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Maxillofacial injury – a retrospective analysis of time lapse between injury and treatment

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CHAPTER 1: INTRODUCTION

1.1 Preface

In the Division of Maxillofacial and Oral Surgery, Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) anecdotal belief of the staff is that facial fractures are treated about 3 weeks after injury. Treatment after such a delay may be complicated by malunion, non-union and sepsis. In contrast to fractures which have been reduced, aligned and immobilised within a few days of occurrence, the fracture site now requires aggressive debridement, mobilisation, hospitalization, and antibiotic therapy. This results in an increase in patient morbidity; there is an extended period where there is no or limited function, patients struggle to eat and speak, and they take extended sick leave if employed.

There is also an increased prevalence of sepsis as a high proportion of the trauma population treated at the CMJAH are already immunocompromised by HIV, which further reduces their ability to keep infection at bay. It has been recently shown by Sefeane[1] that 23% of patients with acute orthopaedic trauma are HIV-positive. Sepsis combined with the poor nutrition, due to limited mastication, can adversely affect the CD4 count of an HIV positive person.

South Africa's public health care system has been described in two ways. Regarding categories of hospitals there are four; District, Regional, Tertiary (provincial tertiary and national central) and Quaternary hospitals. The hospitals offer different levels of service. Of the 388 public hospitals, 64% are district hospitals. Secondary and specialised hospitals make up 16% each of the total number. Together provincial and national hospitals comprise less than 4% of all hospitals in the public sector. [2] The CMJAH website describes the South Africa's public healthcare system as structured in 4 layers:[3]

- Primary Healthcare Clinics
- District hospitals
- Regional hospitals
- Tertiary (Academic) hospitals

Another layer of two Quaternary Hospitals has been added to this healthcare system:

1. Charlotte Maxeke Johannesburg Academic Hospital in Johannesburg
2. Groote Schuur Hospital in Cape Town

For the treatment of MFOS injuries, the Province of Gauteng can be divided into northern and southern regions. The northern region is serviced by Pretoria Academic Hospital. The southern region is serviced by two academic hospitals; CMJAH and Chris Hani Baragwanath Hospital. There is no official referral system that dictates which government clinic or hospital refers to which tertiary / quaternary hospital; rather an unofficial referral system, which has developed over time, operates. Within this unofficial system the CMJAH is the major referral centre for the following regional and district hospitals and primary healthcare clinics:

- Far East Rand Hospital - Springs
- Tambo Memorial Hospital - Boksburg
- Natalspruit Hospital – Kathlehong
- Helen Joseph Hospital – Westdene, Johannesburg
- Pholosong Hospital - Brakpan
- Alexandra Clinic – Alexandra, Johannesburg
- South Rand Hospital – Rosettenville, Johannesburg
- Rahima Moosa Hospital – Coronationville, Johannesburg
- Witkoppen Clinic – Fourways, Johannesburg
- Hillbrow Clinic – Hillbrow, Johannesburg

Patients from the Soweto Clinics, South Rand and West Rand Hospitals (not listed above) are usually referred to the Chris Hani Baragwanath Hospital MFOS Division.

1.2 Background to the study

Facial trauma forms the bulk of cases treated in the Division of MFOS at the CMJAH. A typical demographic of such patients has been shown in a clinical audit of 133 patients with mandibular fractures that was done in the MFOS division at CMJAH from 1/3/2004 – 31/8/2004 by Desai et al.[4] (Table 1.1).

Table 1.1 Demographics of patients with mandibular fractures from March -August 2003[4]

Race	Black 100 (75%), Coloured 10 (8%), Indian 2 (1%) White 21 (16%)
Employment	Professional 1 (<1%), private sector 38 (29%), State 4 (3%), labourer 24 (26%), student 10 (7%), unemployed 46 (35%)
Cause of Injury	Accidental 18 (14%), inter-personal violence 115 (86%)
Alcohol Associated	Yes 86 (65%)

Staff of the MFOS Division have noted that patients typically come for multiple assessments prior to any treatment being done. The following sequence is common:

- First presentation – Patient presents to the MFOS ward with a referral letter. The patient is then booked for the out-patient clinic where all the assessments are done. Generally, this is not the first attempt at obtaining treatment; the patient has usually been assessed at an outlying hospital/clinic or in another department at CMJAH, which referred the patient to the MFOS division.
- Second presentation – Patient presents to the out-patient clinic for assessment. An appointment date for treatment is arranged.
- Third presentation – Treatment for fracture is done under either local or general anaesthetic.

- Fourth presentation – Follow-up post-treatment appointment.
- Further appointments – Most fracture cases require further appointments for monitoring of treatment and eventually removal of intermaxillary fixation.

Desai et al's study[4] as well as earlier ones listed in his article included characteristics of fractures, causes of fractures and types of treatment, but did not deal with timing from injury to treatment and discharge.

Treatment should be provided as soon as possible since delayed treatment of facial fractures has far-reaching implications. These include:

1) Physical and psychological effects on the patient
2) Economic implications
    - For the patient
    - For the state health authorities

The limiting factor in the surgical treatment of facial fractures is the lack of operating theatre staff, particularly anaesthetists. The following statement is quoted from an article appearing in a national South African newspaper, the Mail & Guardian Online – "***Large backlog at Charlotte Maxeke Hospital,* says DA"** (August 24, 2009)[5]
"According to Qedani Mahlangu, (provincial health minister) operations are delayed due to unavailability of anaesthetists, shortage of ICU nurses and the high volume of operations. The hospital is short of 11 anaesthetists, which led to 32 delayed operations in May, June and July this year."

1.3 Psychological implications of delayed treatment

Great amount of physical force is required to inflict a facial or mandibular fracture. The most common causes are assault (including domestic violence), motor vehicle accidents and pedestrian vehicle accidents. The psychological trauma that an individual goes through in these situations should not be underestimated.

In addition to the psychological trauma that occurs at and just after injury, when the fracture treatment is delayed, there are further psychological implications:

- Extended sick leave resulting in unemployment and/or loss of income.

- Facial deformity – if a fracture is displaced or malunion occurs the appearance may be altered.

- Inability to function normally – Patients struggle to speak properly and mastication is impaired.

1.4 Economic implications of delayed treatment

Even though a large proportion of patients treated in the MFOS Division are unemployed, many patients do have permanent jobs. Those who aren't formally employed do what they refer to as "piece-jobs". These are part-time casual jobs that people do as the need for finances arise. These "piece-jobs" are generally low to medium-skilled and involve physical labour (e.g. working on jobs in construction). This type of labour is informal without compensation for injury on duty, no paid sick leave, and no assurance that the person will have a job when he/she returns from an extended sick leave. When an individual who relies on this type of economic activity sustains a facial fracture he/she is unable to work until the fracture has been treated and healing has occurred. If treatment is delayed, it can be up to 2 months before an individual may earn any form of income.

1.5 Complications of the late treatment of mandibular fractures

The majority of fractures treated in the Division of MFOS are isolated mandibular fractures, which vary in severity. Severity of the fracture is another important influence on complication rate. [6,7]

A systematic review of the literature by Hermund et al.[6] examined the influence of treatment delay upon healing complications in six studies. Four studies showed no statistically significant difference between immediate and delayed treatment, one study showed increased healing for cases treated within 3 days. Two other studies indicated that treatment time between 3 and 5 days were optimal with the lowest rate of complications.[7,8,17,18]

Possible complications include:

- Delayed union and Non-union
- Infection

- Malunion [9]
- Nerve Injury[9]
- Ankylosis[9]

1.6 Complications of the Late Treatment of Mid-face Fractures

Displaced midface fractures result in poor aesthetics. In comparison to mandibular fractures, midface fractures require early treatment. [10,11,12,17,18]

Possible complications include: [9,12]

- Orbital Floor Involvement - ocular displacement (enopthalmia)
- Malunion
- Cosmetic Deformity
- Diplopia (by disturbing the movement or position of the eye)
- Zygomatic fracture may restrict mouth opening by impinging on the coronoid process of the mandible.
- Retrusion of upper teeth
- Anterior or lateral open bite
- Intraoral fistulae into nose or maxillary sinus
- Increased/decreased orbital volume
- Orbital dystopia
- Tethering of the ocular muscles
- Depression of the nasal bridge
- Deviation of nasal septum
- Telecanthus
- Obstruction of drainage of the paranasal sinuses (commonly maxillary and frontal sinuses)
- Persistent cerebrospinal fluid rhinorrhoea
- Partial /complete obstruction of the nasolacrimal duct
- Neural damage may occur to the nerves that supply the extraocular muscles of the eye

- These nerves may also be damaged within the superior orbital fissure. This results in the a superior orbital fissure syndrome (which consists of opthalmoplegia, ptosis, proptosis, and a fixed dilated pupil)
- In addition, the Optic nerve may also be damaged resulting in partial or complete blindness (Orbital Apex Syndrome)
- Anosmia (lack of smell) results from fractures involving the cribriform plate of the ethmoid bone.
- Midface fractures may also result in anaesthesia or paraesthesia of the maxillary division of the trigeminal nerve. This results in reduced or absence of sensation in the cheek, upper lip and maxillary teeth.

1.7 Objectives of Study

There has been some debate with regards to the timing of treatment of facial fractures. Some advocate immediate repair in the stable patient, but it has been found that no significant complications result from a delay of 7 to 14 days. Waiting longer than this is not preferred because fibrosis and healing begin to occur, making late repair more difficult. Soft tissue envelope contraction is cited as the major cause of difficulty and poor outcome in late correction of post traumatic defects.[10,11]

No study of the timing of the stages from the fracture to treatment has been reported. I was unable to find previous literature on the subject locally or abroad, in spite of an extensive literature search using Pubmed, Scirus and Google Scholar. Instead I looked at literature which described the effects of delayed treatment of fractures. A source which proved invaluable was the study done by Desai et al.[4], in which he compared the epidemiology in all the South African studies done on fractures. [4, 13-16]

From the limited information available it is clear that we are dealing with a multifaceted challenge all resulting in the delayed treatment of patients with facial fractures. The purpose of this study was to identify where the primary cause of delayed treatment lies; with the patient or with the MFOS Division. This knowledge may improve service planning and delivery in the Division.

CHAPTER 2: METHODS AND MATERIALS

2.1 Data Collection

Before beginning the study ethics clearance was obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand. (Ethics clearance number: M070425; Appendix A). Permission was then sought from the CEO of the CMJAH to gain access to patient files (Appendix B). The protocol for this study was approved by an assessors' committee in accordance with University rules for the degree of MSc (Dentistry).

2.1.1 Pilot study

A concern that the assessors' committee had was that patient records might not be complete enough or available to the extent that this study required. A pilot study was therefore done prior to examine the committees concerns. For the pilot study a sample of 20 patients were taken from the CMJAH MFOS ward admission books and their records examined. A Microsoft Excel spreadsheet was used to record the information which would be required for the study. The relevant information was readily obtained from the existing patient files, so the go-ahead for the study was given.

2.1.2 Definitive study

Inclusion criteria for this study were any facial fractures sustained by patients admitted to the Division of MFOS at the CMJAH in the years 2002, 2004 and 2006. Initial data was obtained from the ward admission books; hospital number, name, age, race, gender, type of fracture sustained and treatment performed. This data was recorded on a Microsoft Excel spreadsheet. Next, each patient's file was located in the hospital archives situated in the basement of the CMJAH, where they had to be examined. Files may not be removed from the archives, as a result this was a slow, time consuming process.

The following data were recorded:

- Mechanism of injury
- Whether the patient had been referred or not
- Where they had been referred from
- Date of injury

- Date of referral
- Date of presentation at the MFOS division
- Date of admission
- Date of treatment
- Date of discharge
- If the patient had been intoxicated at the time of injury
- If domestic violence was implicated in the injury
- Other injuries sustained at time of fracture
- Fracture type and site
- Fracture treatment
- If the treatment was done under local or general anaesthetic

Seven time intervals (in days) were calculated from the dates present in the patient files:

- Injury occurrence to presentation at the MFOS division
- Injury occurrence to referral (if referred)
- Referral of patient to presentation at the MFOS division
- Presentation to treatment
- Referral to treatment
- Treatment to discharge
- Presentation to discharge

Other variables with a potential role included in the spread sheet were:

- Alcohol – yes, no
- Associated injuries
- Presence of sepsis – yes, no
- Domestic violence – yes, no
- Injury mechanism

        - Motor vehicle accident (MVA)
        - Pedestrian vehicle accident (PVA)
        - Interpersonal violence (IPV)
- Re-treatment of the same injury
- Whether treatment was done under local anaesthetic or general anaesthetic
- Treatment type – Open reduction internal fixation (ORIF) / Closed Reduction fractured mandible (CRFM)

2.2 Statistical analysis.

SAS for Windows (version 9.1 SAS Institute, Cary NC, USA) was used for the statistical analysis. The data were entered into an SAS data file via Microsoft Excel. For descriptive statistics Proc Freq, Proc Means and Proc Univariate were used. The continuous data distributions for the dependent variables were markedly skewed and the Wilks-Shapiro test showed that these distributions failed the test for normality. Consequently, on the advice of the statistician (Prof L P Fatti) the continuous data variables were categorized for the non-parametric Chi-squared test. The level of statistical significance was set at $P<0.05$. This will be shown in the next chapter.

When cross-tabulation cells contained low frequencies sufficient to indicate that the Chi-squared test was not appropriate, on the recommendation of the statistical advisor categories were combined.

Once the large quantity of data had undergone statistical analysis the following variables were chosen as appropriate for inclusion in this research report:

- Age
- Gender
- Race
- Referred/ not referred
- Use of alcohol
- The following time intervals
    - Fracture occurrence to presentation

- Fracture occurrence to treatment
- Presentation to treatment
- Treatment to discharge
- Presentation to discharge
- Referral to presentation
- Referral to treatment

CHAPTER 3: RESULTS

Tables in this chapter are often large. They have been kept on a single page for clarity – this results in some pages having a good deal of blank space.

3.1 General Demographics

Table 3.1 Summary of patient demographics by study year

	2002		2004		2006		TOTAL	
	N	%*	N	%*	N	%*	N	%*
Gender								
Male	201	86	213	87	212	87	626	86
Female	33	14	33	13	33	13	99	14
Race								
Black	180	77	177	72	188	77	545	75
Other	18	8	20	8	20	8	58	8
White	36	15	49	20	37	15	122	17
Mechanism of Injury								
Interpersonal Violence	196	84	182	74	194	79	572	79
Other	13	6	24	10	18	7	55	8
Vehicle Accidents	25	11	40	16	33	13	98	13
Referred								
Yes	121	52	181	74	185	76	487	67
No	113	48	65	26	60	24	238	33

*Column %

Eighty-six percent of the patients with facial fractures treated in the CMJAH MFOS Division in 2002, 2004, 2006 were males, 14% were female; 75% were black, 17% white and 8% of the patients were classified as “other”. These included Asian, Indian and coloured minority groups. The most common mechanism of injury was interpersonal violence or assault (79%). Domestic violence and gunshot injuries were sub-classified under interpersonal violence, but were excluded from the study as they were not statistically significant. This was followed by vehicle accidents which were implicated in 13% of injuries. Once again, the other minority causes were grouped together for statistical purposes and classified as “other”. These included injuries caused by sporting accidents and falls. The majority of patients were referred to the CMJAH MFOS Division

(67%). The trends from year to year remain remarkably consistent. There is an increase in the number of patients referred over the 3 study years.

3.2 Overview of results

The total sample size for all years combined is 725 (Table 3.2). This is the total number of patients who met criteria for the study; all maxillofacial fractures are included, there was no subdivision by fracture type. The sample in the referral cells is lower than in other cells due to the lack of referral or missing information.

Table 3.2 Summary of results in days of all the study time intervals for the combined sample and by study year

Variable	Fracture occurrence - Presentation	Fracture occurrence - Treatment	Referral – Presentation	Referral - Treatment	Presentation - Treatment	Treatment- Discharge	Presentation - Discharge
All years combined N Mean Std Dev Min-Max Median	725 10.3 12.7 0-120 6	725 20.4 17.6 0-140 18	333 4.5 8.3 0-80 1	335 14.6 15.6 0-130 12	725 10.3 11.8 0-119 8	725 1.3 2 0-33 1	725 11.7 12.8 0-131 9
2002 N Mean Std Dev Min-Max Median	234 12.5 15 0-120 7	234 24 22.3 0-140 20	71 6.8 12.5 0-80 2	73 18.2 23.9 0-130 13	234 11.4 14.8 0-119 7.5	234 1.7 2.9 0-33 1	234 13.7 16.5 0-131 9
2004 N Mean Std Dev Min-Max Median	246 8.7 10.8 0-64 5	246 18.5 12.8 0-68 17	116 4 5.7 0-33 1	116 14.4 9.8 0-45 14	246 10.2 8.7 0-45 9	246 1.2 1.6 0-13 1	246 11.1 8.5 0-53 10
2006 N Mean Std Dev Min-Max Median	245 9.7 11.8 0-80 6	245 18.8 16.2 0-113 16	146 3.9 7.3 0-48 1	146 12.9 13.6 0-115 10	245 9.4 11.2 0-111 8	245 1 1 0-8 1	245 10.5 12.3 0-114 9

In the combined sample it takes a mean of 10.3 days for a patient to present to the MFOS Division after a fracture has occurred. In 2002 the mean time was 12.5 days. This reduced to 8.7 days in 2004 and increased slightly in 2006 to 9.7 days. The mean for all years combined for the time interval of fracture occurrence to treatment was 20.4 days. This interval was the longest in all 3 years. From 2002 to 2004 there is a reduction in time from fracture occurrence to treatment of 5.5 days (From 24 days to 18.5 days). This number remains constant in 2006. The mean time from presentation to treatment at the MFOS division is 10.3 days. The days from presentation to treatment reduced progressively over the three study years, starting at 11.4 days in 2002 and declined to its lowest in 2006 at 9.4 days. The time from referral to presentation is an average of 4.5 days over the three study years. This time was the most in 2002 with 6.8 days that reduced to 3.9 days in 2006. The mean referral to treatment time was 14.6 days for all three years. Over the three years it reduced from 18.2 days in 2002 to 12.9 in 2006. The shortest time interval is that of treatment to discharge. It is consistently low over the 3 years and reduces to 1 day in 2006. The time interval of presentation to discharge is an important interval as this can be considered the time that the patient is under treatment in the MFOS Division. The mean time of presentation to discharge for all three years combined is 11.7 days. In 2002 the time is the longest at 13.7 days. In 2004 the time drops to 11.1 days and then in 2006 is reduced further to 10.5 days.

Table 3.3 lists the absolute frequencies and percentages within each of the time periods for five 'time groups' which are the categories mentioned in section 2.2. These are convenient categories based on clinical experience of the MFOS division. The bar charts on the following pages are visual representations of Table 3.2 for each of the 3 sample years. Each bar chart is followed by a Table to enable understanding of the absolute frequencies in the charts.

Table 3.3 Frequency distribution of time in days for the five time groups by study year and for all years combined. (% = column in each cell)

	2002		2004		2006		Total sample	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Fracture Occurrence – Presentation								
N=725								
0-1 days	37	15.8	53	21.5	42	17.1	132	18.2
2-7	83	35.5	101	41.1	101	41.2	285	39.3
8-14	38	16.2	48	19.5	53	21.6	139	19.2
15-30	56	23.9	30	12.2	35	14.3	121	16.7
≥31	20	8.6	14	5.7	14	5.7	48	6.6
Fracture Occurrence - Treatment								
N= 725								
0-1 days	13	5.6	16	6.5	11	4.5	40	5.5
2-7	36	15.4	31	12.6	38	15.5	105	14.5
8-14	36	15.4	58	23.6	63	25.7	157	21.7
15-30	95	40.6	103	41.9	103	42	301	41.5
≥31	54	23.1	38	15.5	30	12.2	122	16.8
Presentation – Treatment								
N= 725								
0-1 days	72	30.8	53	21.5	55	22.5	180	24.8
2-7	45	19.2	55	22.4	64	26.1	164	22.6
8-14	45	19.2	62	25.2	74	30.2	181	24.9
15-30	58	24.8	71	28.9	49	20	178	24.6
≥31	14	6	5	2	3	1.2	22	3
Treatment – Discharge								
N= 725								
0-1 days	170	72.7	205	83.3	207	84.5	582	80.3
2-7	59	25.2	38	15.5	37	15.1	134	18.5
8-14	3	1.3	3	1.2	1	0.4	7	1
15-30	1	0.4					1	0.1
≥31	1	0.4					1	0.1
Presentation – Discharge								
N= 725								
0-1 days	22	9.4	21	8.5	20	8.2	63	8.7
2-7	83	35.5	77	31.3	83	33.9	243	33.5
8-14	45	19.2	69	28.1	83	33.9	197	27.2
15-30	63	26.9	74	30.1	56	22.9	193	26.6
≥31	21	9	5	2	3	1.2	29	4
Referral – Presentation								
N= 333								
0-1 days	33	46.5	59	50.9	86	58.9	178	53.5
2-7	19	26.8	35	30.2	38	26	92	27.6
8-14	9	12.7	16	13.8	11	7.5	36	10.8
15-30	6	8.5	5	4.3	10	6.9	21	6.3
≥31	4	5.6	1	0.9	1	0.7	6	1.8
Referral – Treatment								
N=335								
0-1 days	15	20.6	14	12.1	26	17.8	55	16.4
2-7	15	20.6	20	17.2	22	15.1	57	17.1
8-14	8	11	25	21.6	50	34.3	83	24.8
15-30	22	30.1	52	44.8	39	26.7	113	33.7
≥31	13	17.8	5	4.3	9	6.2	27	8.1

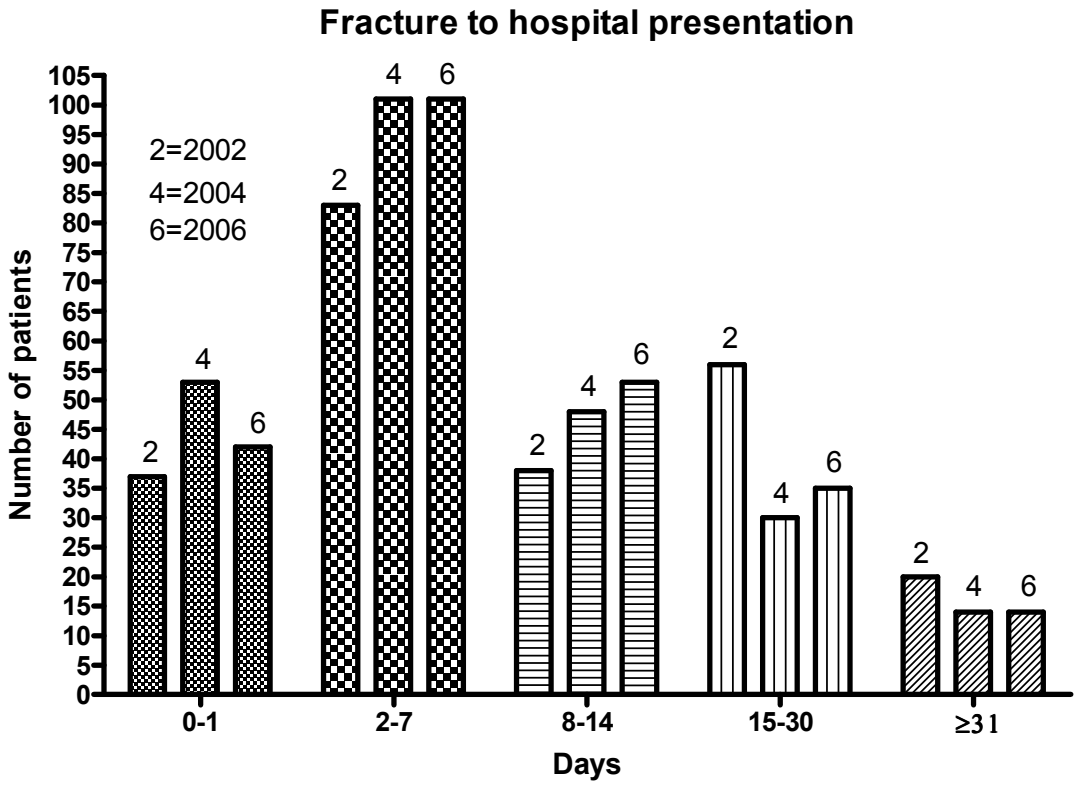


Figure 3.1 Bar chart showing frequencies from fracture occurrence to MFOS Division presentation in days for each year by time group.

Fig 3.1 and Table 3.4 shows that the majority of patients presented to the MFOS Division 2-7 days after the fracture occurred for all three of the years. There was an increase from 2002 to 2004 in the number of patients that presented in this time group. There was a steady increase in the number of patients presenting in the 8-14 day time group from 2002-2006. The number of patients that presented 0-1 days after the fracture had occurred increased from 2002 – 2004, and then decreased from 2004 – 2006. The frequencies from 2004-2006 showed no constant pattern. Looking within each year from 8-14 days onwards, in 2002 there was an increase to the 15-30 day group followed by a drop to the final group. In 2004 and 2006 frequencies in the time graphs after 2-7 days decreased steadily.

Table 3.4 Frequency distribution of fracture occurrence to MFOS Division presentation by year and time group

Time group	Year			
	2002	**2004**	**2006**	**Total**
0-1 Day				
n	37	53	42	132
%	5.1	7.3	5.8	18.2
Row %	28	40.2	31.8	100
Column %	15.8	21.5	17.1	
2-7 Days				
n	83	101	101	285
%	11.5	13.9	13.9	39.3
Row %	29.1	35.4	35.4	100
Column %	35.5	41.1	41.2	
8-14 Days				
n	38	48	53	139
%	5.2	6.6	7.3	17.2
Row %	27.3	34.5	38.1	100
Column %	16.2	19.5	21.6	
15-30 Days				
n	56	30	35	121
%	7.7	4.1	4.8	16.7
Row %	46.3	24.8	28.9	100
Column %	23.9	12.2	14.3	
≥ 31 Days				
n	20	14	14	48
%	2.8	1.9	1.9	6.6
Row %	41.7	29.2	29.2	100
Column %	8.6	5.7	5.7	
TOTAL	234	246	245	725
Column %	32.3	33.9	33.8	100

Chi-square test for independent variables df = 8, chi-square =18.6, P=0.0169

Mantel-Haenszel chi-square test for trend df = 1, chi-square =4.9, P = 0.0275

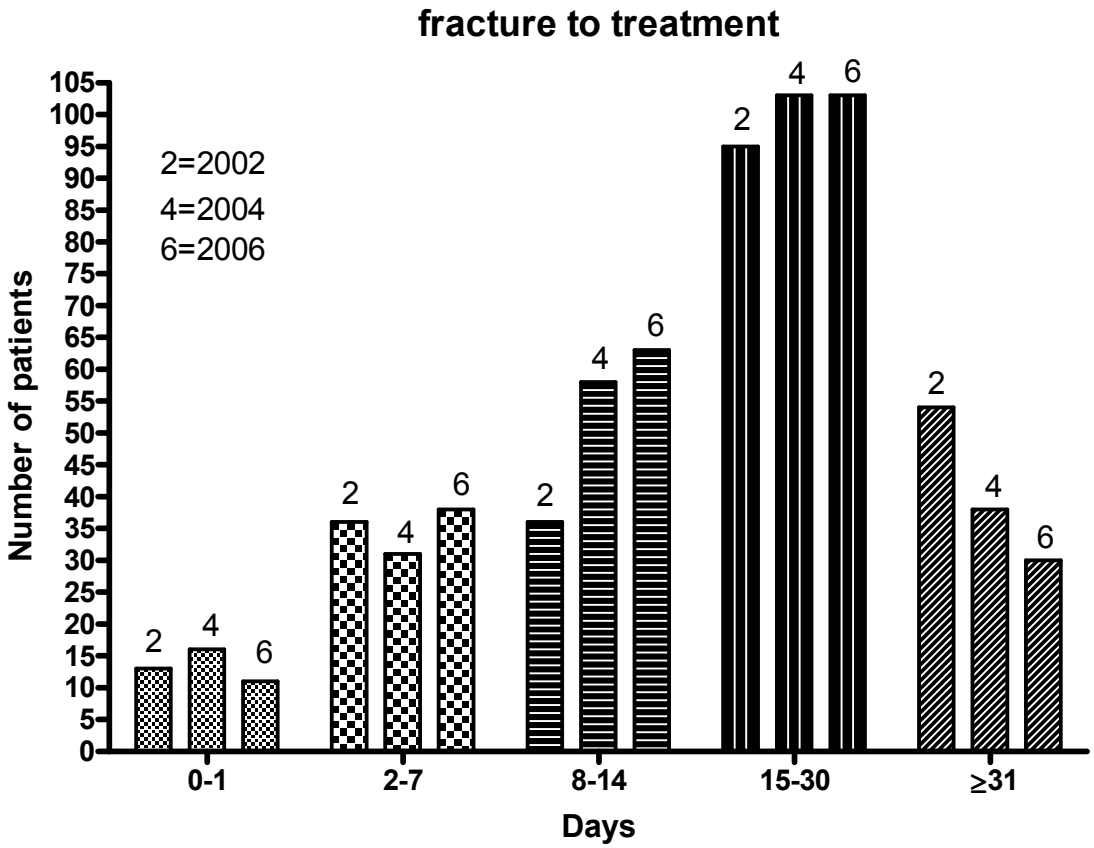


Figure 3.2 Bar chart showing time from fracture occurrence to treatment in days for each year by time group.

Figure 3.2 and Table 3.5 show that most fractures were treated 15 –30 days after the fracture had occurred. There was a slight increase in the number of patients treated during this time group from 2002 to 2004 and 2006. The number of patients treated in the 8-14 day time group increased over the 3 years. After the 15-30 day time group this time group had the most number of patients. The number of patients that were treated after 31 days declined steadily over the 3 years. In Table 3.6 the time from fracture occurrence to treatment tends to be slightly less in female patients as compared to male patients (although not statistically significant with the Mantel-Haenszel chi-square test) , but the majority of both genders still fall into the 15-30 day time group. In Table 3.7 the effect of referral on time from fracture occurrence to presentation is looked at. It appears that the patients who were referred attend later than those who weren't.

Table 3.5 Frequency distribution of fracture occurrence to treatment time group by year

Time group	Year			
	2002	**2004**	**2006**	**Total**
0-1 Day				
n	13	16	11	40
%	1.8	2.2	1.5	5.5
Row %	32.5	40	27.5	100
Column %	5.6	6.5	4.5	
2-7 Days				
n	36	31	38	105
%	5	4.3	5.2	14.5
Row %	34.3	29.5	36.2	100
Col %	15.4	12.6	15.5	
8-14 Days				
n	36	58	63	157
%	5	8	8.7	21.7
Row %	22.9	36.9	40.1	100
Col %	15.4	23.6	25.7	
15-30 Days				
n	95	103	103	301
%	13.1	14.2	14.2	41.5
Row %	31.6	34.2	34.2	100
Col %	40.6	41.9	42	
≥ 30 Days				
n	54	38	30	122
%	7.5	5.2	4.1	16.8
Row %	44.3	31.2	24.6	100
Col %	23.1	15.5	12.2	
TOTAL	234	246	245	725
Column %	32.3	33.9	33.8	100

Chi-square test for independent variables df = 8, chi-square =17.2, P=0.0282

Mantel-Haenszel chi-square test for trend df = 1, chi-square =3.3, P = 0.0708

Table 3.6 Frequency distribution of fracture occurrence to treatment time group by gender

Time group	Female	Male	Total
0-1 Day			
n	2	38	40
%	0.3	5.2	5.5
Row %	5	95	100
Column %	2	6	
2-7 Days			
n	19	86	105
%	2.6	11.9	14.5
Row %	18.1	81.9	100
Column %	19.2	13.7	
8-14 Days			
n	25	132	157
%	3.5	18.2	21.7
Row %	15.9	84.1	100
Column %	25.3	21.1	
15-30 Days			
n	32	269	301
%	4.4	37.1	41.5
Row %	10.6	89.4	100
Column %	32.3	43	
≥ 30 Days			
n	21	101	122
%	2.9	13.9	16.8
Row %	17.2	82.8	100
Column %	21.2	16.1	
TOTAL	99	626	725
Column %	13.7	86.3	100

Chi-square test for independent variables df = 4, chi-square =8.6, P=0.0711

Mantel-Haenszel chi-square test for trend df = 1, chi-square =0.03, P = 0.9

Table 3.7 Frequency distribution of fracture occurrence to treatment time group by referral

Group	Not Referred	Referred	Total
0-1 Day			
n	15	25	40
%	2.1	3.5	5.5
Row %	37.5	62.5	100
Column %	6.3	5.1	
2-7 Days			
n	48	57	105
%	6.6	7.9	14.5
Row %	45.7	54.3	100
Column %	20.2	11.7	
8-14 Days			
n	47	110	157
%	6.5	15.2	21.7
Row %	29.9	70.1	100
Column %	19.8	22.6	
15-30 Days			
n	84	217	301
%	11.6	29.9	41.5
Row %	27.9	72.1	100
Column %	35.3	44.6	
≥ 30 Days			
n	44	78	122
%	6.1	10.8	16.8
Row %	36.1	63.9	100
Column %	18.5	16	
TOTAL	238	487	725
Column %	32.8	67.2	100

Chi-square test for independent variables df = 4, chi-square =12.8, P=0.0124

Mantel-Haenszel chi-square test for trend df = 1, chi-square =3.03, P = 0.08

Table 3.8 Frequency distribution of referral to treatment time group by year

Group	Year			
	2002	**2004**	**2006**	**Total**
0-1 Day				
n	15	14	26	55
%	4.5	4.2	7.8	16.4
Row %	27.3	25.5	47.3	100
Column %	20.6	12.1	17.8	
2-7 Days				
n	15	20	22	57
%	4.5	6	6.6	17
Row %	26.3	35.1	38.6	100
Column %	20.6	17.2	15.1	
8-14 Days				
n	8	25	50	83
%	2.4	7.5	14.9	24.8
Row %	9.6	30.1	60.2	100
Column %	11	21.6	34.3	
15-30 Days				
n	22	52	39	113
%	6.6	15.5	11.6	33.7
Row %	19.5	46	34.5	100
Column %	30.1	44.8	26.7	
≥30 Days				
n	13	5	9	27
%	3.9	1.5	2.7	8.1
Row %	48.2	18.5	33.3	100
Column %	17.8	4.3	6.2	
TOTAL	73	116	146	335
Column %	21.8	34.6	43.6	100

Chi-square test for independent variables df = 8, chi-square =32.5, P<0.0001

Mantel-Haenszel chi-square test for trend df = 1, chi-square =1.3, P = 0.25

Table 3.8 shows that the majority of patients in 2002 and 2004 in the referral to treatment group fell in the 15-30 day time period. This peaked in 2004, where 44.8% of patients took 15-30 days from referral to treatment. In 2006 34.3% of the patients took 8-14 days from referral to treatment.

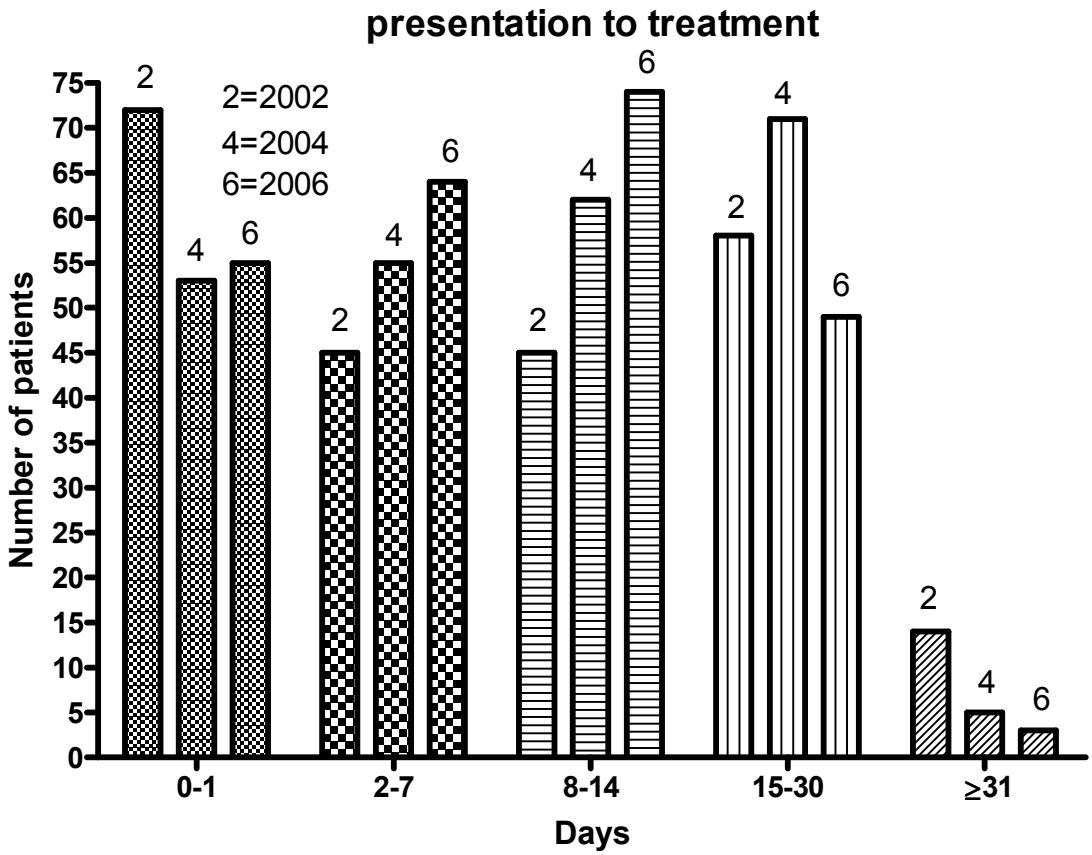


Figure 3.3 Bar chart showing time from presentation to treatment in days for each year by time group.

When patients present to the MFOS division they are assessed, diagnosed and treatment is proposed. A date for the operating theatre is booked and the patient is instructed to return to the ward the day before the scheduled procedure. The time period from presentation to treatment is distributed evenly among all time groups (Fig 3.3, Table 3.9). The time groups from 2-7 days and 8-14 days increased progressively over the 3 years. The 15-30 day time group peaked in 2004 and reduced to its lowest value in 2006. From 2002 to 2004 there was a drop in the number of patients in the 0-1 day time group.

Table 3.9 Frequency distribution of presentation to treatment time group by year

Group	Year			
	2002	**2004**	**2006**	**Total**
0-1 Day				
n	72	53	55	180
%	9.9	7.3	7.6	24.8
Row %	40	29.5	30.6	100
Column %	30.8	21.5	22.5	
2-7 Days				
n	45	55	64	164
%	6.2	7.6	8.8	22.6
Row %	27.4	33.5	39	100
Column %	19.2	22.4	26.1	
8-14 Days				
n	45	62	74	181
%	6.2	8.6	10.2	25
Row %	24.9	34.3	40.9	100
Column %	19.2	25.2	30.2	
15-30 Days				
n	58	71	49	178
%	8	9.8	6.8	24.6
Row %	32.6	40	27.5	100
Column %	24.8	28.9	20	
≥30 Days				
n	14	5	3	22
%	1.9	0.7	0.4	3
Row %	63.6	22.7	13.6	100
Column %	6	2	1.2	
TOTAL	234	246	245	725
Column %	32.3	33.9	33.8	100

Chi-square test for independent variables df = 8, chi-square =27.4, P=0.0006

Mantel-Haenszel chi-square test for trend df = 1, chi-square =0.2, P = 0.66

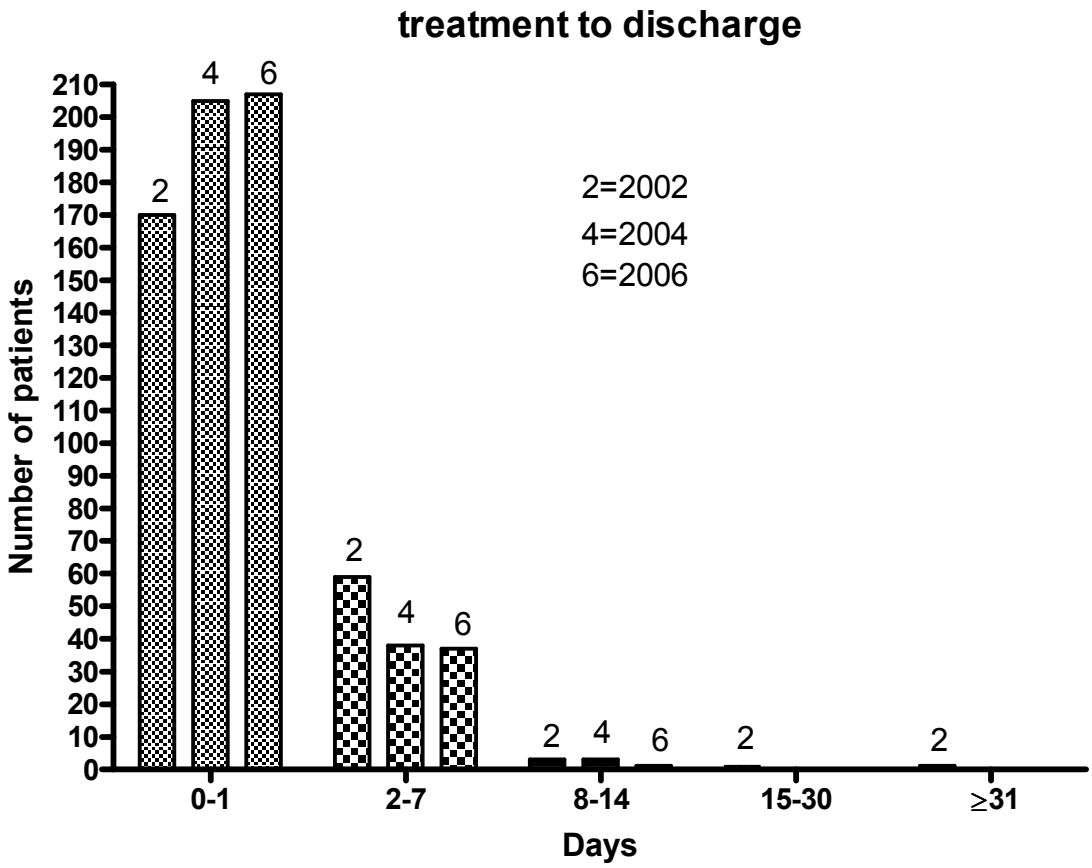


Figure 3.4 Bar chart showing time from treatment to discharge in days for each year by time group.

Once the appropriate treatment has been provided, the majority of patients were discharged within 24 hours (Fig 3.4). A small number of patients were discharged 2-7 days later. The number of patients in this time group reduced from 2002 to 2004, and then remained stable in 2006.

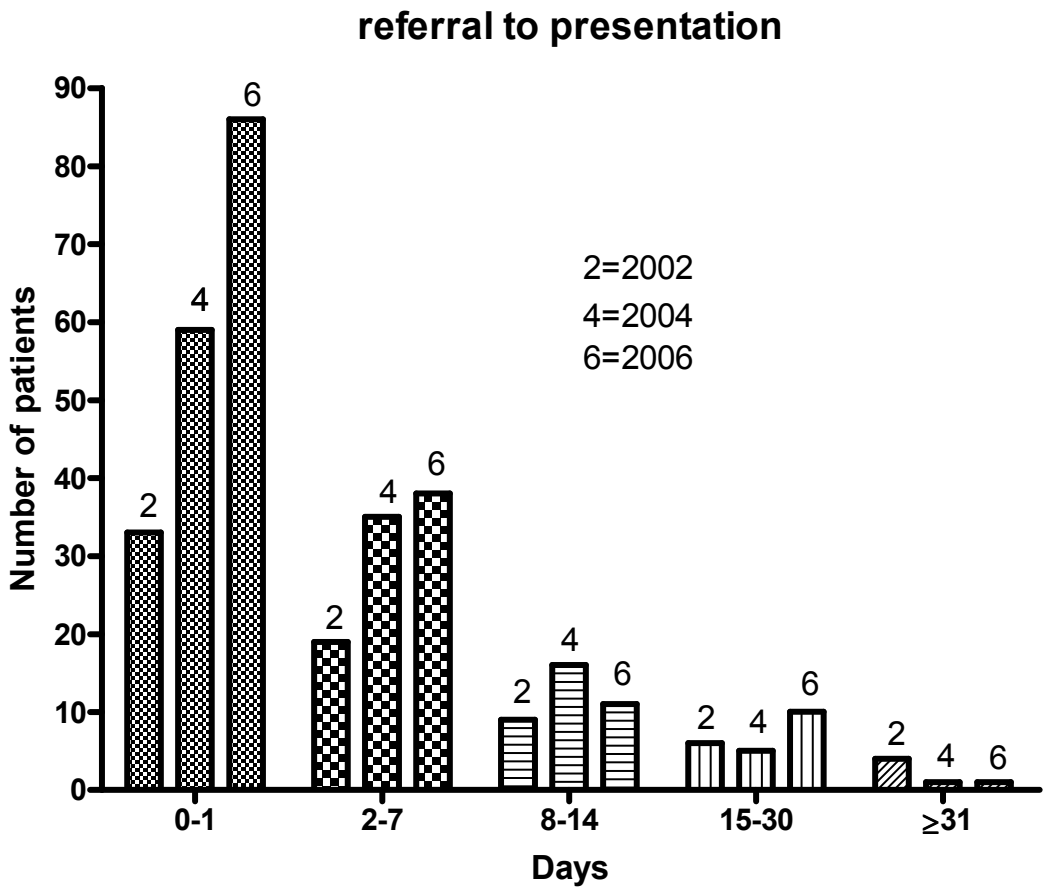


Figure 3.5 Bar chart showing time from referral to presentation in days for each year by time group.

Once referred by an outlying hospital, the majority of patients present to the MFOS division within a day (Fig 3.5). There has been a steady increase in the number of patients referred over the three one year time periods which were studied.

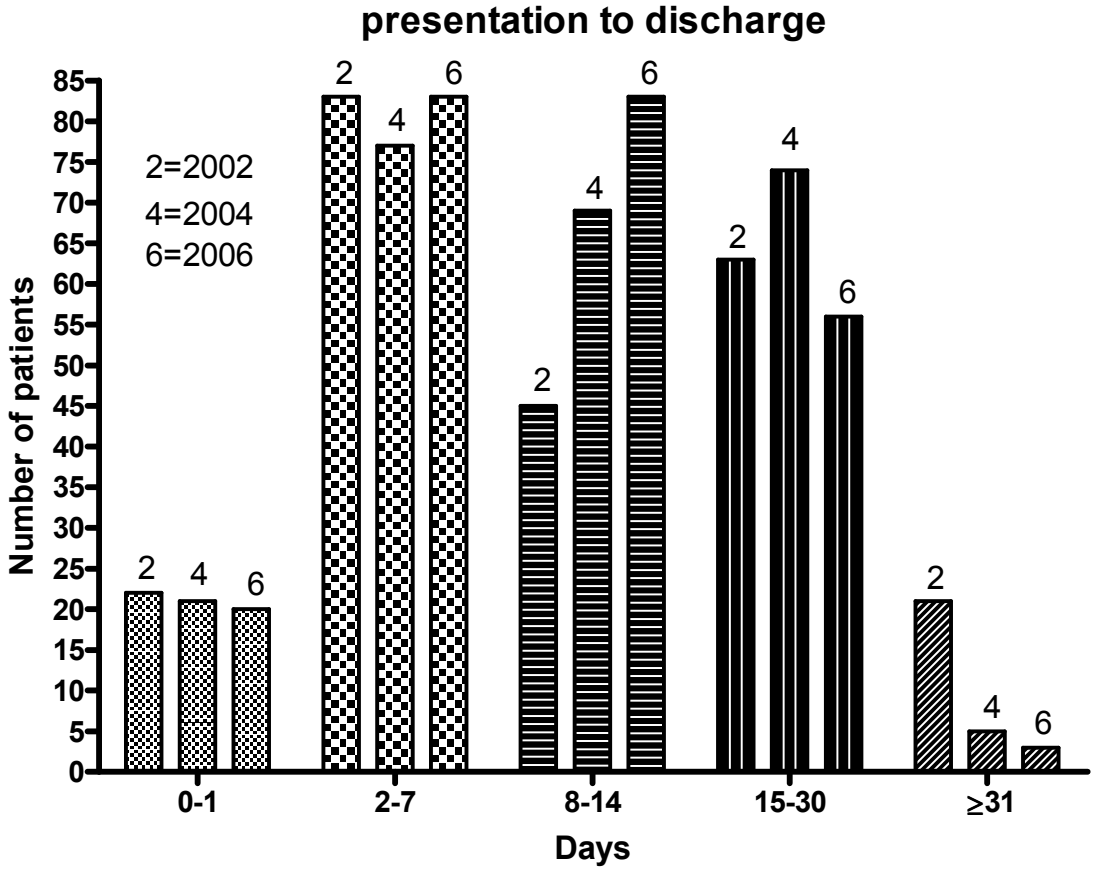


Figure 3.6 Bar chart showing time from presentation to discharge in days for each year by time group.

The time period from presentation to discharge is important as it represents the total time that the patient was in the care of the MFOS division; from the first assessment to discharge after the operative treatment was done. In Fig 3.6 and Table 3.10 the majority of patients that presented to the department received the appropriate treatment for the fracture and were discharged between 2-7 days. Although less, a large portion of the patients were in the MFOS divisions' care from 8-14 days and 15-30 days.

Table 3.10 Frequency distribution of presentation to discharge time group by year

Group	Year			
	2002	**2004**	**2006**	**Total**
0-1 Day				
n	22	21	20	63
%	3	2.9	2.8	8.7
Row %	34.9	33.3	31.8	
Column %	9.4	8.5	8.2	
2-7 Days				
n	83	77	83	243
%	11.5	10.6	11.5	33.5
Row %	34.2	31.7	34.2	
Column %	35.5	31.3	33.9	
8-14 Days				
n	45	69	83	197
%	6.2	9.5	11.5	27.2
Row %	22.8	35	42.1	
Column %	19.2	28.1	33.9	
15-30 Days				
n	63	74	56	193
%	8.7	10.2	7.7	26.6
Row %	32.6	38.3	29	
Column %	26.9	30.1	22.9	
≥30 Days				
n	21	5	3	29
%	2.9	0.7	0.4	4
Row %	72.4	17.2	10.3	
Column %	9	2	1.2	
TOTAL	234	246	245	725
Column %	32.3	33.9	33.8	100

Chi-square test for independent variables df = 8, chi-square =34.4, P<0.0001

Mantel-Haenszel chi-square test for trend df = 1, chi-square =2.7, P <0.0001

Table 3.11 Comparison of time intervals in days in patients who were referred and not referred by study year

	Referred			Not Referred		
	2002	2004	2006	2002	2004	2006
Fracture occurrence – Presentation						
N	121	181	185	113	65	60
Mean	11.9	9	9.2	13.2	8.2	11.3
Std Dev	13.3	10.8	11.1	16.7	11.1	13.6
Median	7	5	6	8	4	7
Mode	3	1	1	1	1	1
Fracture occurrence – Treatment						
N	121	181	185	113	65	60
Mean	23.9	20.2	18	24	13.9	21.2
Std Dev	21.4	12.4	14.3	23.4	12.9	20.9
Median	19	19	16	20	11	17
Mode	18	19	12	24	1	5
Referral - Presentation						
N	71	116	146			
Mean	6.8	4	3.9			
Std Dev	12.5	5.7	7.3			
Median	2	1	1			
Mode	0	0	0			
Referral – Treatment						
N	72	116	146			
Mean	18.5	14.4	12.9			
Std Dev	24	9.8	13.6			
Median	13	14	10			
Mode	0	1	1			
Presentation - Treatment						
N	121	181	185	113	65	60
Mean	11.3	11.2	9.2	11.5	7.4	10.3
Std Dev	16	9	9.6	13.6	7.1	15.1
Median	8	10	8	7	5	7.5
Mode	1	1	1	1	1	1
Treatment - Discharge						
N	121	181	185	113	65	60
Mean	1.8	1.1	1	1.7	1.2	0.9
Std Dev	1.8	1.5	1.1	3.7	1.9	0.8
Median	1	1	1	1	1	1
Mode	1	1	1	1	1	1
Presentation – Discharge						
N	121	181	185	113	65	60
Mean	14.4	12.1	10.5	12.9	8.4	10.7
Std Dev	18.8	8.8	11.3	13.7	6.9	15.1
Median	9	11	9	9	7	8
Mode	2	16	2	2	1	8

Table 3.11 shows the effect that referral has on the seven time intervals. Patients who were referred presented sooner to the MFOS Division after fracture occurrence, except for 2004. Patients who were referred were also generally treated sooner than those who weren't referred, except for 2004. Referral did not have a positive influence on the presentation to treatment time interval. Patients who weren't referred were treated slightly sooner than those who were referred.

Table 3.12 Frequency distribution of alcohol involvement at fracture occurrence
(N=158)

	N %	%	Cumulative Frequency	Cumulative %
Alcohol involved in fracture occurrence				
None	73	46.2	73	46.2
Yes	85	53.8	158	100

Table 3.12 shows that alcohol was implicated in more than half of the fracture cases that present to the MFOS Division. It must also be taken into consideration that alcohol use is only recorded for the patient in patient files. There is no record if the other parties involved used alcohol. (i.e. the assailant or driver of vehicle)

Table 3.13 Summarizes the Chi-Square results within each of the seven time intervals for six independent variables. The year was statistically significant in all groups, except the referral to presentation group. Whether the patient was referred or not was statistically significant in the fracture occurrence to treatment group. Race was only statistically significant in the treatment to discharge group. Whether the patient was referred was statistically significant in the fracture occurrence to treatment group. There was a statistically significance of race in the treatment to discharge group.

Table 3.13 Summary table of chi-square results for the seven dependent variables (time intervals) by six independent variables. (df = degrees of freedom,*= Statistically significant).

Variables Compared	df	X^2	P
Fracture Occurrence – Presentation Group			
Race	8	10.07	0.2599
Gender	4	6.33	0.1759
Decade	12	12.96	0.3721
Year	8	18.65	0.0169*
Injury Mechanism	8	8.08	0.4260
Referred	4	5.15	0.2727
Fracture Occurrence – Treatment Group			
Race	8	12.48	0.1310
Gender	4	8.63	0.0711
Decade	12	12.85	0.3797
Year	8	17.19	0.0282*
Injury Mechanism	8	5.92	0.6564
Referred	4	12.78	0.0124*
Referral – Presentation Group			
Race	8	5.97	0.6502
Gender	4	4.25	0.3733
Decade	12	17.05	0.1476
Year	8	13.35	0.1005
Injury Mechanism	8	7.44	0.4897
Referral – Treatment Group			
Race	8	7.78	0.4554
Gender	4	2.26	0.6880
Decade	12	14.08	0.2957
Year	8	32.46	<.0001*
Injury Mechanism	8	5.06	0.7507
Referred	4	4.89	0.2986
Presentation – Treatment Group			
Race	8	12	0.1514
Gender	4	6.74	0.1504
Decade	12	13.38	0.3417
Year	8	27.36	0.0006*
Injury Mechanism	8	10.5	0.2318
Referred	4	5.77	0.2167
Treatment – Discharge Group			
Race	8	17.45	0.0257*
Gender	4	2.38	0.6663
Decade	12	20.44	0.592
Year	8	16.39	0.0371*
Injury Mechanism	8	14.28	0.0749
Referred	4	4.45	0.3481
Presentation – Discharge Group			
Race	8	5.41	0.7126
Gender	4	3.16	0.5314
Decade	12	10.31	0.5885
Year	8	34.4	<.0001*
Injury Mechanism	8	12.58	0.1271
Referred	4	7.56	0.1091

CHAPTER 4: DISCUSSION

The present study is unique and the first of its type in MFOS – there are no published investigations for comparison.

4.1 Comments on results

From the results one can see that the main problem is that facial fractures are being treated a mean of 20 days after occurrence. Patients presented to the MFOS Division a mean of 10 days after the occurrence, but were treated a mean of 10 days after presentation.

The time interval, of the seven studied, that is of most interest is that of the time of fracture occurrence to when the fracture is treated. The other time intervals all impact this one in one way or another. The MFOS Division is responsible for the time interval from presentation to treatment. The patient or referring hospital are responsible for the time interval from fracture occurrence to presentation, (i.e. an extended fracture occurrence to presentation time interval is independent of the MFOS Division). The breaking down of the process which the patient goes through when sustaining a facial fracture and seeks treatment at the MFOS Division into the time intervals is an attempt to identify the various stages that the patient goes through and identify where potential "bottle-necks" in assessing and treatment may occur. There are other factors, such as patients missing appointment dates which are out of the MFOS Division's control, which would reflect poorly on the presentation to treatment interval.

The mean for all years combined for the time interval of fracture occurrence to treatment was 20.4 days. This was surprisingly close to the 3 week estimate of the MFOS Division staff. From the results, one can see that the time interval from fracture occurrence to treatment is evenly influenced by patient and hospital factors:

- Fracture occurrence to presentation at MFOS Division = 10.3 days
- Presentation to treatment = 10.3 days

Why are patients presenting to the MFOS Division 10 days after the fracture has occurred? This seems like a long time to wait before seeking treatment for an injury.

Possibilities are listed below:

- Alcohol is involved in 53.8% of fractures that present to the MFOS division. People may be too hung over to realise the seriousness of their situation, and seek treatment for a fracture.
- People may expect the injury to heal by itself. Only when the injury "doesn't go away" do they seek treatment.
- People may seek treatment from traditional healers before seeking orthodox medical care.
- In cases of pan-facial fractures, where a large force to the body is required (i.e. a serious motor vehicle accident or severe beating) there are often associated injuries which require more urgent treatment. (The more life threatening injuries are addressed first – pneumothorax, head injuries, spinal injuries.) This doesn't occur often.
- People seek treatment at primary healthcare clinics that in turn refer them to Tertiary / Quaternary Hospitals. Referral does seem to make a difference to the time it takes for a patient to present to the MFOS division. (The fracture occurrence to presentation time interval is on average 2 days shorter for patients who have been referred) See Table 3.11. Once referred by an outlying hospital, the majority of patients present to the MFOS division within a day. There has been a steady increase in the number of patients referred over the three years.
- Transport, finances to pay for transport, finances for treatment, ability to take time away from work or home may all be factors in patients delaying seeking treatment.

Public health care providers face unique challenges in South Africa. The high income population is used to a high standard of healthcare provided by the private sector. The private sector is largely funded by the medical aids and personal funds. The vast majority of South Africans fall into the low income population group. These people do not earn enough money to contribute towards a medical aid and are thus compelled to use government facilities. Most doctors prefer to work in the private sector as there is higher

earning potential and they report greater job satisfaction. (They can work for themselves and do the type of work that they enjoy with more modern equipment) Most of the doctors who do work in the public sector are there because they are furthering their training by specialising. (They are Registrars) There is a great imbalance – the small group of doctors who work in the public sector service the majority of the population. This results in a huge work load falling on the shoulders of a few doctors. In the MFOS division there is a shortage of doctors (medical officers and registrars) available to do the work. Another bottleneck occurs when patients require general anaesthesia for ORIF of a fracture. Shortages of anaesthetists, theatre sisters, anaesthetic drugs, theatres are a daily problem at the CMJAH.

Referral appears to make a noteworthy difference to the time it takes for patients to present to the MFOS Division as well as the time to treatment. Both time intervals; referral to presentation and referral to treatment show reducing number of days over the 3 years. It could also be that as referral procedures become more streamlined over the years resulting in a more efficient referral system. The time of treatment to discharge is consistently low over the 3 years and reduces to 1 day in 2006. This indicates that there is a high patient turnover in the MFOS division. Patients are not unnecessarily kept in the ward for days or weeks post-operative. It also shows that the treatment "bottle-neck" is not a result of lack of ward space.

- Even though referral systems have improved and continue to improve, efficient referral of patients to tertiary /quaternary hospitals improves time from injury to treatment.

4.2 Conclusion

The problem that the MFOS division is faced with is multifaceted, and in no way would I presume to solve this problem with a few suggestions. This study has defined a problem that is present in the MFOS division. I have attempted to isolate problem areas by examining multiple patient files. It would be useful to implement various interventions and repeat this study to assess the success of the interventions. The MFOS division is understaffed for the amount of patients it treats. There are usually 4 doctors working in the division. This is inadequate for the volume of patients seeking treatment. The time

period of presentation to discharge is important because it represents the total time that the patient is in the care of the MFOS Division; from the first assessment to discharge after the treatment has been done. The majority of patients present to the department receive the appropriate treatment for the fracture and are discharged between 2-7 days. Although less, a large portion of the patients are in the MFOS Divisions' care from 8-14 days and 15-30 days.

Once the appropriate treatment has been done, the large majority of patients are discharged within 24 hours.

Possible patient solutions to reducing the time from fracture occurrence to presentation:

- Awareness of the importance of health needs to be created amongst all population groups. Forms of advertising including radio and television commercials and poster campaigns may be used to educate people.
- Access to primary healthcare clinics has improved dramatically since 1994. But these clinics still see more patients than they are capable of. The primary healthcare clinic is the first line of treatment for most people, and their importance mustn't be minimized in the effective management of patients. The creation of more primary healthcare clinics as well as developing some sort of treatment strategy for facial fractures amongst the dentists who work at these clinics. For example, dentists can be taught to apply intermaxillary fixation to a patient with a fractured mandible before referral to a tertiary /quaternary hospitals.