A Four -Year Study of the Demographic Distribution and Treatment of Maxillofacial Fractures Admitted at the Philippine General Hospital

Gerardo G. Germar and Mel Anthony Y. Cruz

Division of Plastic Surgery, Department of Surgery, College of Medicine and Philippine General Hospital, University of the Philippines Manila

ABSTRACT

The epidemiologic data and management done to patients with maxillofacial fractures admitted at the Philippine General Hospital from January 2004 to December 2007 were studied.

Methods: The records of 512 patients were reviewed. The data obtained included age, gender, date of the injury, etiology and types of fractures, and management done. The relationship between the patient age and the etiology of the injury as well as the relationship between the etiology and the type of fracture was determined through a single factor analysis of variance (ANOVA) using STAT-EASE Design Expert Statistical Software Version 7.1.5.

Results: The data obtained from the study is consistent with international data, however, some differences may be noted. Maxillofacial fractures were most common among young adults aged 21 to 30 years old (34.8%), followed by adults aged 31 to 40 years old (22.1%). Men were injured more than women with a 7:1 ratio (males = 87% females = 13 %). The most common etiology of maxillofacial fracture was traffic-related accidents (63.7%) in contrast to physical assault as what was apparent a couple of decades back . Other common causes were physical assault or mauling (14.5%), falls (11.5%), gunshot wounds (6.4%) and hacking (3.1%). Mandibular fractures were the most common (32.8%, n=168) in contrast to nasal bone fractures as what is reported in international literature. Other fractures included frontal (30.9% n=158), orbital (24%, n=123), maxillary (16.4%, n=84), zygomatic (15%, n=77), and nasal bone fractures (14.1%, n=72). Open reduction with internal fixation using titanium miniplates is the most common treatment for displaced fractures. A statistically significant relationship was noted between etiology and type of fracture, as well as age and etiology of fracture.

Conclusion: In the last 30 years, a change in the epidemiologic trends of patients consulting for maxillofacial trauma was noted. Presently, traffic-related accidents overshadow interpersonal violence as the cause of facial fractures. Maxillofacial fractures are more common amongst 21-30 year-olds. The frontal bone is second only to the mandible as the most commonly involved bone in maxillofacial fractures. Miniplate osteosynthesis is the method of choice of fixation, mainly due to its functional and technical advantages. The significant relationship between age and etiology of injury as well as etiology of injury and type of fracture indicates that maxillofacial fractures and their extent can be brought about and influenced by some other factors such as age, etiology and type of injury which have statistically established their own interactions.

Key Words: fractures, maxillofacial fractures, facial injuries, Le Fort, Tripod

Introduction

The Philippine General Hospital is a state-owned tertiary hospital. It is also a major referral center for trauma patients from all over the country. At any given month, a variety of trauma patients are seen at the emergency department. A spectrum of maxillofacial injuries, be it an isolated injury or in conjunction with other injuries of traumatic origin, comprise a number of these consults.

Despite the number of maxillofacial cases seen in our institution, the demographics as well as the management have not been adequately reviewed. This study aims to augment the one-year pilot study done by Marquina et. al.

Significance of the study

The epidemiologic data gathered may prove useful in mapping out both treatment strategies for different maxillofacial injuries as well as the preventive measures which can be instituted. These data may also aid in decision-making for patient care and in creating optimal treatment protocols. The Division of Trauma of the Philippine General Hospital is already working on data that may eventually influence legislative changes, this epidemiologic study may serve as an adjunct providing necessary figures and data. An initial study done by Marquina et. al.[1] served as the pilot study, however, results of his study varied from the results from international studies done. This study provides a larger population which may reconcile the results with international values.

Methods

This is a retrospective study on 512 patients admitted at the Philippine General Hospital from 2004 to 2007 treated for maxillofacial fractures whose medical histories were encoded using the Integrated Surgical Information System (ISIS), a computerized database of the Department of Surgery.

The study includes the retrieval and presentation of different patient data in terms of their age, gender, date of

Corresponding author: Mel Anthony Y. Cruz, MD
Division of Plastic Surgery, Department of Surgery
Philippine General Hospital
Taft Avenue, Manila, 1000 Philippines
Telephone: +632 5548400 local 2454
Email: melcruzalternate@yahoo.com

injury, etiology and types of fracture, treatment done and outcome of management of each maxillofacial case. This also includes the determination of the relationship between the age of the patient and the etiology of the injury, as well as the relationship between the type of injury and etiology of injury.

Respondents

Respondents of the study were 512 male and female patients admitted at the Philippine General Hospital from January 2004 to December 2007 whose records can be retrieved using the ISIS.

The computerized registry had been updated and the new ISIS interface does not include a search engine as of the writing of this paper. The old interface had a built-in search engine, where the following keywords were used: fractures, maxillofacial fractures, and facial injuries. The official hospital charts were cross-referenced for patients with incomplete data sets gathered from the ISIS. Management for the maxillofacial trauma cases were either instituted by the Division of Plastic Surgery, Department of Neurosurgery or the Department of Otorhinolaryngology.

The data gathered included age, gender, date of the injury, etiology and types of fractures, the treatment done (operative or non-operative) and outcome of the management of each maxillofacial case.

Statistical treatment of data

The demographic patient profile in terms of age, gender, date of injury, etiology and types of fracture, treatment done and outcome of management were statistically evaluated using weighted mean and % relative frequency computations for statistical data presentation.

The relationship between the patients' age and the etiology of the injury as well as the relationship between the etiology and the type of fracture was determined through a single factor analysis of variance (ANOVA) using STAT-EASE Design Expert Statistical Software Version 7.1.5.

Guide to interpretation of fishers F-test value (F not)

The P-value approach has been adopted and used by the software indicating that the probability that the test statistical value will take on a value least extreme as the observed value of the α=error. Thus:

If the P-value > α, the null hypothesis is accepted.

If the P-value < α, the null hypothesis is rejected.

Objectives

This study aims to provide a description of maxillofacial fractures admitted at the Philippine General Hospital based on available epidemiologic data from 2004 to 2007. It is also the aim of this paper to review the present management procedures for these injuries. In addition, this study may provide a framework on predicting possible injuries and outcomes based on individual characteristics and mechanisms of injury.

Conceptual Framework

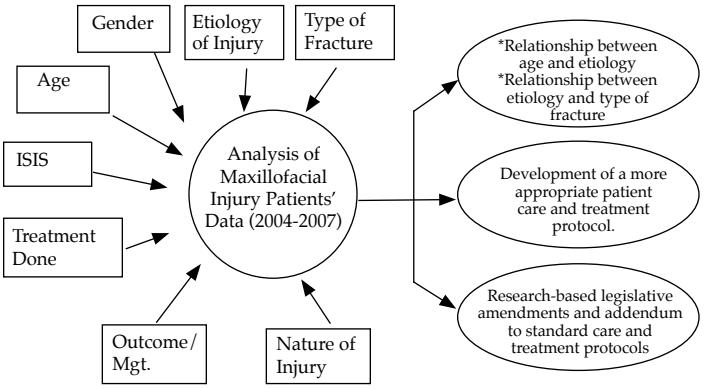

Figure 1. Research Paradigm.

The specific objectives of this study are as follows:

a. To determine the number of maxillofacial trauma cases seen by the Division of Trauma at the Philippine General Hospital from 2004-2007

b. To determine the types of fractures, both isolated and combined, seen by the Division of Trauma from 2004-2007

c. To determine the demographics of patients seen by the Division of Trauma from 2004 to 2007 with regard to:

i. Age
ii. Gender
iii. Month of Consult

d. To review the present management procedures by co-managing services of the Division of Trauma from 2004-2007

i. Plastic Surgery (procedure of choice, patients who underwent treatment, patients who did not undergo treatment, reasons for not undergoing treatment)

ii. Otorhinolaryngology (procedure of choice, patients who underwent treatment, patients who did not undergo treatment, reasons for not undergoing treatment)

iii. Neurosurgery (procedures done, number of patients treated)

e. To determine if there is a significant correlation between:

i. Etiology and type of fracture
ii. Age and etiology of fracture

Results

A total of 512 patients were included in the study. Men were injured more than women with a 7:1 ratio (males = 87%, females = 13%). Maxillofacial fractures were most common amongst young adults aged 21 to 30 years old (34.8%), followed by adults aged 31 to 40 years old (22.1%). (Table 1).

Admissions for facial fractures were lowest during the months of May, June and July (6.3%, 7.2 and 5.3%,

Table 1. Age distribution of maxillofacial fractures.

AGE (in years)	FREQUENCY	PERCENTAGE
< 1	3	0.6%
1 – 10	43	8.4%
11 – 20	82	16.0%
21 – 30	178	34.8%
31 – 40	113	22.1%
41 – 50	50	9.8%
51 – 60	27	5.3%
> 60	16	3.1%
TOTAL	512	100%

respectively). It then increased steadily and peaked during the months of August and September (9.0%, 8.8%) and reached another peak during January and February (12.1% and 10.7%). (Table 2).

Table 2. Monthly distribution of maxillofacial fractures.

AGE (in years)	FREQUENCY	PERCENTAGE
Jan	62	12.1%
Feb	55	10.7%
Mar	43	8.4%
Apr	46	9.0%
May	32	6.3%
Jun	37	7.2%
Jul	27	5.3%
Aug	46	9.0%
Sep	45	8.8%
Oct	44	8.6%
Nov	39	7.6%
Dec	36	7.0%
TOTAL	512	100%

The most common etiology of maxillofacial fracture was traffic-related accidents (63.7%). Other common causes were physical assault or mauling (14.5%), falls (11.5%), gunshot wounds (6.4%) and hacking (3.1%). (Table 3)

Table 3. Distribution of maxillofacial fractures based on etiology.

ETIOLOGY	FREQUENCY	PERCENTAGE
Traffic-related accidents	326	63.7%
Fall	59	11.5%
Falling Debris	2	0.4%
Assault/Mauling	74	14.5%
Blast	2	0.4%
Gunshot wound	33	6.4%
Hacking	16	3.1%
Total	512	100%

Mandibular fractures were the most common (32.8%, n=168). Other fractures included frontal (30.9% n=158), orbital (24%, n=123), maxillary (16.4%, n=84), zygomatic (15%, n=77), and nasal bone fractures (14.1%, n=72). Among the combined fractures of the maxillofacial complex, tripod fractures occurred most often (10.7%), while Le Fort fractures I, II and III occurred in 0.2%, 0.8% and 0.4%, respectively. (Table 4).

Table 4. Distribution of maxillofacial fractures based on type.

Types of Fractures		
Isolated		
Type of Fracture	Frequency	% in population
Frontal	158	30.9%
Nasal	72	14.1%
Orbital	123	24.0%
Zygomatic	77	15.0%
Maxillary	84	16.4%
Mandibular	168	32.8%
Angle	50	9.8%
Ramus	7	1.4%
Body	63	12.3%
Condyle/Subcondylar	17	3.3%
Symphysis/Parasymphyseal	53	10.4%
Combination		
Tripod (lateral orbital, inferior orbital/ maxillary, zygoma)	55	10.7%
Le Fort I (Maxillary/alveolar)	1	0.2%
Le Fort II (Maxillary + naso-ethmoidal)	4	0.8%
Le Fort III (maxillary + naso-ethmoidal + Fronto-zygomatic)	2	0.4%

Thirty five percent (35.5%, n=182) of all patients underwent treatment of fractures. Open reduction with internal fixation using titanium miniplates was done in 56% (n=102) of all the treated patients, wire osteosynthesis combined with titanium plates was done in 3 patients with multiple facial fractures, wire osteosynthesis was done in 9 patients with maxillofacial fractures, and interdental wiring with maxillary-mandibular fixation alone was done in 11 patients. Closed reduction of nasal bone fractures was done in 11 patients and open reduction of the zygoma was done in 2 patients. Of the treated patients, 45 patients were managed by the Neurosurgery Department, majority of which involved frontal bone fractures. Of the treated population, 123 were done by the Division of Plastic Surgery, and 14 were done by the Department of Otorhinolaryngology. Treatment protocols were the same in the two services, and miniplate osteosynthesis was preferred in both. The interdental wiring procedures and arch bar fixations were referred by both services to the Dental Service of the hospital.

Sixty four percent (64.5%, n=330) of patients did not undergo treatment of fractures. Of the untreated patients, 32.5% were managed conservatively, 24.5% were unable to undergo operations due to an unstable condition or had no consent for surgery, and 42.7% had no funds to secure the materials for surgery.(Table 5)

Unfortunately, long term follow-up was not available for analysis in ISIS.

A significant relationship was noted between age and etiology of fracture. A Fisher's test value of 3.63 was obtained with a P-value of 0.0095 indicating that the age of the patient has a direct bearing on the etiology of injury or fracture. There is a very small (0.95%) probability that the

Table 5. Distribution of patients based on treatment/non-treatment

Treatment	Frequency	Percent in Population
Closed reduction (nasal bone fracture)	10	2.0%
Open reduction (zygomatic fracture)	2	0.4%
IDW- MMF alone	11	2.1%
Wiring	9	1.8%
Titanium plates w/wo IDW-MMF	102	19.9%
Wiring + Titanium plates w/wo IDW-MMF	3	0.6%
No Treatment (specify reason)	330	64.5%
Undisplaced / conservative management	108	21.1%
Unstable/no consent	81	15.8%
No funds	141	27.5%

relationship is due to hierarchy of data or randomization bias. Moreover, an adequate precision value of 6.063 which is observed to be greater than 4.0 indicates that the design is adequate to navigate and represent the design space.

This means that the age of the patient can be an indicator of the etiology of injury and vice versa. Thus, a specific type of fracture can be expected from a certain group of patients with respect to their age. Moreover, it can be deduced that certain age groups of people have a susceptibility to one type of fracture over another. Thus, age and etiology of injury are very important considerations in decision-making and the development of care and treatment protocols on maxillofacial injuries. (Figure A and B, and annotation)

A significant relationship was observed between the Etiology of Injury and Type of Fracture. An F value of 56.43 with a P-value of less 0.001 indicate that the significant relationship between Etiology of Injury and Type of Fracture is not due to hierarchy of data nor randomization bias. An adequate precision value of 22.961 which is greater than 4 means that the design has the ability to navigate or represent the design space.

The significant relationship between Etiology of Injury and Type of Fracture shows that certain types of fractures can be observed depending on the etiology of injury. For instance, traffic-related injury or injuries related to gunshots, falls, etc., show different patterns in terms of the type of resultant fracture seen. Statistical results of this study show that the top three types of fractures (Orbital, Mandibular and Frontal) are primary traffic-related but are also occasionally seen due to some other etiology.

The significant relationship between the Etiology of Injury and Type of fracture could suggest that a comprehensive and just-in-time patient care, treatment and prevention protocol must be developed based on traffic–related injuries. (Figure C, D, E and F, and annotation).

Although, the definitive management for patients with these afflictions will still be determined by radiographic and other ancillary procedures, the significant aforementioned relationships would be very useful in constructing preventive measures and protocols.

Discussion

The type of fracture encountered in the emergency department setting varies with the demography of the patient population studied. Apparently, geography, socio-economic status and even the season of the year can greatly influence the type, mechanism and frequency of the injuries seen. Recent data report road traffic accidents as the leading cause of mandibular fractures in many third world countries. In developed countries, however, assault and interpersonal violence are the major etiological factors. The differences may relate to the lack of seat-belt regulations in the third world countries. On the other hand, alcohol abuse appears to be a major factor responsible for interpersonal violence in developed countries.[2,3,6]

In the last 30 years, a change in the etiology of injuries have been noted in the country. There has been a shift from interpersonal violence as the most common cause of facial fracture 30 years ago to traffic-related event as the present most common cause of fracture.[4] However, this paper was not able to note when the change took place. A plausible explanation could be that technological advances, political and economic events, lifestyle changes and other factors may have brought about this shift. Supporting international data confirm this fact. The production of faster cars, mass production of relatively affordable vehicles, superhighway construction, population growth, crowding of streets, reckless lifestyle (alcohol, without seatbelts) and among others may have contributed to this.

However, the predominance of facial injuries of the male population over the female remained constant. The male: female ratio was 9:1 in patients following interpersonal violence (IPV) and 7:3 following motor vehicle accidents (MVA).[5,6]

Similar studies had shown that maxillofacial fractures are more common among young adults particularly those within 21 to 35 years old. In another study, 16 to 30-year-olds accounted for the greatest proportion of injuries (48 and 68%, respectively).[5]

With regard to the type of fractures, the shift in the etiology of the injury also affected the predominance of the involved facial structure. In our time, superhighways, and the resulting increase in high-speed motor vehicle accidents, produced a shift from mandible to midface and craniofacial fractures.[7] However, in the Philippines, mandibular fractures still predominate.

Maxillofacial injuries were lowest during the latter part of the summer vacation and takes another dip during the Christmas holiday season, probably because this is when the populace tend to flock to the provinces, and highest during two peak periods, August and September then January and February when the populace tend to go back to the Metropolis after their out-of-town vacations.

In the emergency department, patients consulting for facial injuries should be cleared for maxillofacial fractures. Swelling and bruises may make the fractures not readily apparent. A healthy level of suspicion on patients with

facial abrasions, lacerations and hematomas must always be entertained. The attending physician should always have in the back of his mind that less than 20 percent of cases will have a palpable or visible bony deformity.

After the initial survey and resuscitation, plain radiographs and computed tomography scans are the most commonly ordered diagnostics. Plain radiographs include Water's view, Towne's view, mandible anteroposterior and lateral oblique views, submentovertex views; and other views such as a panoramic radiograph (PANOREX) of the mandible.[8] Equivocal radiographic results would entail a cranial CT Scan with axial and coronal facial cuts for confirmation.

Currently, with regard to midface injury, orbital and maxillary fractures are the most common fractures versus nasal bone fractures which were more common two and a half decades ago. This, again, may be due to high impact collision in vehicular crashes. Another explanation could be the introduction of the CT scan that can detect even small, undisplaced fractures.

Management of maxillofacial fractures is influenced by a variety of factors. The type, etiology, socio-economic factors and the surgeons' experience are considered in the treatment choice. Treatment can range from conservative to definitive operative management. Stable favorable fractures may be addressed by soft diet alone. Closed reduction using archbar fixation with interdental wiring and maxillo-mandibular fixation (IDW-MMF) for simple fractures of the maxilla and mandible. Open reduction and internal fixation (ORIF) with plates and screws or medical grade wire for displaced or comminuted fractures. In gunshot/blast injuries, wound debridement and initial immobilization is done prior to a definitive ORIF or bone grafting as the situation requires. Treatment of maxillofacial fractures in children is a separate category in itself. Immobilization is difficult, on the other hand, any internal fixations applied may affect facial development.

The titanium plate and screw system for fixation of maxillary and mandibular fractures greatly changed the way maxillofacial fractures are treated. Before, internal fixation was limited to the use of wire osteosynthesis with or without arch bar fixation.[3] Arch bar fixation is simple and economical. However, weight loss, speech difficulty and periodontal complications are significant drawbacks.

The relative ease of application, stability and biomechanical compatibility of titanium miniplates or microplates, as well as faster recovery time and return of function is rapidly making this the treatment of choice for most surgeons. The major disadvantage of this system is its price. Surgeons' preference and the desire of patients for a more comfortable post-operative course usually lead to a lag in the treatment while plates are being acquired thru charitable groups. Eventually, this leads to a delay in treatment, longer pre-operative hospital stay, and even to no treatment at all when patients decide to go home and are lost to follow-up.

Physical examination findings are sometimes difficult to be objectified. Reported findings are variable and are dependent on the attending physician's experience. The findings of intoxication/substance abuse are often circumstantial since objective means of documenting are not readily available locally. Long-term complications were difficult to monitor partly due to poor patient follow up. The information obtained from ISIS is usually dependent on the diligence of the person encoding the information and efforts to correlate the paper trail of the patients' hospital record can be difficult. Also, logging of patient's data in the ISIS was limited to in-patients, and out-patient follow-ups after discharge are usually not included.

Conclusion

In the last 30 years, a change in the epidemiologic trends of patients consulting for maxillofacial trauma was noted. Presently, traffic-related accidents overshadow interpersonal violence as the cause of facial fractures. Maxillofacial fractures are more common among 21 to 30 year-olds. The frontal bone is second only to the mandible as the most commonly involved bone in maxillofacial fractures. The top two involved areas in mid-facial fractures are orbital and maxillary fractures. Treatment protocols do not vary among plastic surgeons and otorhinolaryngologists, the basic tenet being reduction, and if necessary, fixation. Miniplate osteosynthesis is the method of choice of fixation, mainly due to its functional and technical advantages.

The significant relationship between age and etiology of injury, as well as etiology of injury and type of fracture indicates that maxillofacial fractures and their extent can be brought about and influenced by some other factors such as age, etiology and type of injury which have statistically established their own interactions.

The emergence of a very high statistical interaction seen on traffic-related injury with age and type of fracture can signify two important statistical scenarios. First is that the high incidence of traffic-related injury neutralized randomization error, establishing interactions with the rest of etiology indicators. This means that the high values observed for traffic-related injuries influenced the other etiologic indicators and has distributed the error evenly to come up with a statistically significant relation. Another is that the high values of traffic-related injuries influenced the other etiologic indicators but was still able to project itself as an outlier. This means that high values generated for traffic related injuries must be treated independently from the rest of the etiologic indicators, and, as such, should be treated as the highest and top-most priority in any change or development on Maxillofacial Treatment and Care Protocols.

Recommendations

Researches which involve epidemiology of maxillofacial trauma can be used as frameworks in establishing clinical as well as research protocols. These protocols may be directed

to both treatment and prevention of these injuries.

Therefore, the following are the researchers' recommendations:

1. The development of a maxillofacial patient treatment and prevention protocol focusing on age and etiology, and etiology and type of injury.

2. Instituting changes in the maxillofacial patient treatment and prevention protocols directing them to be focused on Traffic-related injury, and such changes be organized into categories of age and type of injury because of its relationship with the aforementioned.

3. The addition of new modules in the Integrated Surgical Information System (ISIS) to improve data collection, that is, to minimize encoding of incomplete data sets and reduce the necessity to perform patient-record counterchecks which might influence statistical data collection. (e.g. maxillofacial registry checklist, see Appendix A)

4. Further studies to be undertaken with the treatment of Traffic-related injury as an independent etiologic indicator, to be compared with age and type of injury.

5. The addition of modules in ISIS dealing with the long term follow-up on an out-patient basis of patients with these injuries.

6. The implementation of an objective measure of alcohol in the emergency department setting may also be useful, taking into consideration that most traffic related and interpersonal violence related events are also alcohol related.

References

1. Marquina M, et. al. A One-Year Study of the Demographic Distribution and Treatment of Maxillofacial Fractures Admitted at the Philippine General Hospital Using the Integrated Surgical Information System. Unpublished Study: Division of Plastic Surgery, Philippine General Hospital, 2004.
2. Kontio R, et al. Have the Causes of Maxillofacial Fractures Changed Over the Last 16 Years in Finland? An Epidemiologic Study of 725 Fractures. Dent Traumatol. 2005; 21(1).
3. King RE, et al. Mandible Fracture Patterns: A Suburban Trauma Center Experience. Am J Otolaryngol. 2004; 25(5).
4. Joson R, et al. Management of Facial Injuries. Unpublished Study: Division of Plastic Surgery, Philippine General Hospital, 1979.
5. Lee KH, et. al. Comparison Between Interpersonal Violence and Motor Vehicle Accidents in the Aetiology of Maxillofacial Fractures. Anz Journal of Surgery. 2007; 77(8):695-698.
6. Abbas I, et.al. Spectrum of Mandibular Fractures at a Tertiary Care Dental Hospital in Lahore: Department of Oral & Maxillofacial Surgery, Ayub Medical College Abbottabad, De Montmorency College of Dentistry, Lahore. Available at http://ayubmed.edu.pk/JAMC/PAST/15-2/Iram%20Mandibular%20Fractures.htm. Accessed March 2008.
7. Assael LA. Managing the trauma pandemic: learning from the past. Journal of Oral and Maxillofacial Surgery. 2003; 61(8):859-860.
8. Aston SJ, et al (Ed). Grabb and Smith's Plastic Surgery – 5th Ed. PA: Lippincott-Raven, 1997.

APPENDIX A

Study of the Demographic Distribution and Treatment of Maxillofacial Fractures
Admitted At the Philippine General Hospital from 2004-2007

DATA SHEET

Name: _____ Age/Sex: _____ Case Number : _____

I. History

A. Date of Injury : __ / __ / __
m d y

B. Etiology
O Traffic accident
O Fall
O Falling Objects/ Debris
O Assault/Mauling
O Hacking
O GSW
O Animal-inflicted
O Work accident
O Sports-related

C. Nature of Injury
O Accidental
O Homicidal
O Self-Inflicted (Suicidal)

II. Fractures
O Frontal
O Nasal
O Orbital
O Zygomatic
O Maxillary
O Mandibular (specify below)
O Angle
O Ramus
O Body
O Condyle/Subcondylar
O Symphysis/Parasymphyseal
O Condyle + symphysis/parasymphyseal: O contra O ipsilateral
O Condyle + body : O contra O ipsilateral
O Condyle + angle : O contra O ipsilateral
O Condyle + ramus: O contra O ipsilateral
O Angle + body : O contra O ipsilateral
O Angle + ramus: O contra O ipsilateral
O Angle + symphysis/parasymphyseal : O contra O ipsilateral
O Body + ramus : O contra O ipsilateral
O Body + symphysis/parasymphyseal : O contra O ipsilateral
O Ramus + symphysis/parasymphyseal : O contra O ipsilateral
O Combination (specify below)
O Tripod (lateral orbital, inferior orbital/maxillary, zygoma)
O Le Fort I (Maxillary/alveolar)
O Le Fort II (Maxillary + naso-ethmoidal)
O Le Fort III (maxillary + naso-ethmoidal + Fronto-zygomatic)

III. Treatment
O IDW- MMF alone
O Wiring
O Titanium plates w/wo IDW-MMF
O Wiring + Titanium plates w/wo IDW-MMF
O No Treatment (specify reason)
O undisplaced / conservative management
O unstable patient / co morbidities (spinal/ CNS)
O no consent
O no funds
O Others : (specify) _____

IV. Complications
O None O Bleeding O Infection
O Others : _____

IV. Outcome
O Improved O Not Improved O Died O Repeat operation _____

APPENDIX B
Figures and Computations

Age and etiology

ANOVA for RELATIONSHIP BETWEEN AGE AND ETIOLOGY

Analysis of variance table [Classical sum of squares - Type II]

Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	
Model	**24442.21**	**9**	**2715.80**	**3.63**	**0.0095**	**significant**
A-Age	4658.00	3	1552.67	2.08	0.1391	
B-Etiology	19784.21	6	3297.37	4.41	0.0065	
Residual	13457.50	18	747.64			
Cor Total	37899.71	27				

Std. Dev.	27.34	R-Squared	0.6449
Mean	18.29	Adj R-Squared	0.4674
C.V. %	149.53	Pred R-Squared	0.1408
PRESS	32563.83	Adeq Precision	6.863

Response RELATIONSHIP BETWEEEN ETIOLOGY AND TYPE OF FRACTURE

ANOVA for selected factorial model

Analysis of variance table [Classical sum of squares - Type II]

Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	
Model	21234.48	8	2654.31	56.43	< 0.0001	significant
A-Type of Fracture	*159.52*	*2*	*79.76*	*1.70*	*0.2246*	
B-Etiology	*21074.95*	*6*	*3512.49*	*74.67*	*< 0.0001*	
Residual	564.48	12	47.04			
Cor Total	21798.95	20				

Std. Dev.	6.86	R-Squared	0.9741
Mean	21.38	Adj R-Squared	0.9568
C.V. %	32.08	Pred R-Squared	0.9207
PRESS	1728.71	Adeq Precision	22.961

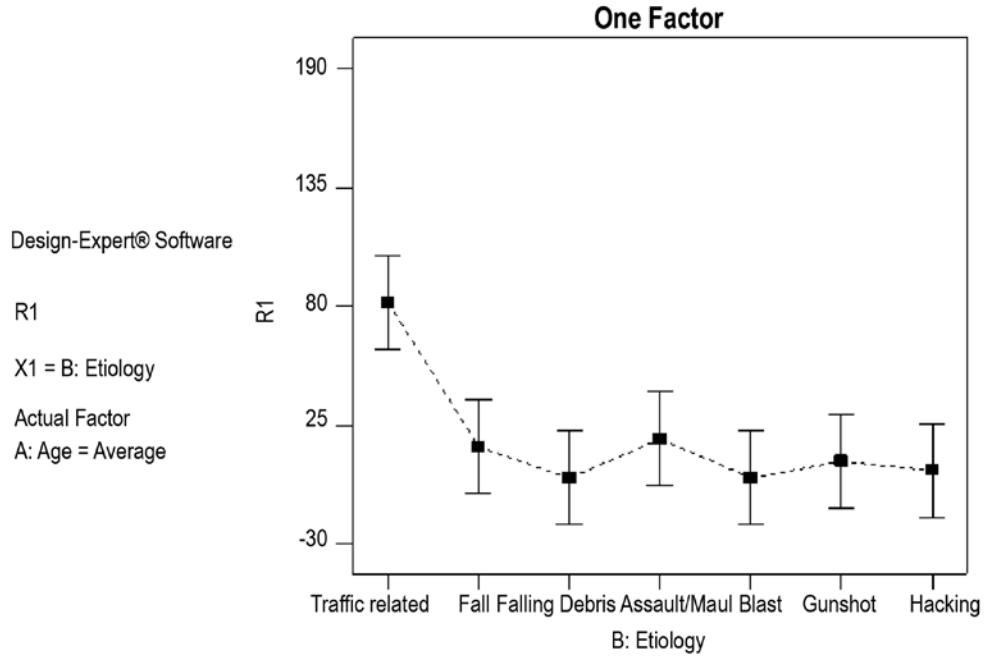

Figure A. Interaction between Age and Etiology of Injury.

Graph of etiology of injury versus average age revealed that over the age group range, traffic-related injury is the topmost cause of maxillofacial fractures. This is related moreover to the occurrence of the other causes of injury such that if traffic-related injuries prevailed at different age groups, other causes can be considered as secondary causes.

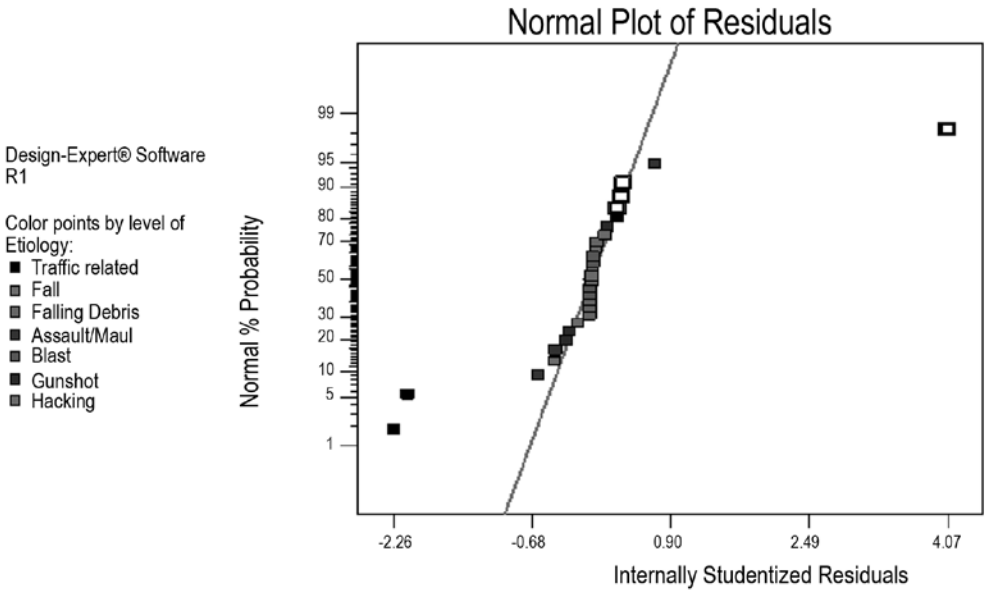

Figure B. Normal plot of residuals.

All the points almost hit or touch the trend line indicating the actual error is not as large as expected. This indicates that the design has a very small error as compared to α=0.05. Thus, no unusual behavior.

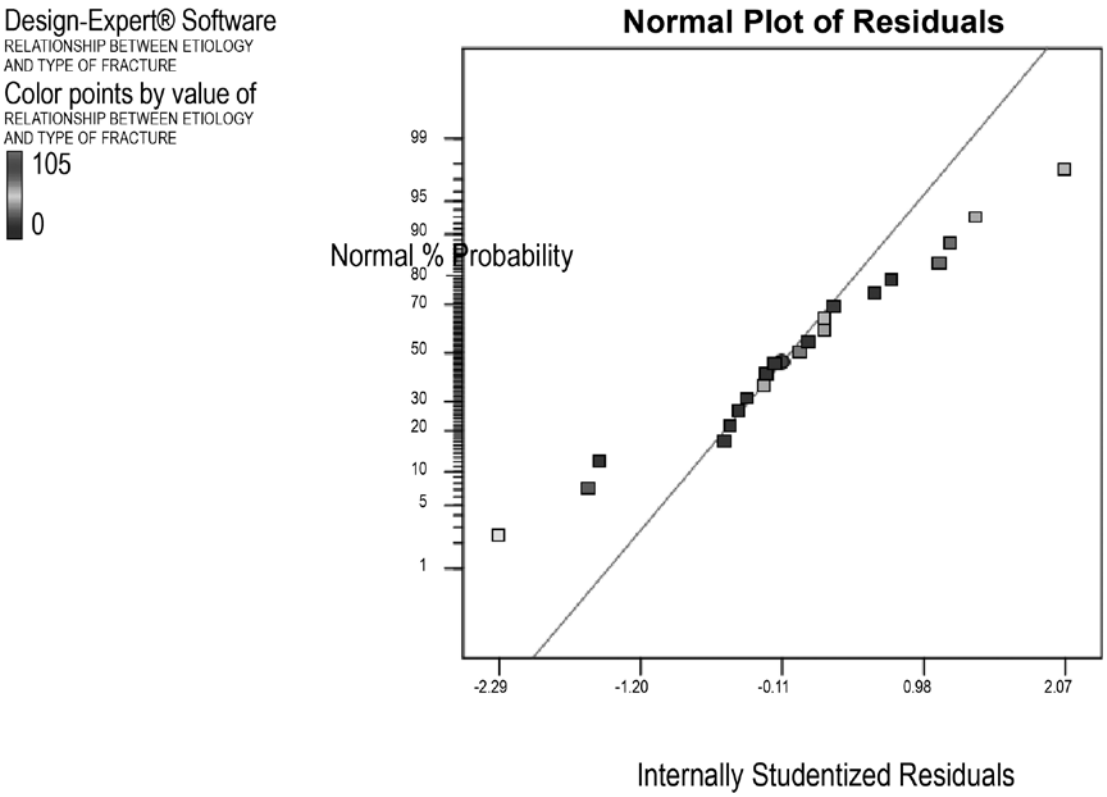

Figure C. Normal Plot of Residuals for the Relationship between Etiology and Type of Fracture

The normal plot of residuals for the relationship between Etiology and Type of Fracture is shown. It is observed that majority of the points lie on the straight line, indicating that the actual error is less than that of the expected error which is set at $\alpha = 0.05$. This means that the error in the design is very small to interfere with the significant relationship of the factors.

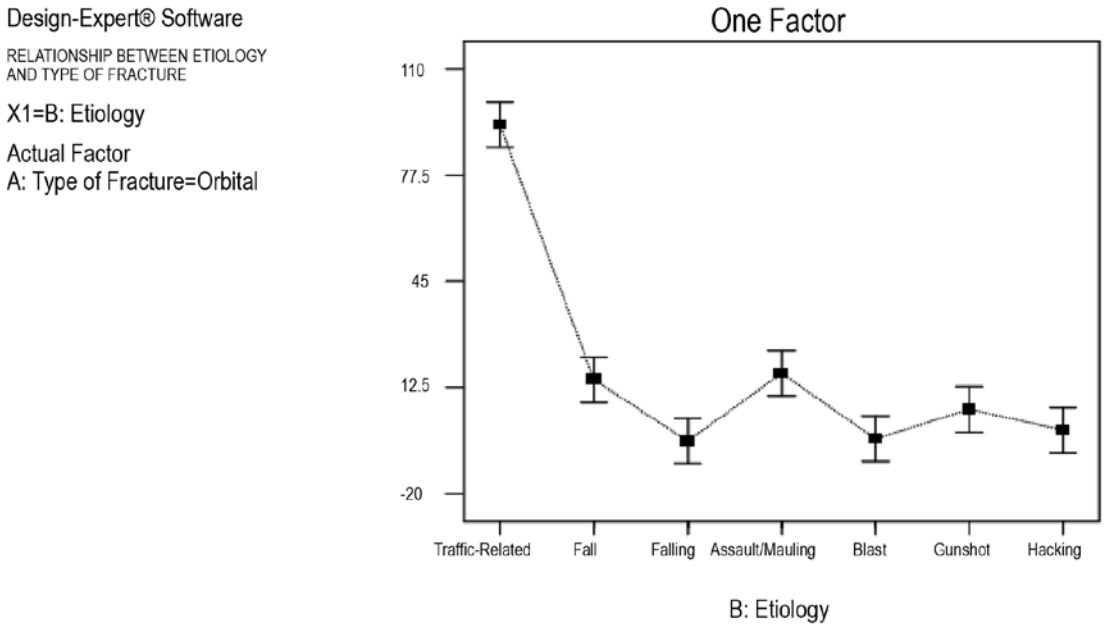

Figure D. Relationship between Etiology and Type of Fracture (Orbital Fractures)

Orbital fracture can be clearly seen common among traffic-related cases but also occasionally seen in other Etiologies.

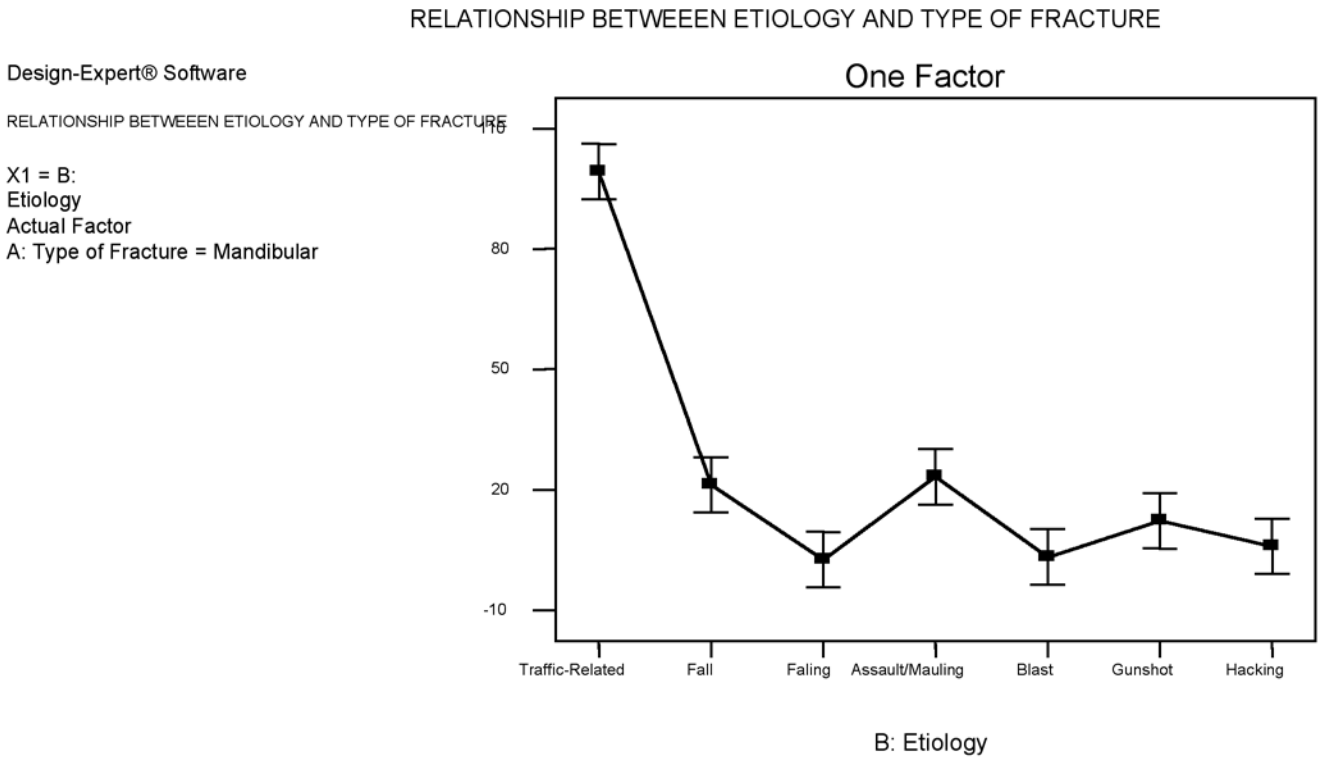

Figure E. Relationship between Etiology and Type of Fracture (Mandibular Fractures)

Majority of the mandibular fracture cases were seen on traffic-related injuries.

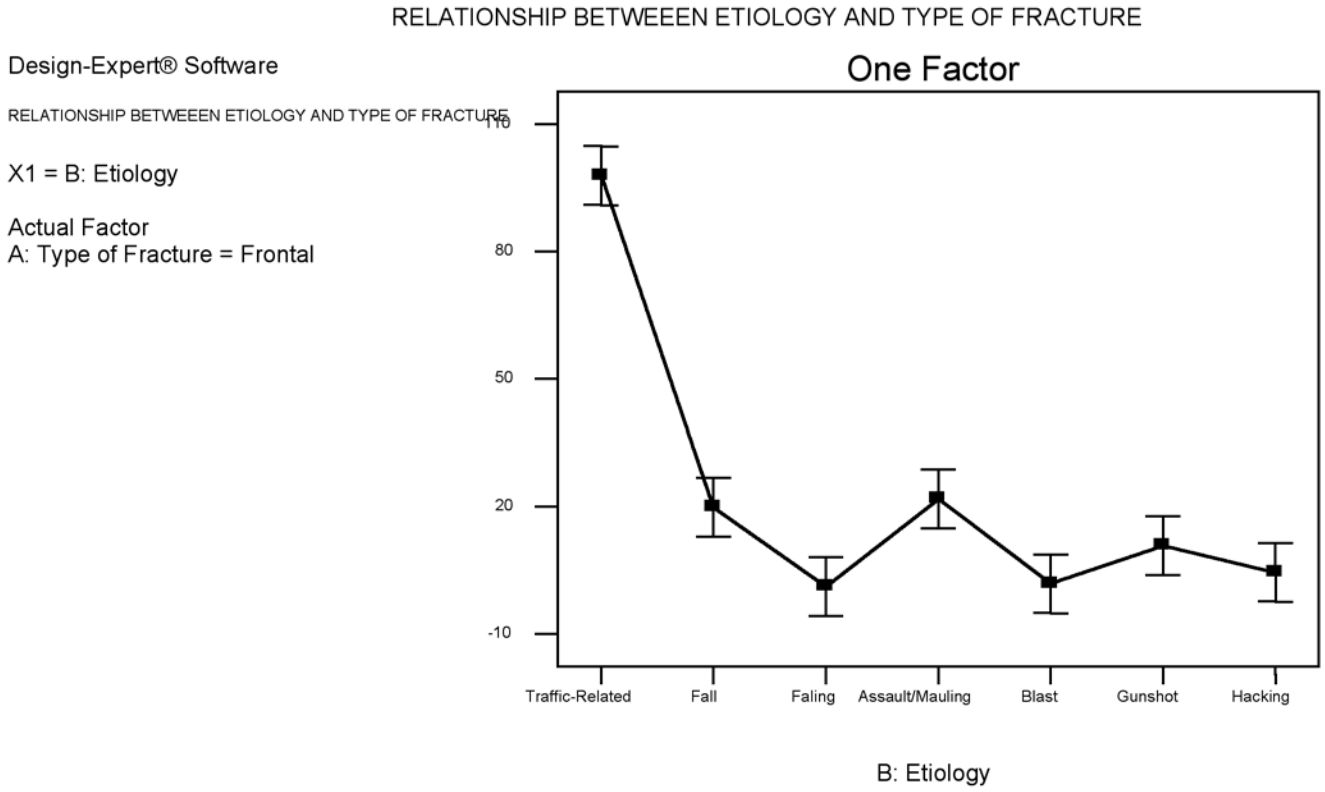

Figure F. Relationship between Etiology of Injury and Type of Fracture (Frontal Fractures)

Frontal fractures are most commonly seen in traffic related injuries.