures

There were 2 (18.18%) females and 9 (81.82%) males.

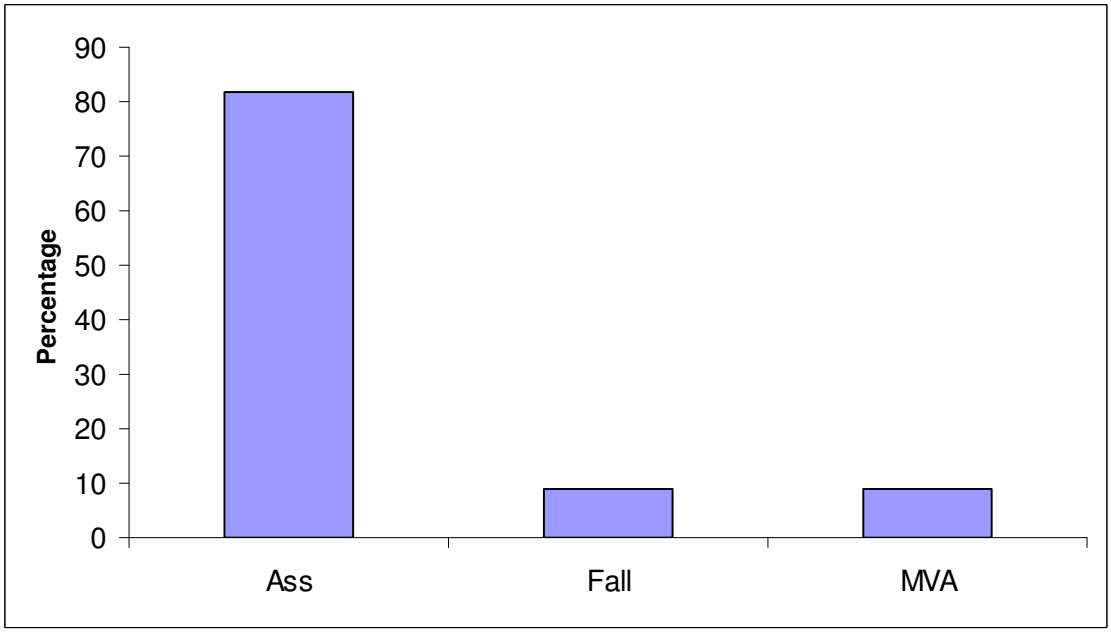

Figure 5.43 Gender distributions for right body and left parasymphysis combination fractures

Etiological factors were assault 81.82%, Fall 9.09% and MVA 9.09%.

Left angle and Right parasymphysis combination fractures

Table 5.21 Age distribution for left angle and right parasymphysis combination fractures

N	Mean	Std Deviation	Minimum	Maximum
70	32.51	12.29	13.00	67.00

A total of 70 patients had a minimum age of 13 years and a maximum of 67 years with a mean age of 32.51years.

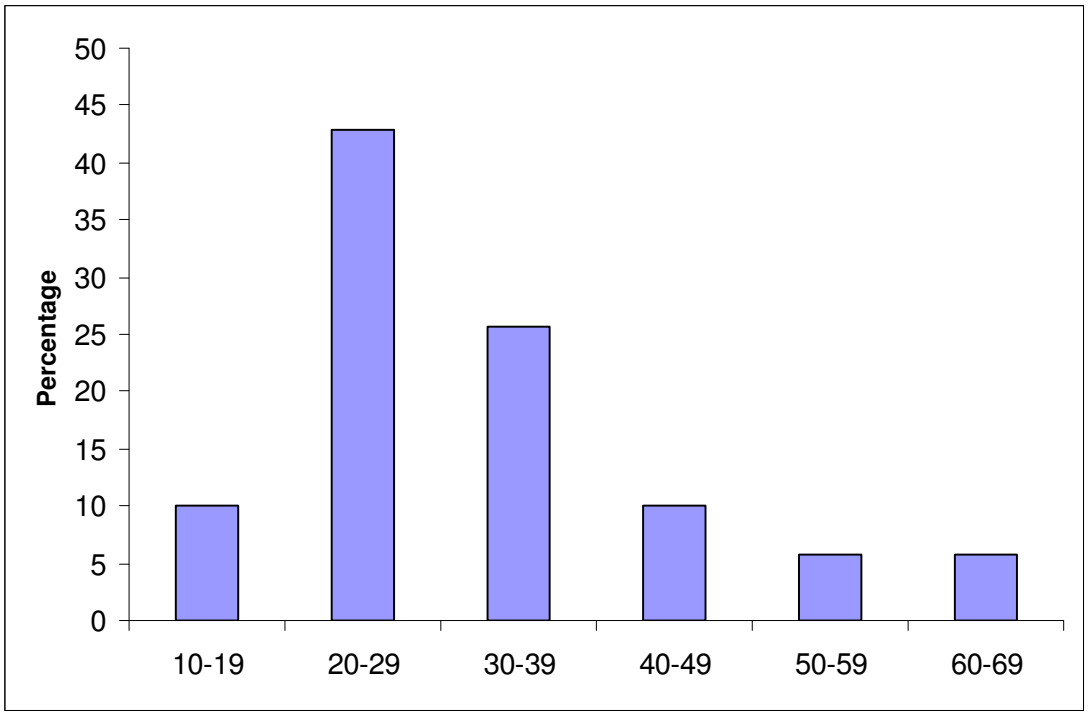

Figure 5.44 Histogram for left angle and right parasymphysis combination fractures

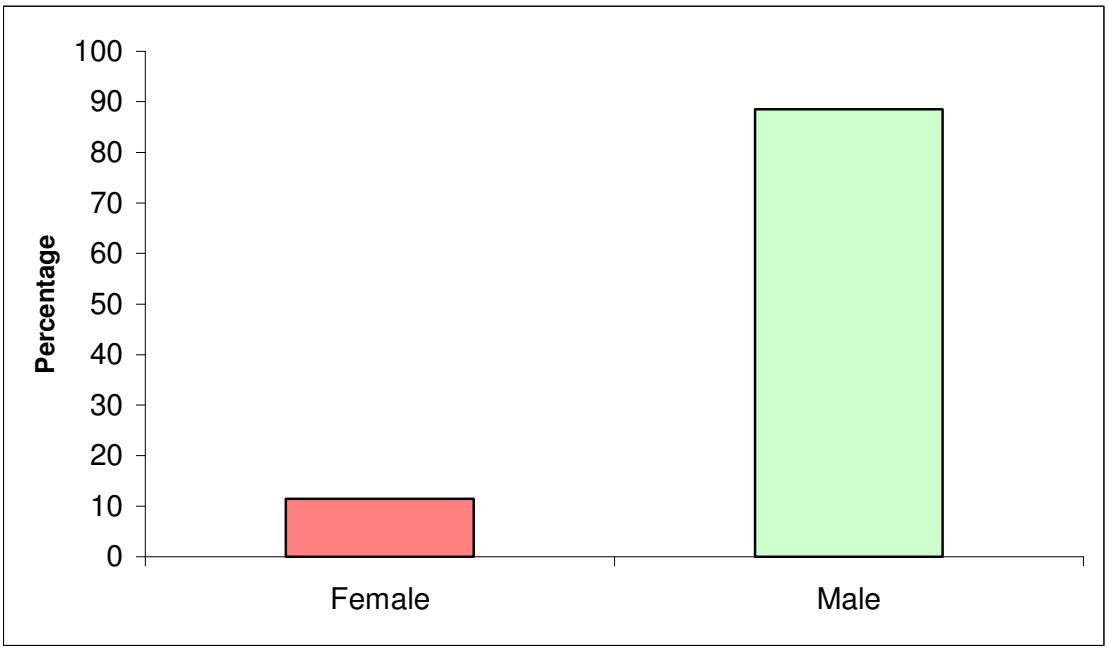

Figure 5.45 Gender distributions for left angle and right parasymphysis combination fractures

There were 8(11.43%) females and 62 (88.57%) males.

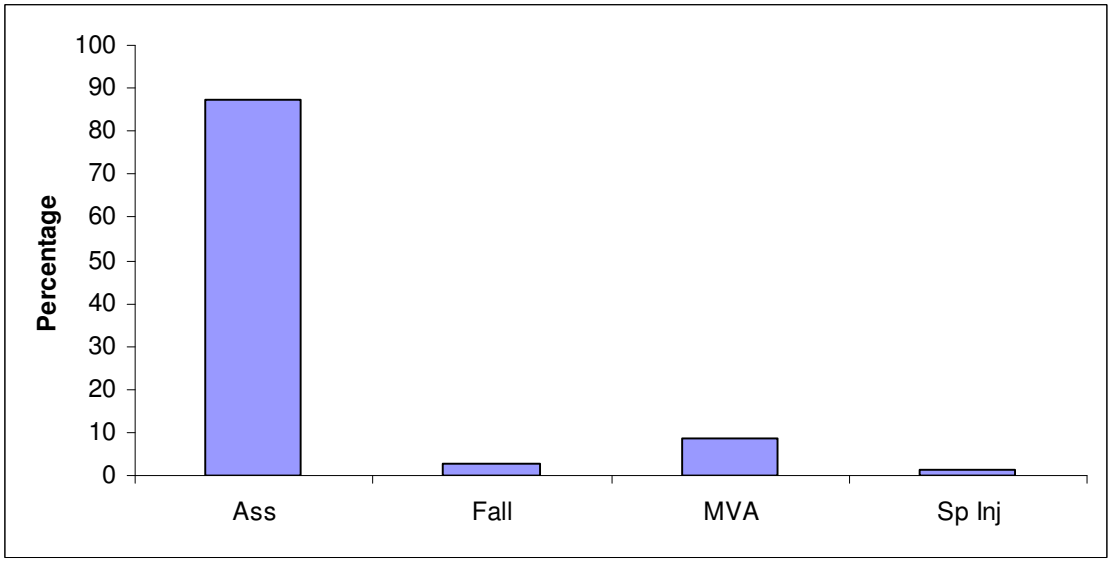

Figure 5.46 Etiology for left angle and right parasymphysis combination fractures

Etiological factors were assault 87.14%, Fall 2.86%, MVA 8.57% and sport injury 1.43%.

Left angle and Symphysis combination fractures

Table 5.22 Age distribution for left angle and symphysis combination fractures

N	Mean	Std Deviation	Minimum	Maximum
29	29.52	11.20	2.00	51.00

A total of 29 patients showed a minimum age of 2 years and a maximum age of 51 years with a mean of 29.52 years.

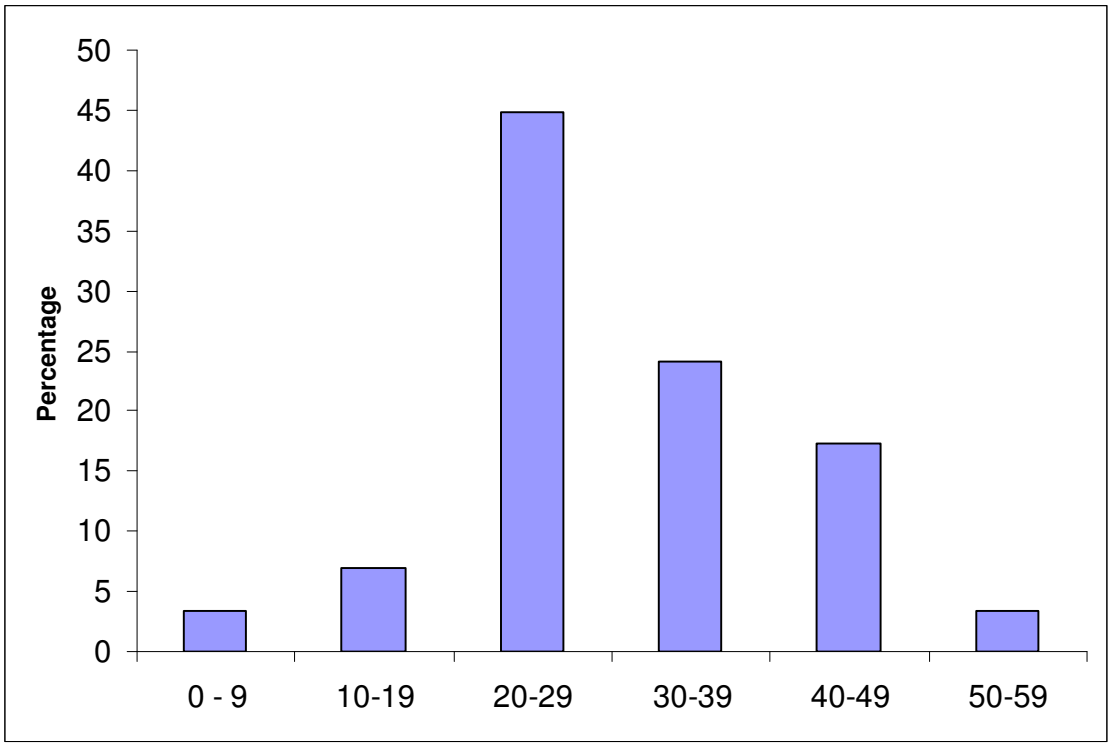

Figure 5.47 Histogram for left angle and symphysis combination fractures

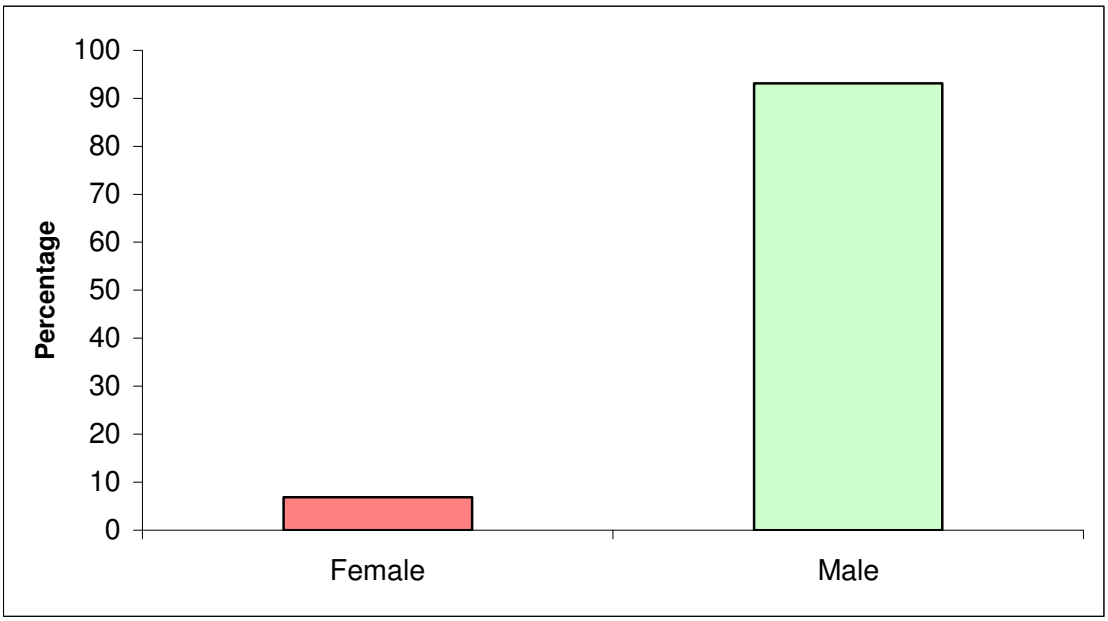

Figure 5.48 Gender distributions for left angle and symphysis combination fractures

There were 2 (6.90%) females and 93.10% (27) males who sustained left angle and symphysis combination fractures.

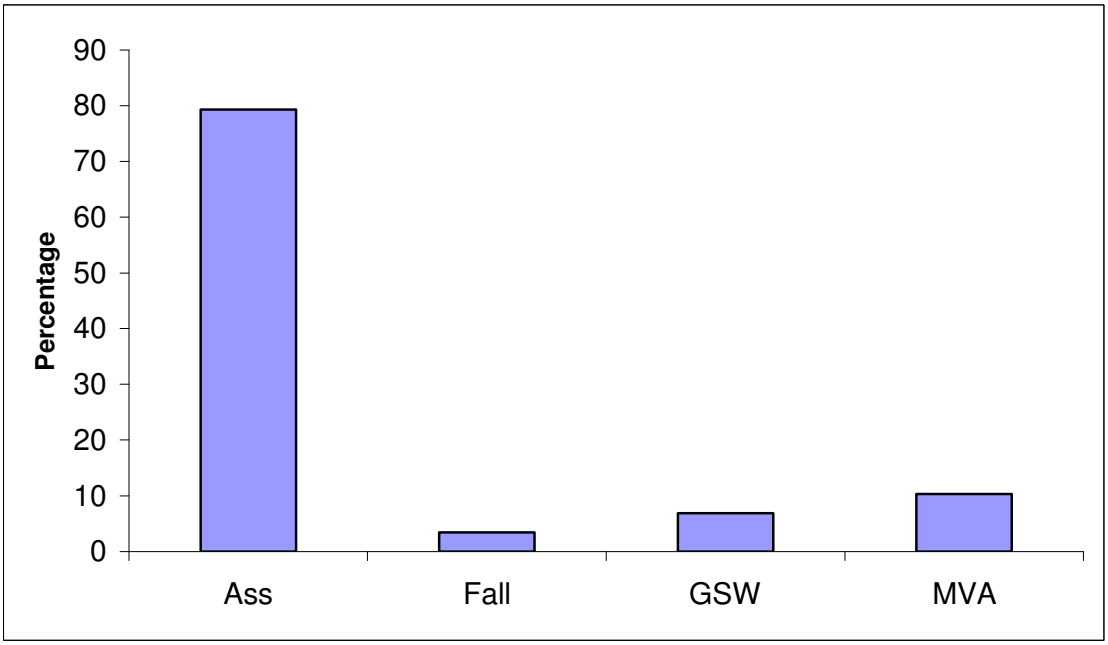

Figure 5.49 Etiology for left angle and symphysis combination fractures

The etiological factors were assault 79.31%, MVA 10.34%, GSW 6.90% and Fall 3.45%.

Left angle and Left parasymphysis combination fractures

Table 5.23 Age distribution for left angle and left parasymphysis combination fractures

N	Mean	Std Deviation	Minimum	Maximum
10	34.40	12.64	16.00	54.00

The minimum age was found to be 16 years and the maximum 54 years with a mean of 34.40 years.

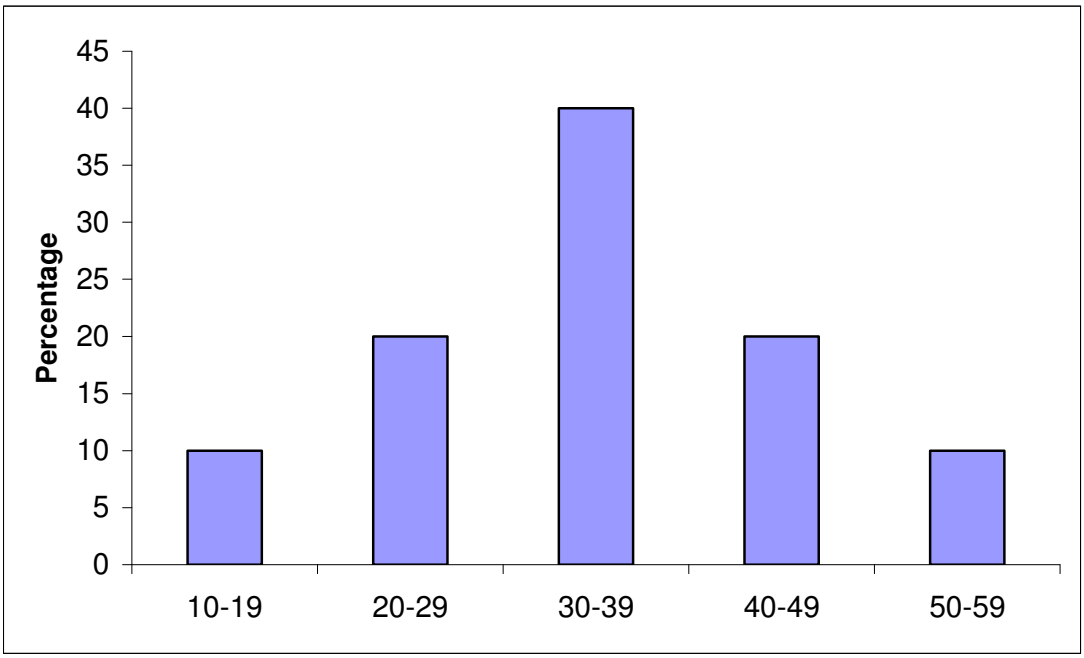

Figure 5.50 Histogram for left angle and left parasymphysis combination fractures

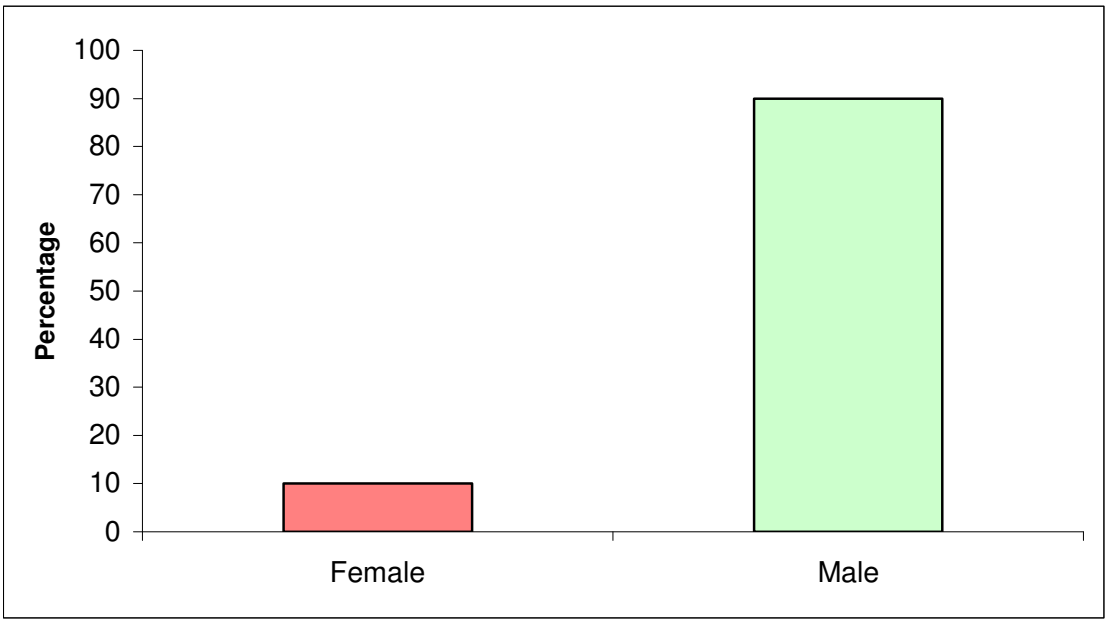

Figure 5.51 Gender distributions for left angle and left parasymphysis combination fractures

There were 10 % (1) females and 90% (9) males who sustained left angle and symphysis combination fractures.

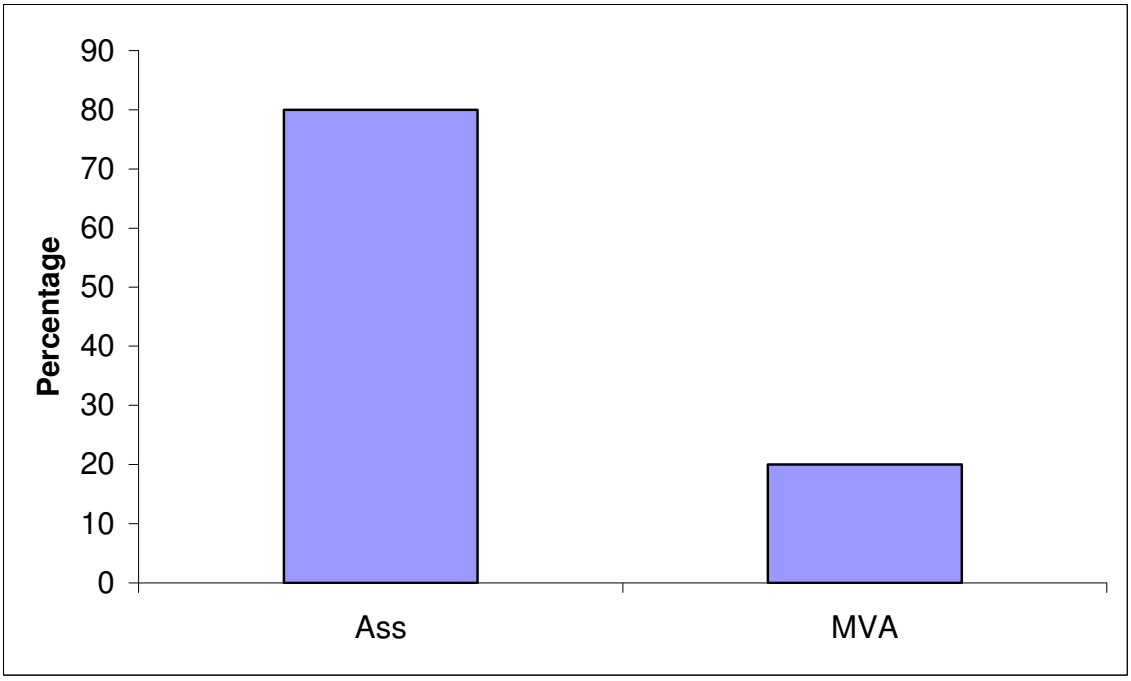

Figure 5.52 Etiology for left angle and left parasymphysis combination fractures

The etiological factors were assault 80% and MVA 20%.

Ramus combination fractures

Table 5.24 Age distribution for ramus combination fractures

N	Mean	Std Deviation	Minimum	Maximum
31	34.58	14.60	6.00	61.00

The mean age was found to be 34.58 years with a minimum of 6 years and a maximum of 61 years.

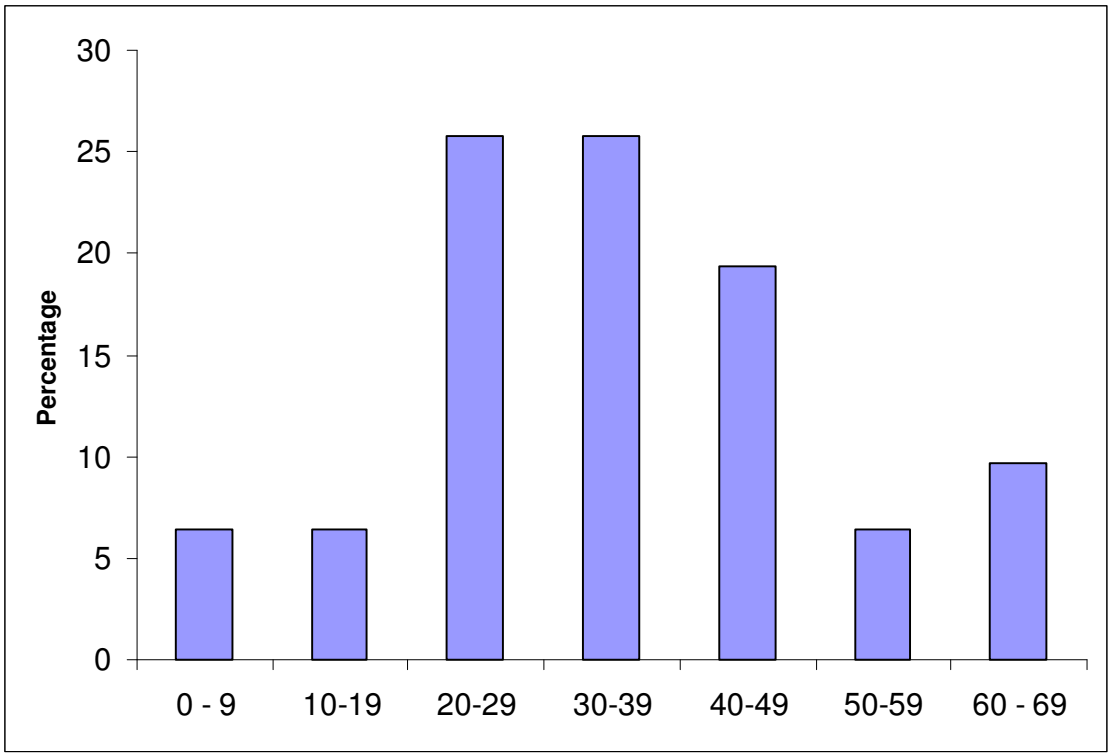

Figure 5.53 Histogram for ramus combination fractures

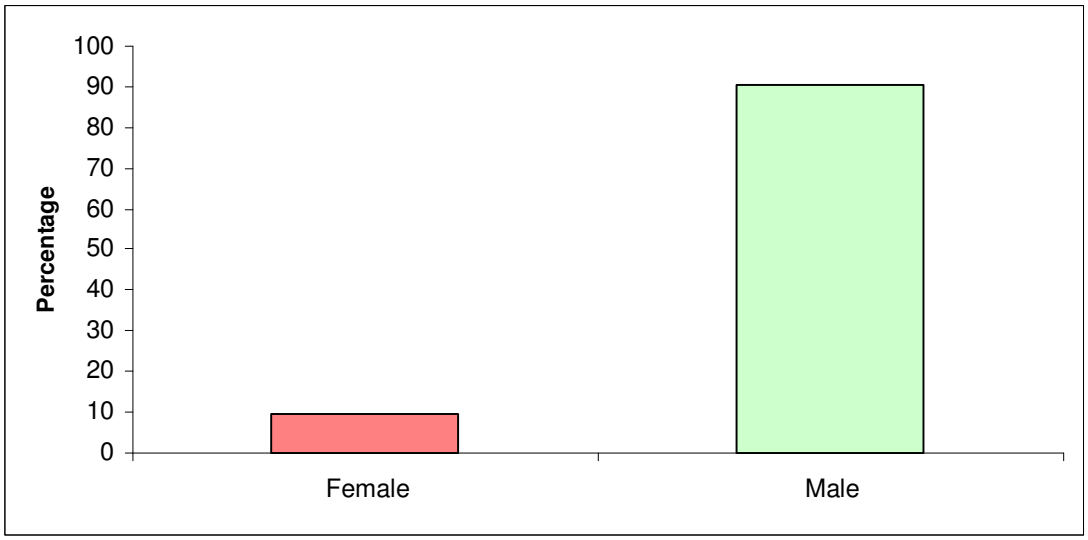

Figure 5.54 Gender distributions for ramus combination fractures

There were 3 (9.68%) females and 28 (90.32%) males who sustained left angle symphysis combination fractures.

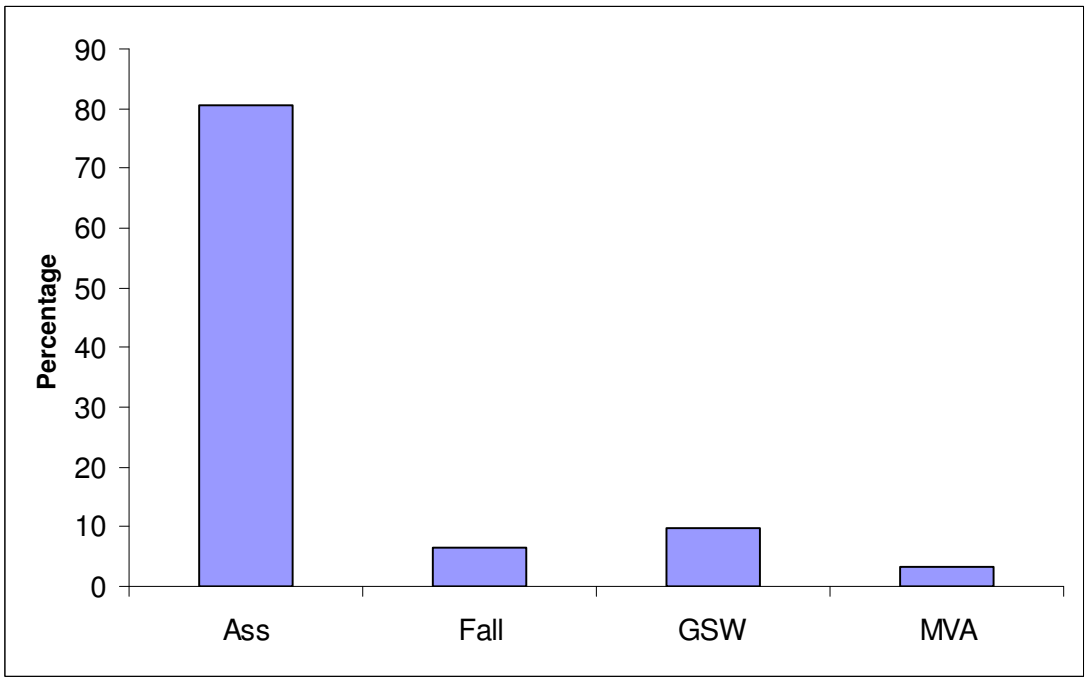

Figure 5.55 Etiology for ramus combination fractures

The etiological factors were assault 80.65%, GSW 9.68%, Fall 6.45% and MVA 3.23%.

The combination fractures of the ramus consisted of the right ramus 64.52% (20) and left ramus 35.48% (11).

The following combination fractures have also been recorded. The sample sizes were smaller than the other recorded samples.

Table 5.25 Other combination fractures

Site	Etiology	Age	Gender
Right angle Right body	MVA	44	M
	ASS	19	M
	ASS	43	M
	ASS	37	F
Right body symphysis	MVA	23	F
	FALL	32	M
	ASS	23	M
Left angle Left body	MVA	26	M
	ASS	33	M
	ASS	26	M
Right parasymphysis symphysis	FALL	45	M
	GSW	20	M
	ASS	22	M
Right parasymphysis Right body	ASS	43	M
	ASS	37	F
Left body Left parasymphysis	ASS	17	M
	ASS	47	M

5.5 Race

All patients in this study were black.

5.6 Etiology

The etiological factors are summarized in table 5.9.

Table 5.26 Etiological factors

CAUSE	FREQUENCY	PERCENTAGE
Assault	387	76.63
Fall	22	4.35
GSW	11	2.18
IOD	1	0.2
MVA	82	16.24
Sport Injuries	2	0.4
Total	505	100

Chapter 6

Discussion

Audits such as this one is of importance to both society and to health authorities responsible for planning and implementation of health care. The result of this study enables a health care professional to accurately predict fracture patterns occurring in the mandible. This in turn aids in better diagnosis and treatment outcomes. Furthermore, knowledge about the causes of injury can assist authorities in implementing better preventative programmes. This will ultimately result in a reduction of such injuries, thereby reducing the costs on an already over burdened health budget.

There were 1755 patients treated for maxillofacial injuries during the 4-year period from 2002 to 2005. A total of 1222 (69.63%) patients sustained fractures of the mandible. However 505 (41.33%) patients sustained combination fractures of the mandible i.e. fractures at more than one site. This study therefore shows that statistically, there is a 41.33% chance of another fracture occurring in a patient who has been diagnosed with a single fracture of the mandible.

Various etiological factors contributed to these mandibular fractures. Interestingly, the major etiological factor in this study was found to be assault (interpersonal violence). This is in conformity with the results obtained by Depprich *et al*, (2007) and Olasoji *et al*, (2002), who also found assault to be the most common cause of injury. However, other reports found road traffic accidents and falls to be the main causes of injury, (Martini *et*

al, 2006), (Brasilairo and Passeri, 2006), (Adebayo *et al,* 2003). The major contributing factor in Innsbruck was found to be sport related injuries (Gassner *et al*, 2002).

In South Africa interpersonal violence is strongly linked to factors such as unemployment, overcrowding and low socio-economic status. A major contributing factor to interpersonal violence is alcohol abuse (van der Spuy, 2000). According to the National Injury Surveillance System of 2000, South Africa has one of the highest per capita alcohol consumption rates in the world (MRC, 2008). Almost 80% of assault patients presenting at a trauma unit were found to be under the influence of alcohol or injured because of alcohol.

Another significant finding of this study was the involvement of young adult males in the 20 to 29 year age group (42.77%), and the 30 to 39 year age group (24.36%) respectively, where interpersonal violence and alcohol abuse is rife. The results of this study are supported by other studies with a similar age range, (Olasoji *et al*, 2002), (Patricinio *et al*, 2005), (Atanasov, 2003), (Eghtedari F. and Khezri S., 2003).

Responsible alcohol consumption can only be implemented by stricter alcohol sales. Existing government programmes and interventions are clearly insufficient to control alcohol abuse, and a much bolder approach to tackle the problem is required. The government has instituted strict anti-tobacco legislation, which is to be commended. This includes an increase in the price of cigarettes, the introduction of smoke free zones, an age restriction for the purchasing of cigarettes and public awareness programmes on the dangers associated with smoking. Similar intervention strategies need to be implemented

in order to counter the ill effects of alcohol abuse. In addition to this, adequate housing and employment aimed at reducing poverty and promoting health will go a long way to addressing the problem of interpersonal violence.

The gender distribution still remains expectant, with males topping the list in most parts of the world. This study confirms the results of other studies that males are affected more than females. The average male to female ratio is 3:1 geographically (Zachariades *et al*, 2006), (Patrocinio *et al*, 2005), (Olasoji *et al,* 2002), (Adebayo *et al* 2003). The current study found the male to female ratio to be 8.2:1. According to the literature, this is the highest male to female ratio that has ever been reported in the world for mandibular combination fractures. The reasons for this are that females do not frequent shabeens and pubs as often as males, thereby reducing their exposure to such injuries.

In this study assault (72.73%) followed by MVA (16.36%) were the most common causes of injury in females. Assault among females in the majority of cases is due to domestic violence, where alcohol abuse also plays a significant role. Domestic violence or intimate partner violence (IPV) is a worldwide problem that crosses all cultural, racial, and socioeconomic lines (Arosarena *et al*, 2009). The yearly incidence of intimate partner violence is 9 cases per 1000, and the prevalence is estimated to be 25% to 33% in the United Sates.

The sites of fractures varied with different combinations. The highest number of fractures was recorded in the left angle (159), followed by the right parasymphysis (142). This means that the left angle of the mandible is more prone to fracture than any other site.

Since assault was the major contributing factor, it can be assumed that in the event of interpersonal violence, the left angle and right parasymphysis are more prone to fracture.

In the combination category, however, the left angle right parasymphysis combination fracture (70) showed the highest incidence, followed by the left parasymphysis and right angle combination fracture (47), right angle and left body combination fracture (37) and left angle and right body (36) combination fracture. The incidence of sustaining a left angle and right parasymphysis combination fracture is 13.86%. Since assault is a major contributor to fracture of the mandible, it would be possible to hypothesize that most people are right handed and facing their victim at the time of assault, thus when striking the mandible it would result in a left angle and right parasymphysis combination fracture. The least common combination fractures to occur are the right body and right parasymphysis combination fracture (0.40%), followed by the left angle and left body combination fracture (0.59%), right body and symphysis combination fracture (0.59%) and right parasymphysis and symphysis combination fracture (0.59%).

Interestingly though, the etiological factors for left parasymphysis and symphysis combination fracture were assault and MVA. Both these factors contributed equally at 50% for this particular combination.

A total of 92 (18.22%) condyles sustained fractures with various combinations. Fifty fractures occurred on the left side while 42 occurred on the right side. In the entire sample, the most common combination fracture involving the condyles was the right condyle and symphysis combination fracture (2.77%), followed by the left condyle and

symphysis combination fracture (2.57%) and the left condyle and right parasymphysis combination fracture (1.98%).

Among the sample of condylar fractures, the most common was the right condyle and symphysis combination fracture (15.22%), followed by the left condyle and symphysis combination fracture (14.13%) and the left condyle and right parasymphysis combination fracture (10.87%). The least common were the left condyle and left angle combination fracture (0.2%), the left condyle and left body combination fracture (0.2%) and the right condyle and right angle combination fracture (0.2%). As can be seen from these results the closer the fracture to the same side condyle is the lower the incidence of sustaining a fracture of the same side condyle. When the symphysis is involved there is a 38.04 % chance of sustaining either a unilateral or bilateral fracture of the condyles, since there were 35 condyle fractures associated with symphysis fractures in the condylar sample. When compared to the entire sample of combination fractures, there is a 6.93% chance of sustaining condylar fractures associated with symphysis injuries.

With regards to condylar fractures, the most common age group to be affected was the 20 to 29 year age group, followed by the 30 to 39 year age group. The ages ranged from 13 years to 86 years with a mean age of 32.33 years. There were more males (91.30%) affected than females (8.70%). The major contributing factor for condylar fractures was assault (58.70%) followed by MVA (33.70%). This study reports similar findings as Zachariades *et al*, (2006). In their report they found that the incidence of condylar fractures among all mandibular fractures was between 17.5% and 52%.

CHAPTER 7

Conclusion

In conclusion, this study has shown that there is a 41.33% chance of a combination fracture occurring in a mandibular fracture. This result is statistically significant given the fact that the mandible is a commonly injured bone. It is therefore important for the healthcare worker who diagnoses a fracture of the mandible to remember that there is a 41.33% chance of another fracture occurring in a different anatomical site of the mandible. Therefore, careful evaluation of diagnostic radiographs is necessary since some fractures are not diagnosed clinically.

Among the most frequent combination fractures (left angle and right parasymphysis, 13.86%) one can expect to find fractures corresponding to these anatomical sites and the various combinations as recorded in the results.

Although the mandibular condyle is one of the most common sites to be injured in the facial skeleton, it is also the most overlooked and under-diagnosed fracture in the head and neck region, (Dimitroulis G., 1997). According to this study, there is an 18.22% chance of a condylar fracture occurring when a fracture of the mandible is sustained. This is extremely high when considering the sample size is only 505. This should make clinicians aware that a condylar fracture may exist when there is a fracture of the mandible. There is a 38.4% chance of a condylar fracture existing when the symphysis of the mandible is fractured, and therefore, the clinician needs to pay careful attention to the condyles when a fracture of the symphysis is diagnosed.

Males are more commonly affected than females, and present with the most number of combination fractures. Assault is the predominating factor contributing to this type of injury. Alcohol and interpersonal violence, along with domestic violence, are compounding factors that contribute to this menace at an increasing rate with socioeconomic factors playing a pivotal role.

The age groups of 20 to 39 years are more affected than any other age group. In South Africa, violent crime such as hijacking and robbery are other factors contributing to combination fractures. These factors usually affect the older age group.

Trauma is among the most neglected health problem in South Africa. The effect that trauma such as mandibular fractures has on the health budget and the manpower needs has a major economic and fiscal impact on the health system of the country. The result is limited funds for research into and the management of such conditions as HIV/AIDS and other infective conditions, cancer, and other elective conditions. Stricter legislation is required on the part of the government with regards to the indiscriminate use of alcohol. Changes in the criminal justice system will go a long way to ensuring that violent crime, usually alcohol related, is brought under control.

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