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A STUDY OF MAXILLOFACIAL
FRACTURES IN AN INNER CITY AREA

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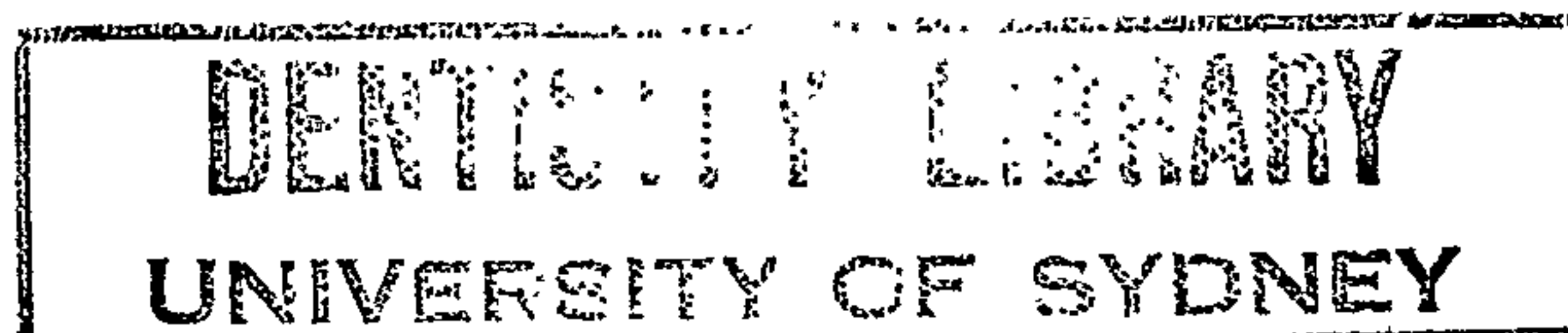
Department of Oral Surgery

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ABSTRACT

A study of 222 consecutive cases of maxillofacial fracture treated at two inner city hospitals over a four year period is reported. Analysis of the data collected revealed a high incidence of males (87.4%), alcohol abusers (42%), smokers (67%) and unemployed (34%). Assault was the aetiological factor in 68.5% of cases with alcohol consumption being implicated in 60%. Injuries were found to occur most frequently on Saturdays. Fractured mandibles were the most common injury (61%) with zygomatic fractures (27%) being the next most frequent. Miniplate osteosynthesis was the most common method of treatment of the mandibular fractures (58%). Various aspects of the management of the patients utilising miniplate osteosynthesis were discussed with the complication rate using this form of treatment being 9%. This compared favourably to similar studies of miniplate osteosynthesis. The complication rate in the remainder of the study population was 8%. The efficacy and advantages of miniplate osteosynthesis as a method of treatment of mandibular fractures is discussed, with particular reference to the specific features associated with the patient population in an inner city area.

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INTRODUCTION

Maxillofacial fractures are responsible for a significant number of hospital casualty attendances and it has been reported that the incidence of these types of injuries is increasing^{2,3,12,40}. Facial fractures are frequently the result of some form of interpersonal violence and Shepherd et al²⁸ reported that in victims of assault, there was an 89% incidence of facial fractures. This is of significance particularly as it has been reported that violent crime in general is increasing^{4,30,33}. Thus these injuries, which can be serious in nature, are of concern not only to the surgeons and patients involved but to society in general as they continue to become more common.

Studies of maxillofacial fractures have been widely reported in the literature with most originating from the U.K., U.S.A. and Europe. In comparison, there has been relatively little data available from Australia. Apart from the current study, only two studies have been published in the last decade^{3,8}. Studies of this nature not only provide interesting comparisons but indicate the considerable influence social, cultural and environmental factors have on the incidence and patterns of facial injuries. Information regarding the aetiology of maxillofacial trauma has proven useful in giving an indication of the severity of injuries to be expected and assists in the planning of health services and preventive programmes. Data concerning the type and severity of facial fractures also assists in assessing the level of service and specialist training required to deal with these injuries.

The treatment of maxillofacial fractures can be facilitated and influenced by our knowledge of patients' socio-economic backgrounds, the presence of drug or alcohol abuse and the circumstances of the injury. This information may also help to identify particular groups in society at greater risk of sustaining these injuries. Alcoholic patients have been reported as being four times as likely to present with facial fractures than non-alcoholics⁶ and it is these patients that are frequently associated with high incidences of complications^{6,31}. Heimdahl et al¹⁵ stated that ".....the problem of clinical treatment of these patients is therefore not only surgical but very much social."

Treatment modalities must therefore be assessed not only on the basis of their effectiveness but on their suitability for the particular groups of patients being treated. For instance, treatments for jaw fractures that rely on the utilisation of intermaxillary fixation are contraindicated for drug and alcohol abusers²² due to the risk of airway embarrassment and the poor compliance of these patients.

Therefore a study was carried out to investigate the cases of maxillofacial fractures that were treated by the Department of Oral Surgery, University of Sydney at both Sydney Hospital and the United Dental Hospital. The aims of this study were as follows:-

7.

1. To collate demographic and socio-economic details of the patients presenting with maxillofacial fractures to Sydney Hospital and the United Dental Hospital. Particular note was to be taken of alcohol consumption and the presence of alcohol or drug abuse. This information would help to identify common features amongst patients suffering these injuries and to investigate the possible influence of alcohol.
2. To identify the predominant aetiological factors involved in these injuries.
3. To record the methods of treatment used and the incidence of complications.
4. To evaluate miniplate osteosynthesis as a method of treatment of mandibular fractures with special reference to the appropriateness of this treatment for the particular patient group under investigation.
5. Compare the findings of this study with those of comparable investigations with regards to demographics and treatment outcomes.

MATERIALS AND METHOD

All patients who presented to either Sydney Hospital or the United Dental Hospital with maxillofacial fractures during the four year period of July 1987 to June 1991 were included in this study. These hospitals are both located in the inner city area of Sydney (3.5 million population). Patients suffering nasal fractures alone were excluded from the study as these patients are frequently managed by other medical specialties. The patients in this study were all managed by members of staff of the Department of Oral Surgery, University of Sydney, based at the United Dental Hospital. Treatment was carried out at both hospitals, although all the post-operative reviews were conducted at the United Dental Hospital. Data was collated from the patient records, radiographs, personal interview and clinical examination whenever possible. Thus, this study was for the most part retrospective in nature and as a result, complete sets of data were unobtainable for some patients. This has been taken into consideration in the results.

A variety of different methods of treatment were utilised according to the site of the fracture and the individual case requirements. These ranged from conservative management to full hospital admission with fracture reduction and fixation under

general anaesthesia. The majority of mandibular fractures were treated utilising miniplate osteosynthesis, with the first 83 cases of mandibular fractures, forming part of this study group, being treated by the department using this technique. Additional data specifically relating to this treatment method was recorded for these patients.

The operative techniques employed for the miniplate osteosynthesis followed that described by Champy et al⁹ with some minor modifications. All except four patients were treated under general anaesthesia. An intra-oral approach was used in 90% of the cases with the occasional need to place screws transbucally. Intermaxillary fixation in the form of eyelet wires or archbars, was usually applied intra-operatively, in order to stabilise the fragments with the teeth in the correct occlusion whilst the plates were adapted and screwed into position. Two plates were used for fractures anterior to the mental foramen and one plate used for fractures at other sites, except for condylar fractures which were managed conservatively. A modification utilising only one plate and a loop wire was occasionally used for fractures in close proximity to the the mental foramen in order to avoid trauma to the nerve. Stainless steel plates (Champy plates, Gebruder Martin Co.) were used in all but seven cases where titanium plates were preferred. The operator ranged from specialists to trainees with varying levels of experience.

The data recorded for each patient is summarised below and the sample data collection forms are included in the appendix.

General Data

hospital numbers

gender

date of birth

residence (or vagrancy)

occupation

welfare recipients

medical problems of significance

average alcohol consumption

nicotine use

I.V. drug use

date of injury

date presented with injury

aetiology

alcohol consumption immediately prior to injury

position of fractures

number of fractures

associated injuries

treatment method used

hospital admission

Data relating to the method of treatment

inpatient time

time from injury to 'operation'

anaesthesia used (GA or LA)

operator level

operation performed

length of operation

Intermaxillary fixation used

review appointments and failure to attend clinic

complications

Data relating to miniplate osteosynthesis

number and types of plates used

plate material

position of plates

method of placement

additional modalities

complications

plate removal

RESULTS

The period of time covered by this study is four years from July 1987 until June 1991. A total of 222 consecutive cases of facial fractures were included, of which 194 (87.4%) are male. The peak incidence was in the 20-30 year age group (fig.1) with ages ranging from 11 to 88 years. Based on the classification used by the Royal College of Psychiatrists²⁵, 42% of patients were classed as alcohol abusers with 17% considered as suffering from alcoholism. Twenty three of the alcoholic patients were also vagrant. The majority of the patients (67%) were tobacco smokers, however, only 14 patients (6%) were intravenous drug users. Thirty four percent of the patients were unemployed with a preponderance of non-professionals amongst the 46% who were employed. The remainder consisted of 8% students, 6% aged pensioners, 5% on sickness benefits and in 1% of cases the employment status was not recorded. Table 1 gives a comparison of some of the social characteristics of the study group compared to the general Australian population^{10,16}. Only the statistics for the males in the general population were used in order to make the groups more comparable.

Thirty three percent of the patients had medical conditions of significance including - respiratory disease, cardiovascular disease, epilepsy, kidney disease, diabetes and psychoses. Medical conditions related to alcoholism included - cirrhosis of the liver,

Figure 1
Age Distribution

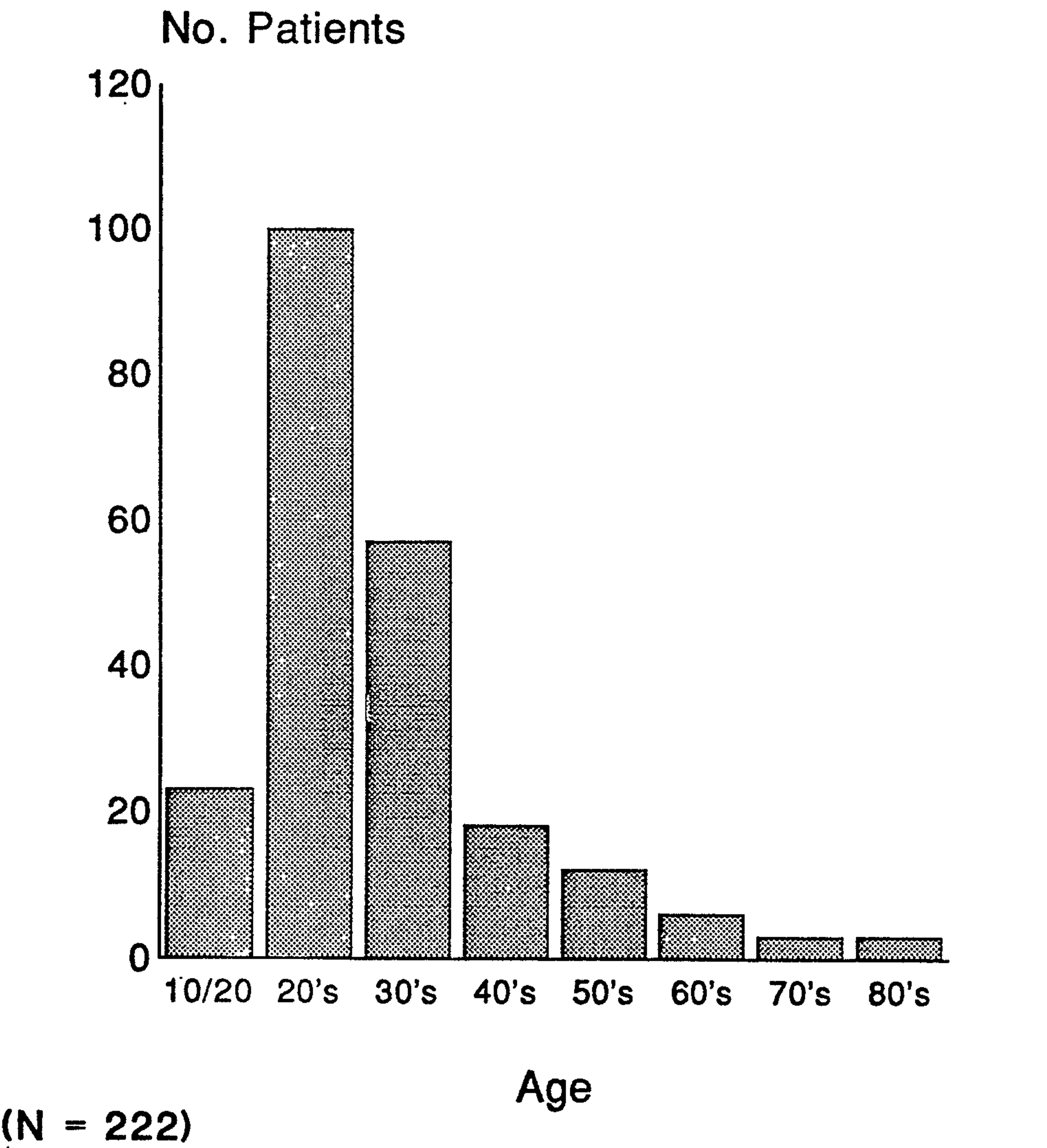


Table 1
Social Characteristics

	Study Group (87% male)	Adult Males (N.S.W.)*
Alcohol abusers	42%	3.6%
Tobacco smokers	67%	33%
I.V. drug users	6%	2%
Unemployed	34%	8.7%

(N = 222)

*** New South Wales**

alcohol related seizures and gastric ulcers. Four patients were classified as being infectious with one patient HIV positive, two patients Hepatitis B carriers and one a Hepatitis C carrier.

The aetiological factor of greatest significance was assault, being responsible for 68.5% of the injuries. The remainder were due to - falls, motor vehicle accidents, sports, industrial accidents, epileptic fits, exodontia and spontaneous fracture (table 2). Alcohol also appeared to be of significance with 60% of patients admitting to consuming alcohol immediately prior to being injured. Saturday was the most common day for injuries to occur (fig. 2), with the most common months being December, March and July (fig. 3) coinciding with the peak holiday periods of Christmas, Easter and the winter break.

Fractured mandibles (61%) were the most common injury occurring more than twice as frequently as middle third fractures (table 3). Zygomas (27%) were the next most frequent fracture with the remainder being combinations of fractures and other middle third fractures. There were five associated nasal fractures. Approximately 10% of patients sustained other injuries of significance including - fractured hips, hands, ribs, skull, legs, concussion, pneumothorax and lung contusions.

Table 2

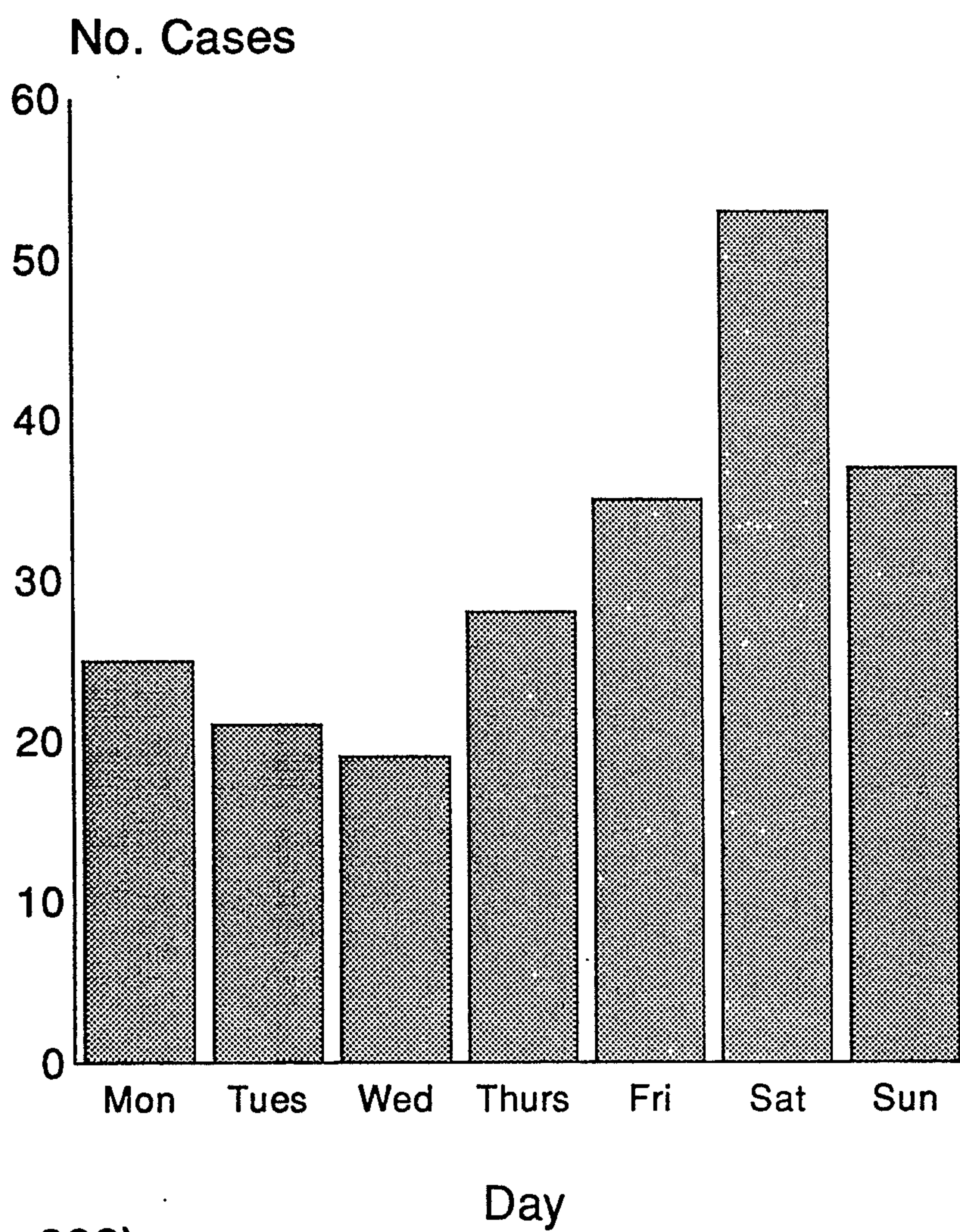
Aetiology

Aetiology	No. Patients	(%)
Assault	152	(68.5)
Fall	23	(10.5)
Sports	17	(8)
M.V.A.*	16	(7)
Industrial	9	(4)
Epileptic Fit	3	(1)
Spontaneous	1	(0.5)
Iatrogenic	1	(0.5)
	222	

* Motor Vehicle Accident

Figure 2

Day of the Week



(N = 222)

Figure 3

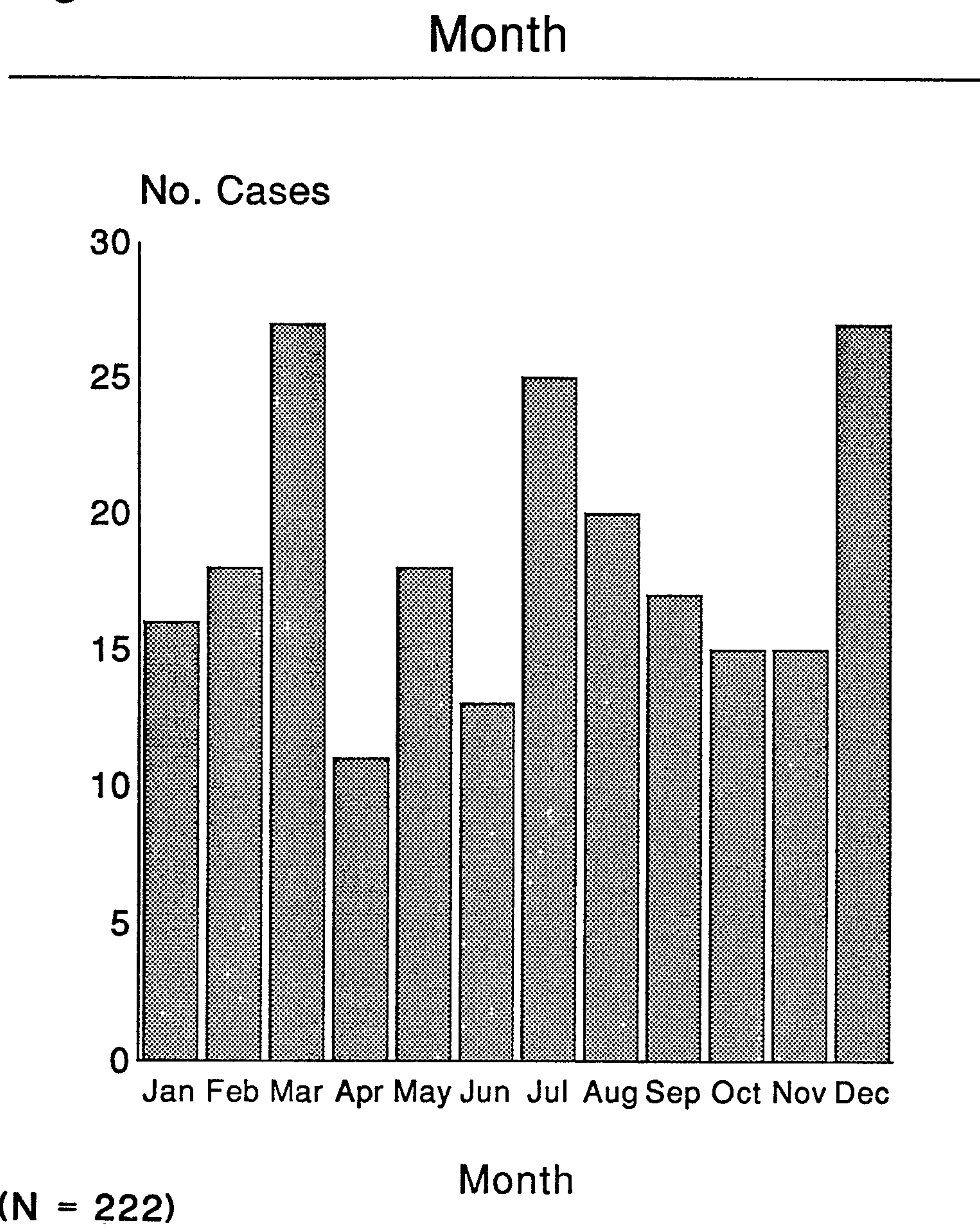


Table 3

Fracture Cases

Mandible	136	61%
Middle Third	74	33.5%
(Zygoma	59)	
(Maxilla	6)	
(Orbital Floor	5)	
(Alveolar	3)	
(Ethmoid	1)	
Multiple Facial Fractures	12	5.5%
(Mandible / Middle Third	8)	
(Multiple Middle Third	4)	

222

There was a total of 144 fractured mandibles with 95% having only one or two fracture sites, with three or more sites being generally an infrequent finding. The angle was the most common site for fractures to occur, followed by the body and the condyle. There was a slight predominance of fractures occurring on the left side (57%) (fig 4.).

Miniplate osteosynthesis was the most commonly utilised method of treatment for mandibular fractures (58%), followed by wiring techniques and conservative management (table 4). Out of the total of 63 zygomatic fractures nearly half could be managed conservatively, with 33% requiring surgical reduction only and a further 14% requiring the use of wire or miniplate fixation following reduction (table 5).

Mandibular fractures treated with miniplate osteosynthesis

There were a total of 83 cases of mandibular fractures treated using miniplate osteosynthesis. Forty of these were single fractures, 38 were bilateral and the remaining five cases had three or more fracture sites. Sixty five percent of cases were plated within four days of the injury, and a small proportion were treated after a considerable delay (fig. 5). This was due to either the late presentation of the patient, a delay necessitated by the urgent treatment of the patient's other injuries or to the

Figure 4

Distribution of the 217 Fractures

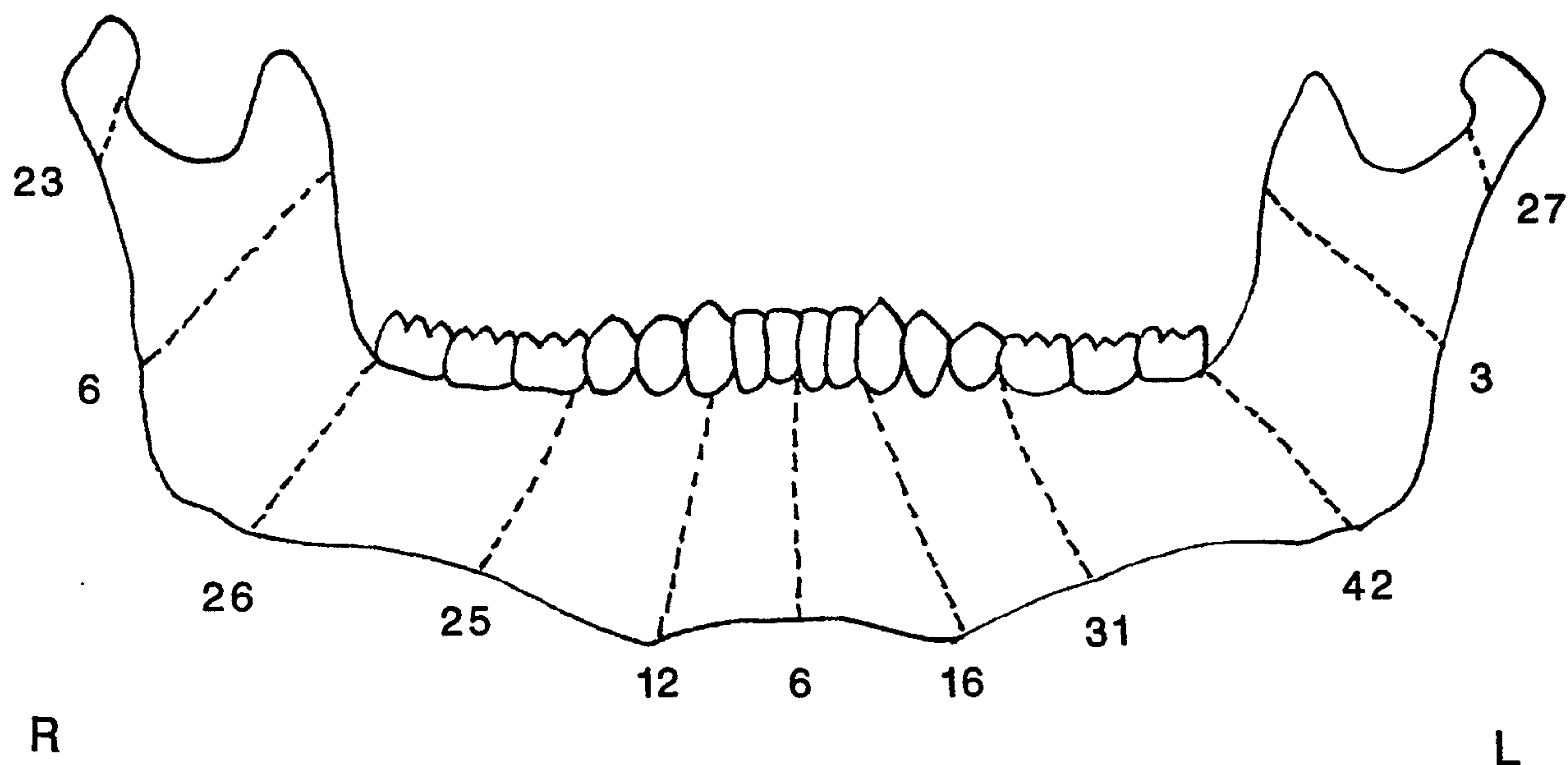


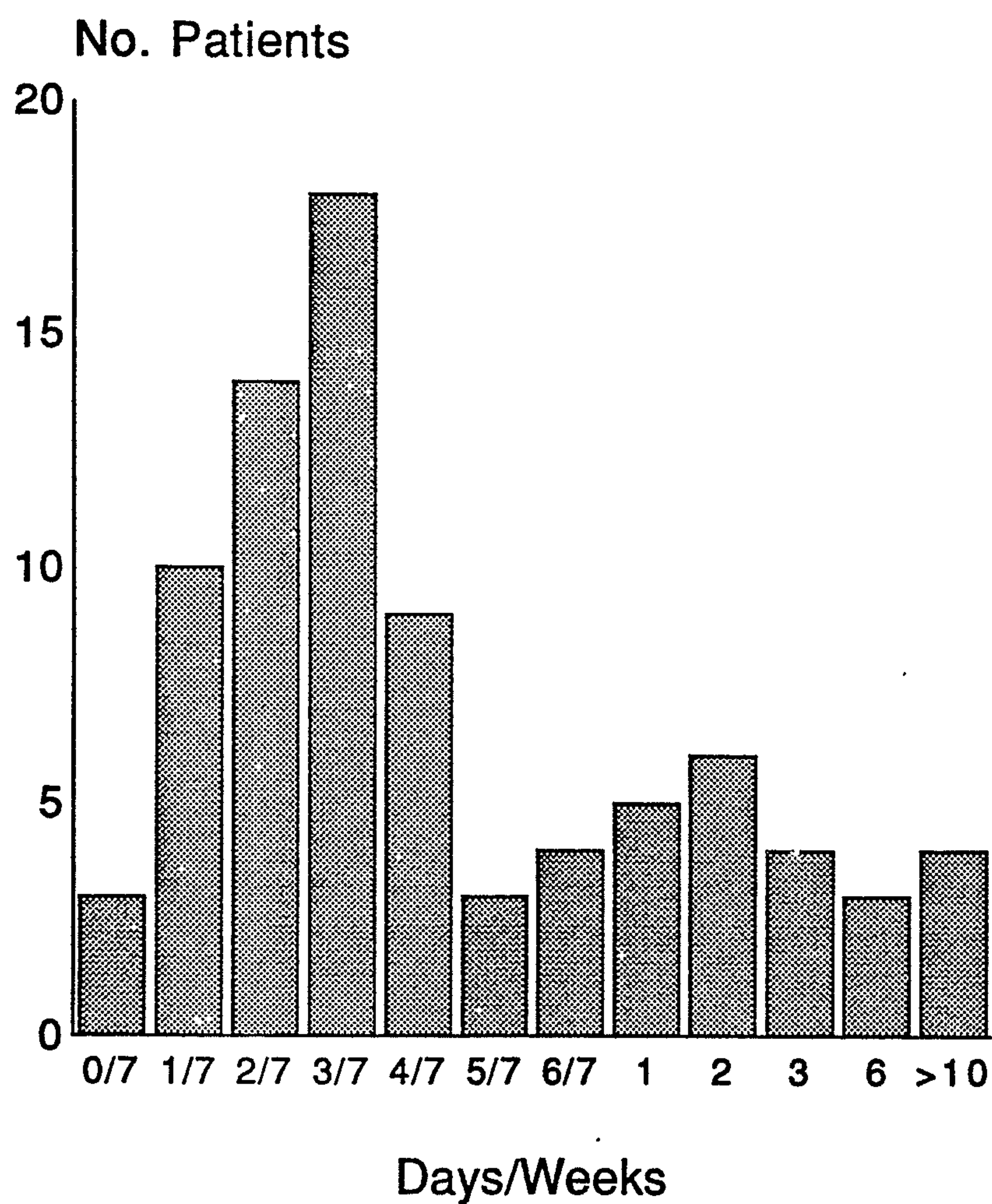
Table 4
Treatment Methods used for the
Mandibular Fracture Cases

Plating	83	(58%)
Eyelet Wiring	28	(20%)
Arch Bars	1	
Conservative	25	(17%)
Orthodontic Brackets	4	(3%)
Gunnings Splint	1	
Cap-Splint	1	(2%)
Refused Treatment	1	
	144	

Table 5
Treatment Methods used for the
Zygomatic Fracture Cases

Conservative	30
Reduction only	21
Reduction + plating	6
Reduction + wiring	5
Refused Treatment	1
	63

Figure 5
Time from Injury to Operation



(N = 83)

fracture failing to respond to other methods of management. Ninety five percent of the plating procedures were carried out under general anaesthesia, with two cases treated using a combination of intravenous sedation and local anaesthesia and two cases treated using local anaesthesia alone.

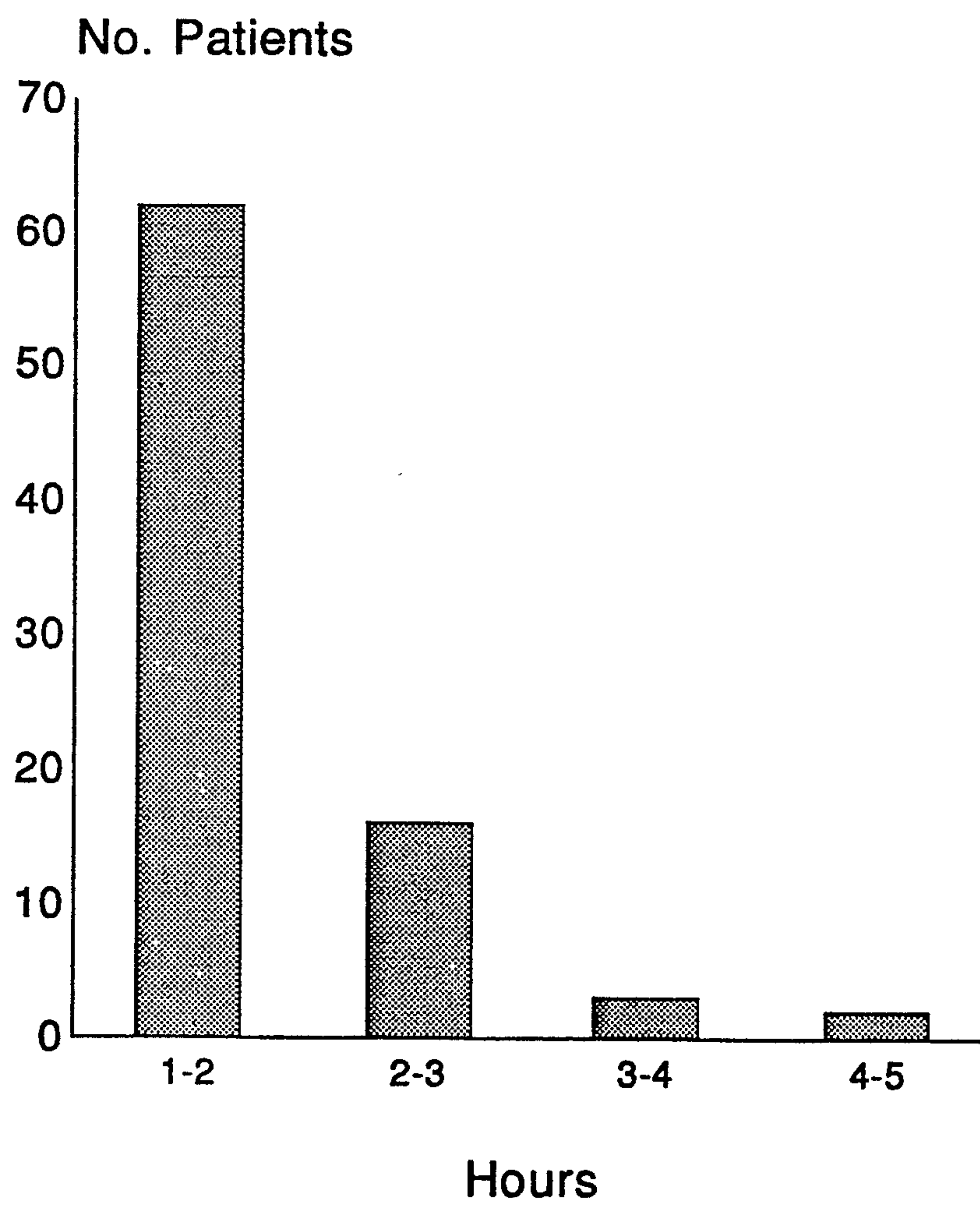
A total of 143 plates were placed in the distribution demonstrated in table 6. The majority of plates used were stainless steel which are less expensive than titanium plates of which seven were used. Another cost factor considered was the amount of theatre time required for the operations, which ranged from one to five hours with 75% of cases completed in two hours or less (fig. 6). Consultant specialists were the surgeons in 65% of cases with registrars the surgeons in the remaining 35%. The plates were placed via an intraoral approach in 85% of cases. An extraoral approach was utilised in 10% of cases and screws were placed transbuccally in 5% of cases.

Intermaxillary fixation in the form of eyelet wiring or archbars with elastic traction was required post-operatively in nine cases (12%). This was usually necessitated by the presence of a displaced condylar or maxillary fracture. The periods of hospitalisation ranged from 1 to 55 days, with two patients managed on an outpatient basis (fig. 7). Seventy two percent of patients were discharged within five days with the lengthy periods of hospitalisation and operative times being associated with the cases of multiple injuries.

Table 6
Position of Plates

Angle	45
Body	37
Parasymphysis	53
Symphysis	8
	143

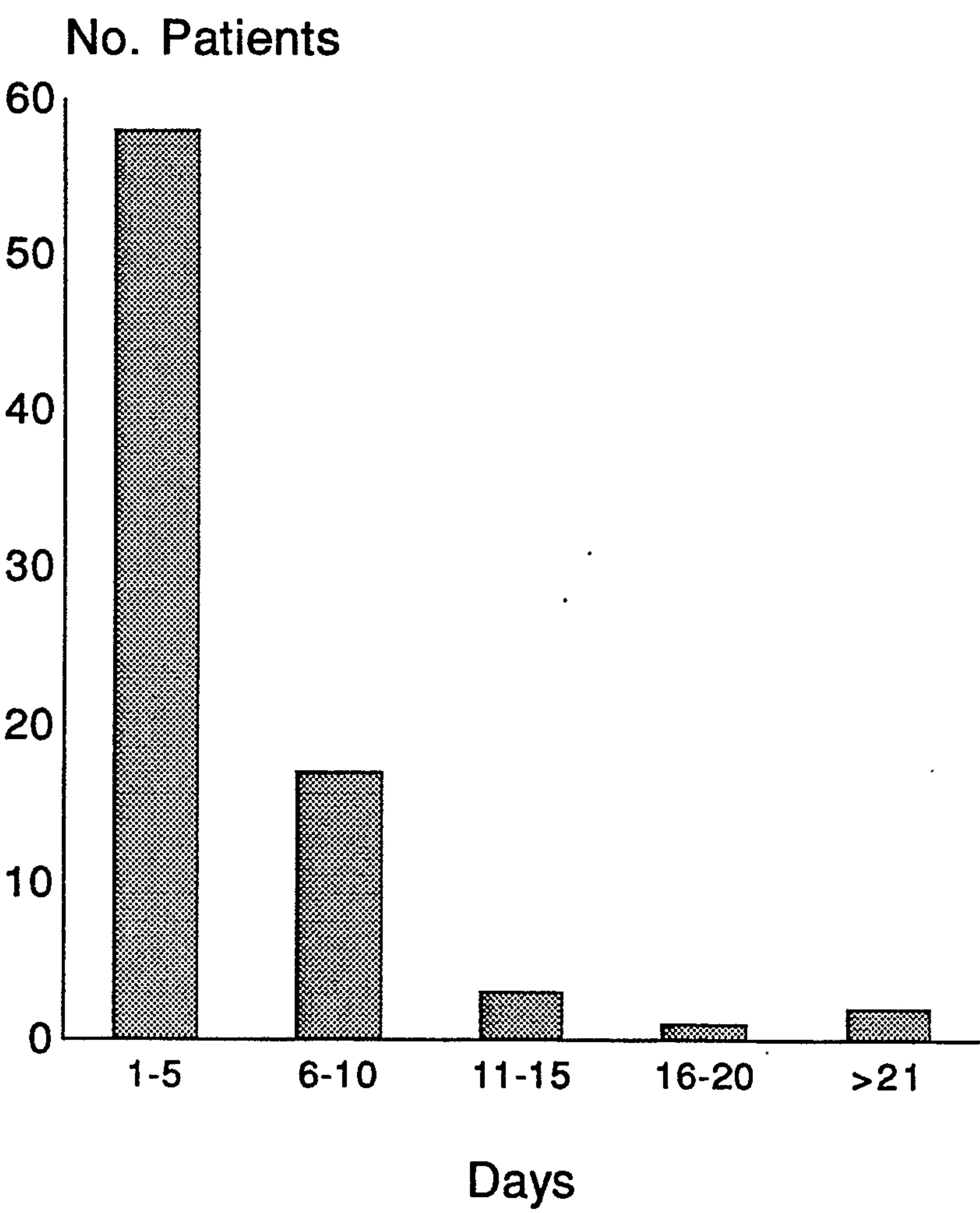
Figure 6
Operating Time (Hours)



(N = 83)

Figure 7

Inpatient Time



(N= 83)

Patients were examined on a regular basis for up to 12 months, except for five patients who failed to attend review appointments and could not be contacted. The incidence of complications in the remaining patients is illustrated in table 7, with 9% having persistent complications. A considerable number of transient complications were in evidence in the early post-operative review period of less than one month. Hypoaesthesia of the inferior alveolar nerve was primarily a result of the initial trauma plus manipulation of the nerve during the plating procedure. Only three cases failed to resolve (4%). Similarly, the majority of the early occlusal discrepancies resolved spontaneously with a few requiring minor occlusal adjustment. Only two patients (2.5%) had residual occlusal complications, one with an anterior open bite and one with a residual step defect.

There was only one case of fibrous union in a medically compromised elderly patient. Weakness of the mandibular branch of the facial nerve occurred in three out of the eight patients where an extraoral approach had been used to place the plates. In one case this has failed to completely resolve although it is unsure whether this was due to the plating procedure or the facial lacerations sustained in the motor vehicle accident responsible. Two dental complications resulted, both involving the tooth in the fracture line.

Table 7
Complications of Mandibular Fractures
Treated with Miniplates

	1 Month	~6 Months
Malocclusion	13	2
Dysaesthesia	33	3
Delayed union	-	1
Infection	nil	nil
Wound dehiscence	2	nil
Facial N. weakness	3	1
Periodontal defect	-	1
Resorption of tooth in fracture line	-	1

Total complications = 7 patients (9%)

* 5 patients unable to be reviewed
(N = 78)

Comparison of complication rates

The incidence of complications found in this study is compared to that of similar studies on miniplate osteosynthesis in table 8. These results are also comparable to that achieved with traditional methods of mandibular fractures treatment utilising intermaxillary fixation³⁸. The incidence of complications in the remainder of the study population was also very similar being 7%. Details of these complications are illustrated in table 9. There were 18 patients who failed to attend review appointments and out of the 121 patients examined, nine had some form of post-operative complication.

Table 8

**Comparison of Complication Rates
of Other Studies**

Complication	Cawood (1985)	Champy (1978)	Ikemura (1988)	Wald (1988)	Sydney
Malocclusion	8	4.8	3	1.9	2.6
Infection	6	3.8	3	7.4	nil
Dehiscence	12	-	7.6	-	2.6
Delayed union	-	0.5	-	-	1.3
Sensory disturbance	8	-	-	3.7	3.8
	(N=50)	(N=100)	(N=66)	(N=61)	(N=78)

(Figures expressed as percentages)

Table 9
Complications in Remaining Mandibular
and Middle Third Fractures

	<u>~6 Months</u>
Facial Deformity	2
TMJ Pain	2
Dysaesthesia	1
Malocclusion	2
Dental Complications	2

Total complications = 9 patients (7%)
 * 18 patients unable to be reviewed
 (N = 121)

DISCUSSION

During the last ten years there have been a number of papers published on the patterns of facial trauma in different countries^{1,2,4,11,12,15,17,23,33,34,35,40}. Many of the trends reported in these studies have also been apparent in the current study. Males in the 20-30 year age group have uniformly been found to be at most risk of sustaining maxillofacial fractures. The main causes of these fractures in all countries are motor vehicle accidents and assaults, with the remainder being due to falls, industrial accidents, sporting injuries and miscellaneous other causes.

The Aetiology of Maxillofacial Fractures

Aetiological factors are interesting in that they are a reflection of the social and cultural factors in the local environment. For example, in developed countries there has been a reduction in the number of facial fractures due to motor vehicle accidents, attributed to government legislation enforcing the wearing of seatbelts and restricting the consumption of alcohol when driving. In less developed countries this trend seems to be reversed as facial fractures resulting from motor vehicle accidents are increasing. Adekeye¹ suggests that this is due to the increasing urbanisation, poor roads and little government legislation. In the current study 68.5% of the fractures were due to assault, which is one of the highest incidences so far reported. This is a reflection of the inner city location of the hospitals concerned, an area where there

is a concentration of licensed premises and entertainment venues and there is limited opportunity for high speed motor vehicle accidents. It may also be a symptom of the general increase in interpersonal violence in society. Telfer et al³³ reported a 70% increase in the incidence of violent crime in Britain in the ten years from 1977 to 1987. Allan et al³ carried out a study of mandibular fractures occurring in the Newcastle region of NSW, Australia. During the period from 1966-70 to 1981-85 a vast increase (356%) in the number of assault related fractures was reported. Voss³⁵, in a Norwegian study, reported that in 1970, 39% of the facial fractures seen were due to assault. By 1980 this had increased to 54%.

The aetiology of an injury also effects the patterns of fractures produced. Assaults tend to result in relatively simple fractures whereas motor vehicle accidents tend to result in multiple injuries and fractures with a higher incidence of comminution²³. This has been demonstrated in the current study where there was only a 5.5% incidence of extensive facial fractures with few cases of comminution and only 10% of cases with associated bodily injuries. In the case of mandibular fractures assault tends to produce greater numbers of angle and body fractures compared to motor vehicle accidents where more condylar and symphyseal fractures result^{2,11,23}. This has also been demonstrated in the current study where the majority of mandibular fractures (61%) were either in the angle or body regions.

The Influence of Social Factors on Maxillofacial Fractures

The numbers of patients in the current study who were alcohol abusers (42%) and those consuming alcohol prior to being injured (60%) were also markedly high. This may provide further evidence of a strong link between alcohol consumption and interpersonal violence^{17,20,28,29}. Seventeen percent of the patients in the current study were classed as alcoholics, which have been recognised as a particularly difficult group of patients to treat⁶. This is due to not only the presence of associated medical problems but to their poor compliance and anti-social attitudes⁶. Alcoholics have also been shown to have an increased incidence of post-operative infections and delayed healing following facial fractures^{6,31}. Although in this study, the alcoholic patients did not seem to contribute significantly to the incidence of complications, they did account for nearly half the patients who failed to attend review appointments and could not be contacted. This could be associated with the fact that 23 of these patients were vagrant. The alcoholic patients were also reported as being difficult to manage on the ward and frequently failed to comply with post-operative antibiotic regimes.

Another interesting social characteristic of the study population is the high numbers of unemployed compared to that in the general population. This contributes to the evidence gathered by Wood³⁹ and by Shepherd et al²⁷ of the relationship between unemployment and interpersonal violence. Wood³⁹ observed that the increase in numbers of assaults coincided with the increasing unemployment rate in Merseyside, England. Shepherd et al²⁷ found a significant difference between the assault rate amongst unemployed males compared to the rest of the population in Bristol.

Unemployment is an important indicator of social deprivation but other factors such as overcrowding, boredom and frustration, lack of material wealth and increased amounts of "leisure" time may also contribute to the incidences of assault²⁹.

The significance of the high proportion of smokers in the study group compared to the general population¹⁶ is less apparent. It may be that smoking and high levels of alcohol consumption are part of the same patterns of social behaviour. Another aspect of this social behaviour is the fact that over half the injuries in the study occurred in the period from Friday night to Sunday, giving evidence to the weekend "binge" on alcohol which frequently leads to some form of altercation. These altercations often result in injuries due to a loss of judgement and co-ordination and therefore an inability to avoid the blows of an assailant²⁸.

The Treatment of Mandibular Fractures using Miniplate Osteosynthesis

The advantages of plating techniques for the treatment of mandibular fractures have been highlighted by a number of authors^{5,7,9,21,21,24,32,34}. Miniplate osteosynthesis allows a more precise anatomical reduction to be achieved by means of the direct visualisation of the fracture fragments. It provides a solid and stable fixation, greater than that achieved with intermaxillary fixation alone or by intraosseous wiring⁹. This is of particular advantage in difficult situations such as fractures of the angle distal to the last tooth and fractures of edentulous mandibles²² where the muscles of

mastication tend to distract the fracture fragments. For comminuted fractures longer plates can be used to span all the fragments and completely stabilise the fracture.

Miniplate osteosynthesis has greatly reduced the necessity for post-operative intermaxillary fixation as indicated by only 11% of the mandibular fracture cases in this study requiring this additional fixation. This was usually in the form of elastic traction and required for the management of concurrent displaced condylar fractures. Intermaxillary fixation is associated with a number of problems the most significant being the restricted access to the airway in the unconscious patient. It has therefore been considered unsuitable for use in certain groups of patients. These include - epileptics, alcohol and drug abusers, patients with chronic obstructive airway disease, those unable to attend for regular reviews and patients whose health would be adversely affected by the decreased nutrition associated with a liquid diet^{7,22,37}. When considering the current study population, 33% of patients would fall into these categories where intermaxillary fixation is contraindicated.

By avoiding intermaxillary fixation, plating techniques allow a rapid return to normal masticatory function and mouth opening resulting in less disturbance to body weight and less time lost from employment^{7,9,13,22,36}. In addition, early mobilisation has been recognised as a significant advantage when concurrent condylar fractures are

present^{18,22,36}. In the current study condylar fractures were present in 22% of the plated mandibular fracture cases. The post-operative course is more arduous with intermaxillary fixation due to the close monitoring of the patients that is required and the fact that wires frequently need adjustment²². Intermaxillary fixation has the additional disadvantages of being associated with an increased risk of periodontal disease and residual trismus^{13,26}.

Some authors have suggested that the use of metal plates for the treatment of mandibular fractures results in an increased incidence of post-operative complications including infection and malocclusion³⁸. However as plating techniques have been refined, all recent reports on miniplate osteosynthesis including the current study, have demonstrated low levels of complications (table 8). These are comparable to the complication rates associated with traditional methods of fracture fixation³⁸. In the current study there were no incidences of post-operative infection despite the delay in treating some of the fractures and the high numbers of susceptible patients such as alcoholics. This contributes to the evidence provided by Johansson et al¹⁹ who showed the effectiveness of miniplate osteosynthesis in treating mandibular fractures that were initially infected.

The necessity of hospital admission and the use of general anaesthesia have been cited as disadvantages of plating techniques. However, in a study of the common practices of U.K. Oral and Maxillofacial surgeons, it was revealed that the vast majority always use general anaesthesia for the treatment of mandibular fractures regardless of the method of treatment used¹⁴. In the current study, four patients were satisfactorily treated using local anaesthesia and two of these patients were managed as day cases. Due to the rapid rehabilitation of the patients the inpatient periods were generally brief with three days being the most common length of stay. It is also often assumed that miniplate osteosynthesis would require lengthy operation times. In the current study the operating time for the majority of patients was less than two hours. Brown et al⁵ found that there was no significant difference in the operating times required for miniplate osteosynthesis when compared to intermaxillary fixation techniques. In this same report it was determined that it was actually cheaper to treat mandibular fractures with miniplate osteosynthesis (table 10). This was attributed to the fact that patients with intermaxillary fixation require intensive care nursing, longer periods of hospitalisation and greater numbers of outpatient visits. These factors more than discounted the extra costs of materials in miniplate osteosynthesis.

Oikarinen et al²² suggested that miniplate osteosynthesis is a complicated technique unsuitable for a small teaching unit. This is contrary to the experience of our own small unit where approximately a third of the patients were treated by

Table 10

Average Cost of Managing a Mandibular Fracture

	Cost
Intermaxillary fixation	£919-1000
Miniplate osteosynthesis	£794

(from JS Brown et al
Br J Oral Maxillofac Surg 1991)

junior registrars with no untoward affect on the treatment outcomes. The intra-oral approach which avoids scarring and the small, easily manipulated plates contributes to the ease of use of this particular plating system.

The necessity of the routine removal of the plates following the healing of the fracture is a controversial issue. Clinical indications for the removal of plates infrequently occur during the course of treatment and may include - pain, infection, mobility of the plate or screws, or parasthesia due to the position of the plate⁷. Theoretical grounds for the routine removal of plates exists in orthopaedic surgery and includes the "stress shielding" effect which may result in osteoporosis⁷. However there is as yet no clinical or experimental evidence to indicate any risks associated with the long term retention of stainless steel or titanium plates in the maxillofacial region. In the current study, the plates have been removed in 28 the cases, predominantly for research purposes. No local or systemic adverse effects from the retention of the plates has been noted thus far. Brown et al⁵ also has found no complications from the retention of plates over a 5-10 year period.

However, in the case of mandibular fractures treated with miniplate osteosynthesis, the plates can usually be easily removed under local anaesthesia with minimal associated risks to the patient. Considering the youthfulness of the majority of these patients and therefore the potential for plates to lie in situ for very long periods, the option of removing the plates following fracture healing should be discussed with the patient.

CONCLUSION

This study has highlighted some interesting features of patients suffering maxillofacial fractures in an inner city area and has confirmed the significant role alcohol plays in these injuries. It has clearly shown that young males, the unemployed and heavy drinkers and smokers are at particular risk of sustaining these fractures. This seems to be related to the fact that interpersonal violence is the major aetiological factor. Young males who have been consuming large amounts of alcohol seem prone to become involved in violent incidences, with the frustrations of being unemployed possibly being a contributing factor. The alcoholic patients in this study constitute a significant group because of their high prevalence and the difficulties in management they present. These patients often have medical conditions of note, may be unsuitable for certain methods of treatment and were notorious for not returning for review appointments. Therefore, care must be taken in identifying these patients, carrying out a thorough medical assessment and instituting a treatment regime most suited to their needs. Ideally more emphasis and resources should be directed towards providing accommodation and access to rehabilitation programmes for these alcoholic patients.

Miniplate osteosynthesis has proved to be an effective method of treatment for mandibular fractures as evidenced by the low levels of complications reported in this study. It has proved a successful treatment for the often difficult, non-compliant patients that formed part of this study population. The advantages of using miniplate osteosynthesis in these patients compared to traditional methods included - rapid patient rehabilitation, precise anatomical reduction with less reliance on patient compliance and most importantly the reduced risks to the airway. Miniplate osteosynthesis has also proved to be safe and predictable when used by operators with varying levels of experience as exists in a teaching unit.

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DATA COLLECTION FORM (1)

STUDY NO.

labels

S.H.
U.D.H.

SEX:

AGE:

OCCUPATION:

RESIDENCE:

MEDICAL HISTORY:

ALCOHOL USAGE:

SMOKING:

IV DRUG USE:

DATE INJURY:

DATE CASUALTY:

AETIOLOGY: mva assault fall sports industrial other

ALCOHOL PRIOR TO INJURY:

POSITION OF FRACTURE(S): R L

condyle
coronoid
ramus
angle
body
parasymphysis
symphysis
Le Fort
zygoma
alveolar

NO. FRACTURES:

ASSOC. INJURIES:

TREATMENT: conservative plating wiring other

2.

ADMITTED: yes no

INPATIENT TIME:

DATE OPERATION:

DAYS - INJURY TO OPERATION:

ANAESTHESIA: local general

OPERATOR LEVEL:

OPERATION: eyelet wiring archbars reduction only
 intra-osseous wiring other

I.M.F.: yes no

PERIOD I.M.F.:

NO. REVIEWS:

F.T.A.'s:

COMPLICATIONS:	1st MONTH	LATER
wires replaced		
infection		
wound breakdown		
delayed healing		
malocclusion		
nerve damage		
other		

DATA COLLECTION FORM - PLATING

STUDY NO.

labels

S.H.
U.D.H.

SEX:

AGE :

OCCUPATION:

RESIDENCE:

MEDICAL HISTORY:

ALCOHOL USAGE:

SMOKING:

IV DRUG USE:

DATE INJURY:

DATE CASUALTY:

AETIOLOGY: mva assault fall sports industrial other

ALCOHOL PRIOR TO INJURY:

POSITION OF FRACTURE(S) : R L

condyle
coronoid
ramus
angle
body
parasymphysis
symphysis
Le Fort
zygoma
alveolar

NO. FRACTURES:

ASSOC. INJURIES:

TREATMENT: conservative plating wiring other

2.

ADMITTED: yes no

INPATIENT TIME:

DATE OPERATION:

DAYS - INJURY TO OPERATION:

ANAESTHESIA: local general

OPERATOR LEVEL:

LENGTH OF OPERATION:

I.M.F.:	yes	no	DURATION	I.M.F.:
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TYPE I.M.F.: eyelets archbars / wires elastics

NO. PLATES PLACED: 1 2 3 4 5 6

TYPE PLATES: 4 hole 4L 5 6 7 8

POSITION OF PLATES: R L

angle
body
parasymphysis
symphysis
maxilla
F/Z suture
I/O rim

METHOD OF PLACEMENT: intra-oral extra-oral transbuccal

ADDITIONAL MODALITIES: essig intra-osseous wires other

NO. REVIEWS:

F.T.A.'s:

COMPLICATIONS:	1st MONTH	LATER

wires replaced
infection
wound breakdown
delayed healing
malocclusion
nerve damage
other

PLATES REMOVED: yes no

MONTHS IN PLACE:

REASON FOR REMOVAL:

MANDIBULAR FRACTURES TREATED WITH MINI-PLATE OSTEOSYNTHESIS: THE SYDNEY EXPERIENCE

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This study is a retrospective analysis of 61 consecutive cases of mandibular fractures treated with mini-plates. The aim was to gain an understanding of the socio-economic profile of the patients, the nature of the injuries involved and to assess the efficacy of the treatment being provided.

The patients were treated at Sydney and the United Dental Hospitals during the period of July 1987 to May 1990. 93% were male and the majority were in the 20-30 year age group. Slightly less than half were unemployed and 8 patients were vagrant. 15% of the patients were classed as alcoholics and a further 26% were heavy drinkers. Two thirds of patients were smokers.

Assault was the aetiological factor in 69% of cases and alcohol was implicated in 56% of the injuries. The injuries were predominantly simple, with 92% of patients having only one or two fractures and 13% with other facial fractures. The angle was the most common fracture site.

Approximately two thirds of cases were plated within 3 days of their injury, although some were treated much later. 108 plates were placed, with most patients requiring 1 or 2 plates. In 7 cases, additional inter-maxillary fixation was used. 69% of patients were discharged within 5 days.

Our treatment outcome compared favourably to that found in similar studies on mini-plates with only 4 patients having significant complications. Considering the types of patients treated and the fact that operators ranged from trainees to specialists, mini-plate osteosynthesis has proved to be an effective method for the treatment of mandibular fractures.

An analysis of 80 cases of mandibular fractures treated with miniplate osteosynthesis

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L. Rix, A. R. L. Stevenson, A. Punnia-Moorthy: *An analysis of 80 cases of mandibular fractures treated with miniplate osteosynthesis. Int. J. Oral Maxillofac. Surg.* 1991; 20: 337-341.

Abstract. A study of 80 consecutive cases of mandibular fractures treated utilizing miniplate osteosynthesis is reported. Analysis of the data collected from 2 inner city hospitals revealed a high incidence of males (90%), alcohol abusers (44%), smokers (77%) and unemployed (36%). Assault was the aetiological factor in 72.5% of cases, with alcohol implicated in 58%. The injuries were predominantly non-complex in nature, 94% having one or 2 mandibular fractures and only 11% having additional facial fractures. The results compared favourably with those found in previous studies with 8% having complications. The efficacy and advantages of miniplate osteosynthesis as a method of treatment of mandibular fractures is discussed.

Key words: mandibular fractures; assault; alcohol; miniplate osteosynthesis; complications; trauma.

Accepted for publication 3 August 1991

Osteosynthesis of mandibular fractures utilising non-compression monocortical miniplates was introduced by MICHELET et al.¹⁴ and developed and refined by CHAMPY et al.⁶ This system is now well recognised and practised in many countries^{5,11,12,22,25}. However, its introduction into Australia has been recent and as yet no results have been reported. The aim of this study was to analyse data collected from patients suffering mandibular fractures who presented to the University of Sydney Department of Oral Surgery. The nature of their injuries was assessed and the effectiveness of this technique in treating these fractures was examined.

Material and methods

Eighty consecutive cases of mandibular fractures treated during the period July 1987 to March 1991 were included in this study. The patients were treated at Sydney Hospital and the United Dental Hospital, both of which are located in the inner city area of Sydney. Data was collated from the patient records, radiographs and from clinical examination whenever possible. The operative techniques employed followed that described by CHAMPY et al.⁶ with some minor modifications. The patients were treated under general anaesthesia in all but 4 cases. An intra-oral approach was used in 90% of cases with the occasional need to place screws transbuccally. Intermaxillary fixation, in the form of

eyelet wires or archbars, was usually applied intra-operatively in order to stabilise the fracture whilst the plates were adapted and screwed into position. Two plates were used for fractures anterior to the mental foramen and one plate for fractures at other sites except for condylar fractures which were managed conservatively. A modification was occasionally used for fractures in close proximity to the mental foramen to avoid trauma to the nerve. Instead of the customary 2 plates, only one plate was placed, above the foramen, and supplemented with loop wiring which included 2 or more teeth on either side of the fracture line. The loop wire was left in place for approximately 4-6 weeks. Stainless steel plates (Champy plates, Gebruder Martin Co.) were used in all but 7 cases where titanium plates were used. The operators ranged from specialists to trainees with varying levels of experience.

Prophylactic antibiotics (predominantly penicillin and/or metronidazole) were administered either intravenously or orally from the time of presentation until the 7th post-operative day. 8 mg of dexamethasone was administered intra-operatively, with 2 further doses the following day in certain cases. An antiseptic mouthwash, 0.2% chlorhexidine, was routinely issued for 7 days. Minivac drains were also used for the first 24 h when indicated. Post-operatively, patients were examined on a regular basis for up to 12 months.

Results

Ninety percent of mandibular fractures occurred in men. The peak incidence

was in the 20-30 year age group with ages ranging from 16 to 83 years (Fig. 1). Assault accounted for 72.5% of the injuries while motor vehicle accidents were responsible for 7.5%, the remainder being due to sports, industrial accidents, epileptic fits, spontaneous fracture and following exodontia (Table 1). Fifty-eight percent of patients admitted to consuming alcohol within a short time of being injured. Based on the classification used by the Royal College of Psychiatrists¹⁸, 44% of patients were classed as alcohol abusers with 11 patients diagnosed as alcoholic, 10 of whom were also vagrant. Seventy-seven percent of the patients were smokers and 7.5% were intravenous drug users. Thirty-six percent of patients were unemployed and there was a preponderance of non-professionals amongst the

Table 1. Classification according to aetiology

Aetiology	No. patients (%)
Assault	58 (72.5)
MVA*	6 (7.5)
Sports	5 (6)
Fall	4 (5)
Industrial	3 (4)
Epileptic fit	2 (2.5)
Spontaneous	1 (1.25)
Iatrogenic	1 (1.25)
Total	80

* Motor vehicle accident

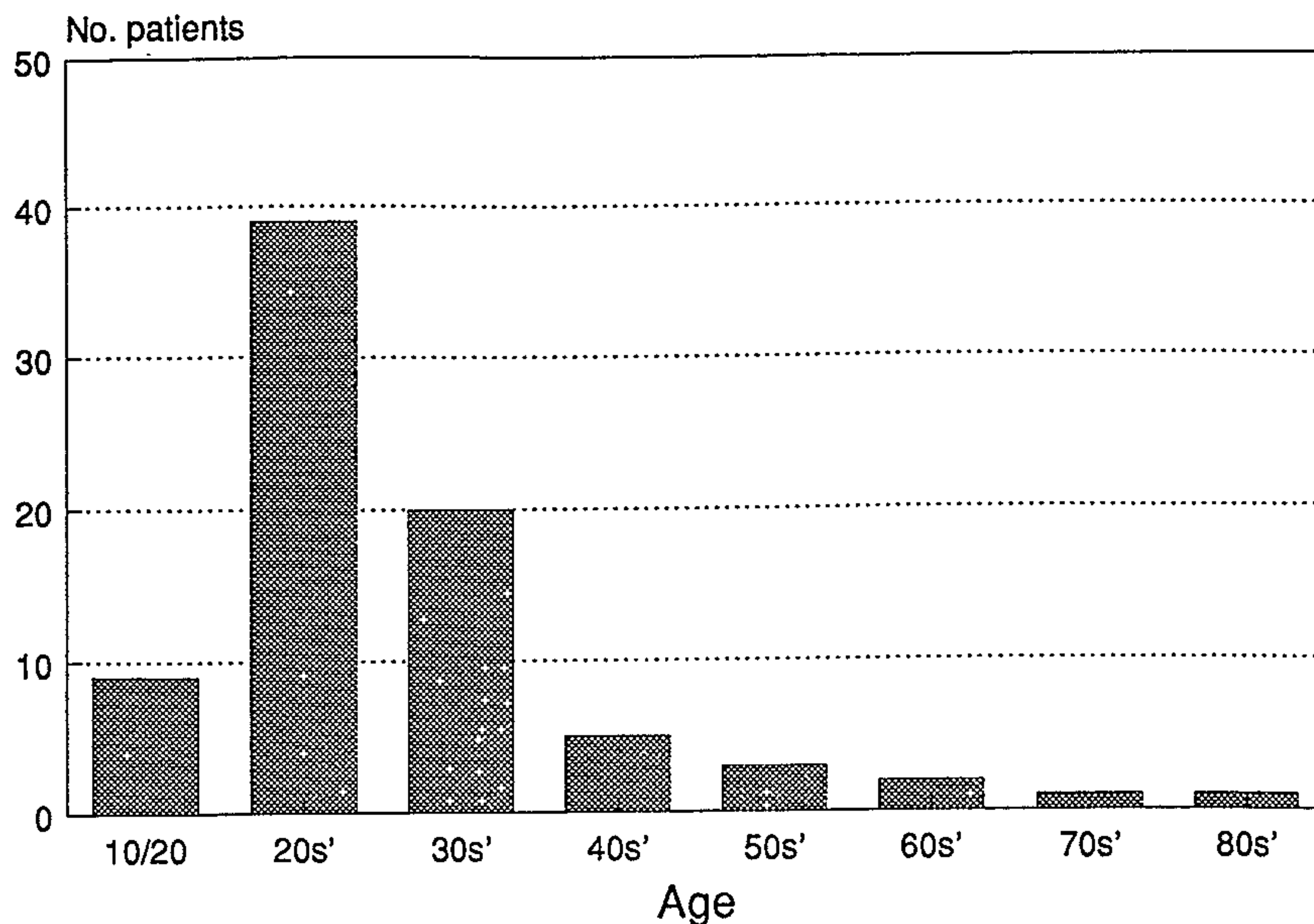


Fig. 1. Age distribution.

Table 2. Social characteristics of the study group compared to the male population of the state of NSW

	Study group (90% male)	Adult males (NSW)*
Alcohol abusers (%)	44	3.6
Tobacco smokers (%)	77	33
IV drug users (%)	7.5	2
Unemployed (%)	36	8.7

* New South Wales

46% employed. The remaining 18% were composed of students, old-age pensioners and those on sickness benefits. A comparison of social characteristics of the study group with that of the general population indicated marked differences (Table 2)^{7,9}. As the study group was predominantly male (90%), only the statistics for adult males in the state of New South Wales were used

for comparison. Twenty-five percent of patients had medical conditions of significance which included: heart disease, respiratory disease, cirrhosis of the liver, epilepsy and anaemia. Two patients were classed as infectious, one being HIV-positive and the other a hepatitis C carrier.

There were a total of 125 fractures, with the angle being the most common

site (Fig. 2). This is consistent with other studies which have shown that assault tends to result in more angle and body fractures, whilst motor vehicle accidents cause more condylar and symphyseal fractures^{2,8,16}. The majority of fractures occurred on the left side which would correspond to most assailants being right-handed. Ninety-four percent of the injuries were non-complex having only one or 2 fractures of the mandible, and only a few cases being comminuted. A total of 12.5% had additional facial fractures involving the nose, zygomatic complex or the maxilla. Nine patients had associated injuries of significance which included fractured hips, legs, hands, skull and vertebrae. It was these patients that required longer periods of hospitalisation. Sixty-seven percent of cases were plated within 4 days of the injury; however, a small proportion were treated after a considerable delay (Fig. 3). This was due to either the late presentation of the patient, the nature of their other injuries, or when the fracture had initially been inadequately treated. A total of 139 plates were placed in a distribution indicated in Table 3. Intermaxillary fixation was required post-operatively in 9 cases, usually necessitated by the presence of a displaced condylar or maxillary fracture.

The amount of theatre time required ranged from 1 to 5 h with 73% of cases completed in 2 h or less (Fig. 4). Longer operative times were associated with cases of multiple facial injuries. The period of hospitalisation ranged from 1 to 55 days with 2 patients managed as outpatients and 72% of patients discharged within 5 days (Fig. 5). The lengthy inpatient times were associated with cases of multiple injuries.

Five of the 80 patients failed to attend review appointments and could not be contacted. The incidence of complications in the remaining patients is illustrated in Table 4, with only 8% having persistent complications. During the early post-operative period (<1 month) a considerable number of transient complications were in evidence. There were 32 cases of hypoesthesia of the inferior alveolar nerve, a result of the initial trauma plus manipulation of the nerve during the plating procedure. Only 2 failed to resolve (2.5%), one of which was also the only case of delayed union. Occlusal disturbances were reported by 13 patients in the initial post-operative phase. Minor occlusal adjustment was

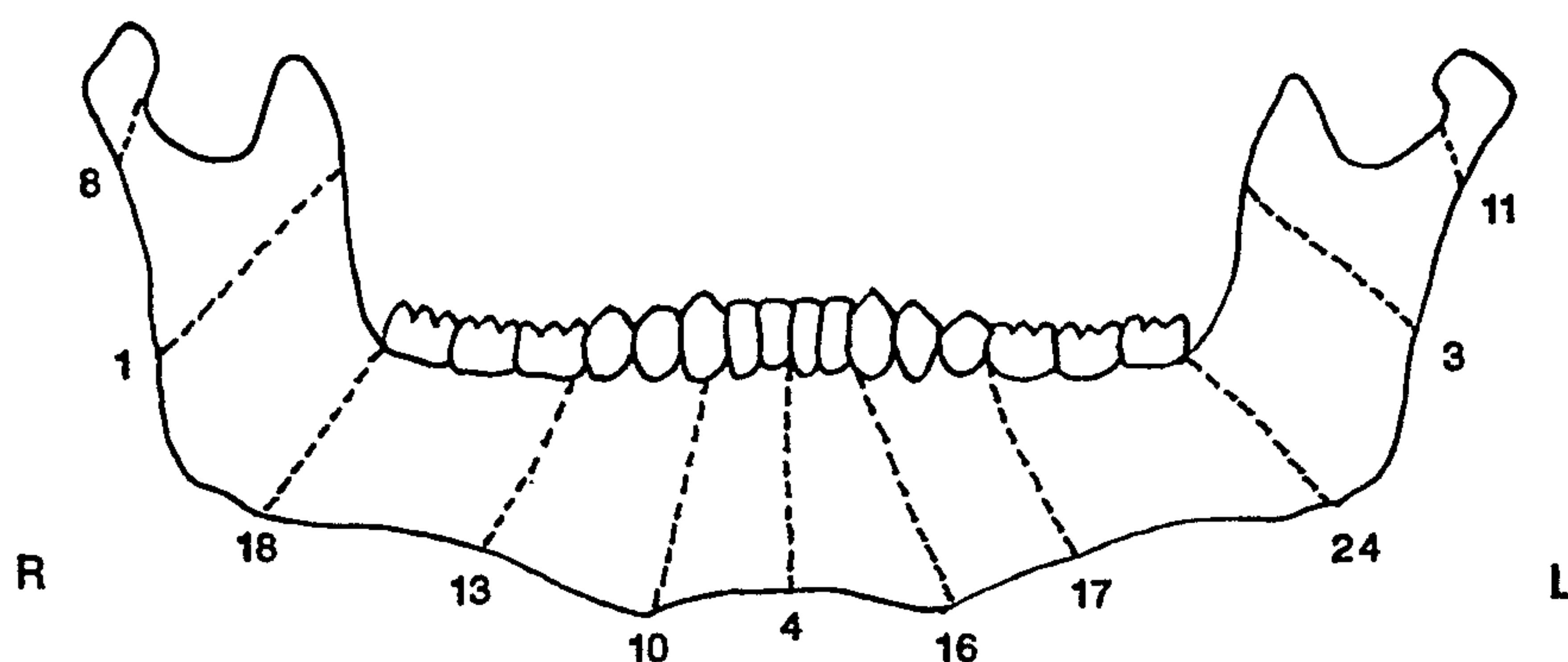


Fig. 2. Distribution of the 125 fractures according to site.

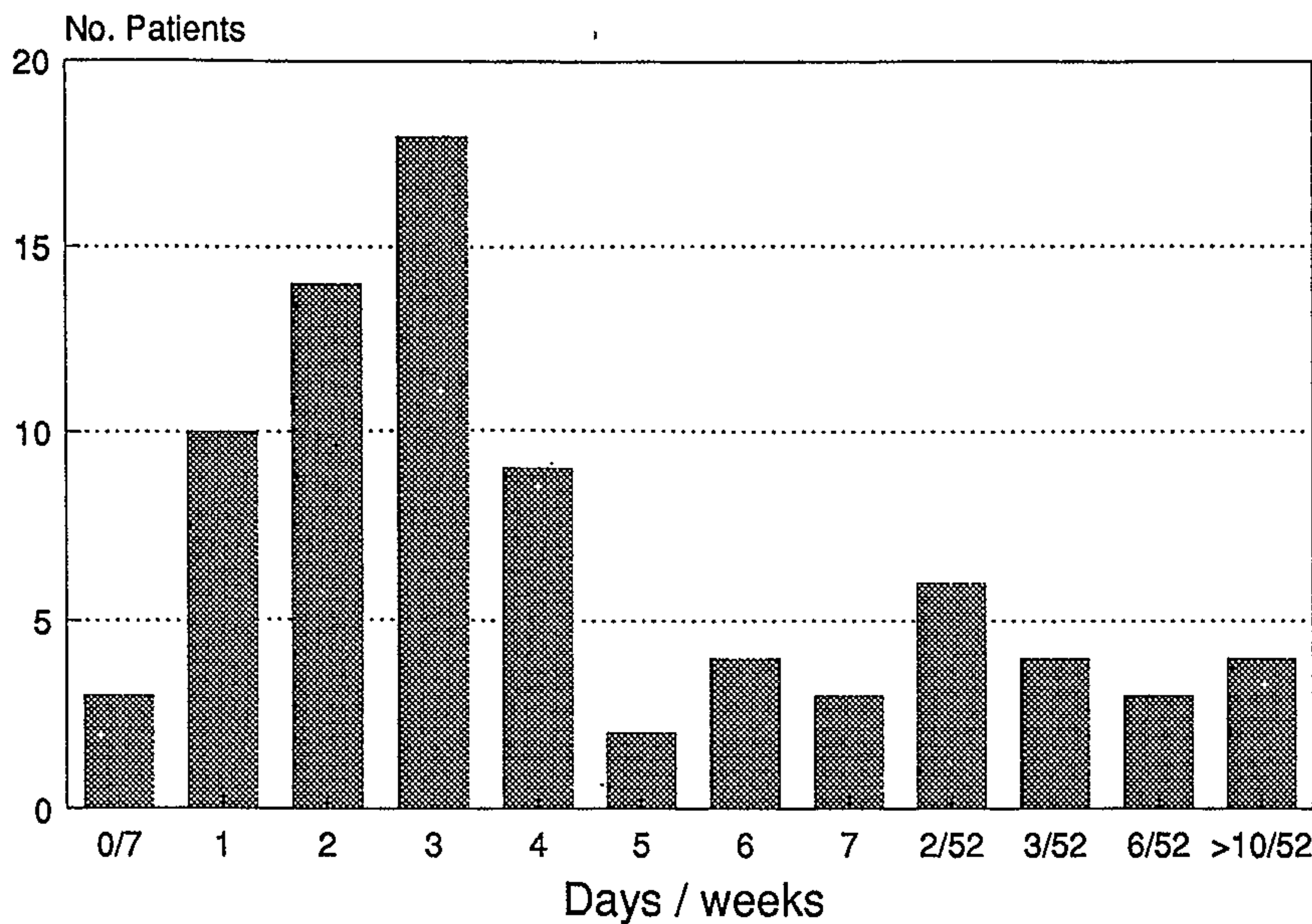


Fig. 3. Time elapsed between the injury and the operation.

carried out in a few cases; however, the majority of these cases resolved spontaneously. Only 2 cases (2.5%) had residual occlusal complications, one with an anterior open bite and one with a residual occlusal step defect. Both of these cases had associated condylar fractures. Transient weakness of the mandibular branch of the facial nerve occurred in 3 of the 8 patients where an extraoral approach had been used to place the plates. These all resolved after some months. Two dental complications occurred both involving a tooth in the fracture line. In one case a periodontal defect developed and in the other resorption of the apical portion of the root was detected, although the tooth remained asymptomatic.

The incidence of complications in this study compared favourably with that in similar studies on miniplate osteosynthesis (Table 5). These results are also similar to those achieved with traditional methods of fracture treatment utilising intermaxillary fixation⁵.

Discussion

During the last 10 years there have been a number of papers published on the

Table 3. Distribution of the 139 plates placed

Position of plates	
Angle	45
Body	35
Parasymphysis	51
Symphysis	8
Total	139

patterns of facial trauma in different countries^{1,2,3,8,10,16,24,27}. The patient group analysed in this current study however, shows some interesting features. The most obvious of these is the high proportion (72.5%) of mandibular fractures that were caused by assault, which is one of the highest figures so far reported. The number of patients considered alcohol abusers (44%) and those consuming alcohol prior to being injured (58%) were also markedly high. This gives further evidence to the relationship between alcohol and interpersonal violence^{10,13,19}. The large proportion of smokers in this study may

also be a reflection of the social behaviour of this group. The high percentage of unemployed patients (36%) was also significant, contributing to the evidence of a link between unemployment (or increased leisure time) and violence^{2,19}. The profile presented by the patients in this study epitomises what one would expect in hospitals located within an inner city area of a large, modern city. In such an area there is a concentration of licenced premises and entertainment venues, with minimal opportunity for high-speed motor vehicle accidents¹⁹.

The advantages of plating techniques for the treatment of mandibular fractures, over more traditional methods, have been highlighted by a number of authors^{5,6,14,15,17,22,25}. These include the rapid return to normal masticatory function and mouth opening, resulting in less disturbance to body weight and less time lost from employment^{5,6,15,25}. In addition, early mobilization has been recognised as a significant advantage when concurrent condylar fractures are present^{11,15,25}. Direct visualisation also allows for a more precise anatomical reduction, with the fragments subsequently held in a more stable position by the plates⁵. This stability is of particular advantage for edentulous mandibles and in angle fractures distal to the last tooth where the masticatory muscles tend to cause displacement¹⁵. For comminuted fractures longer plates can be used to span all fragments, thus completely stabilizing the area of fracture.

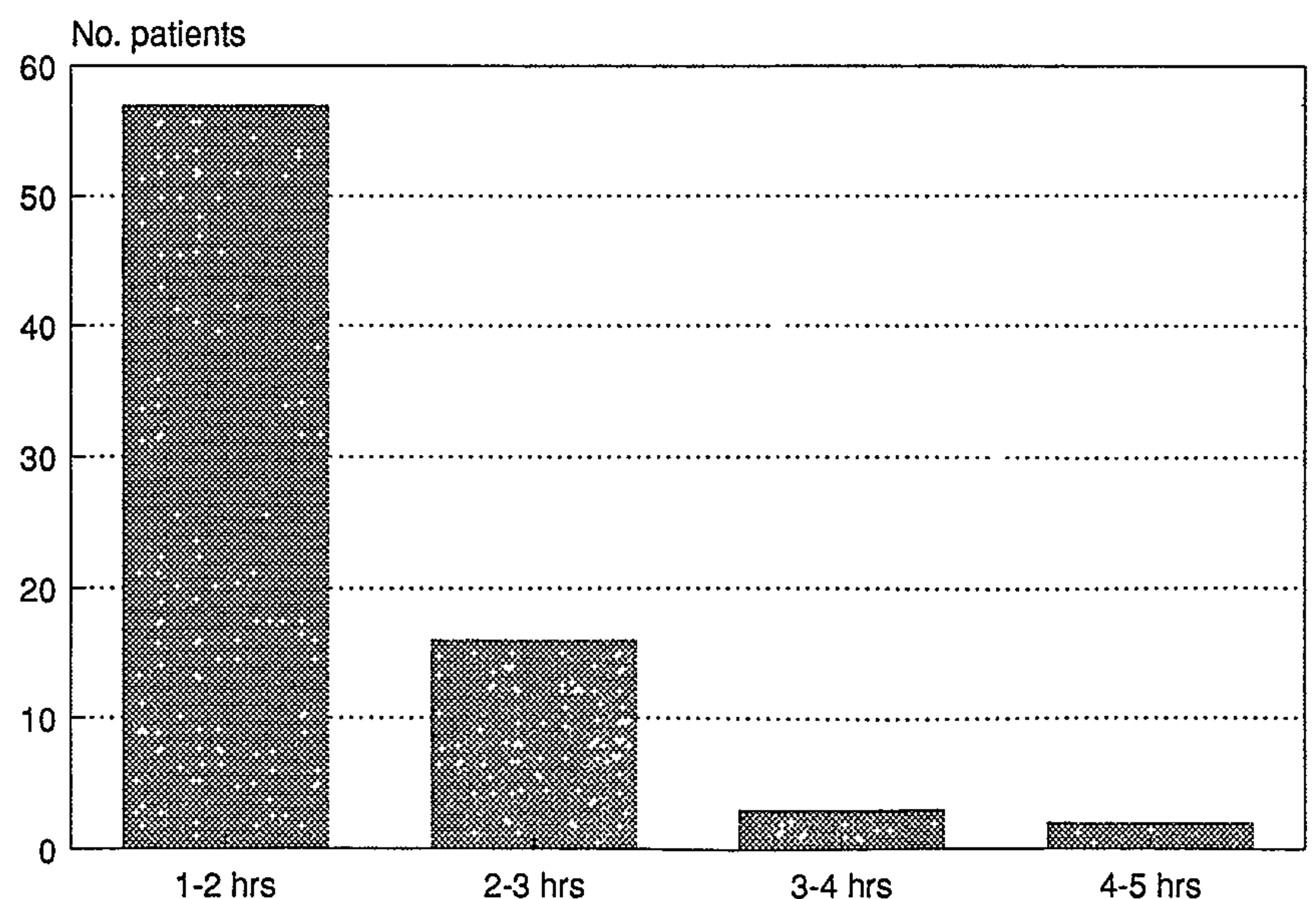
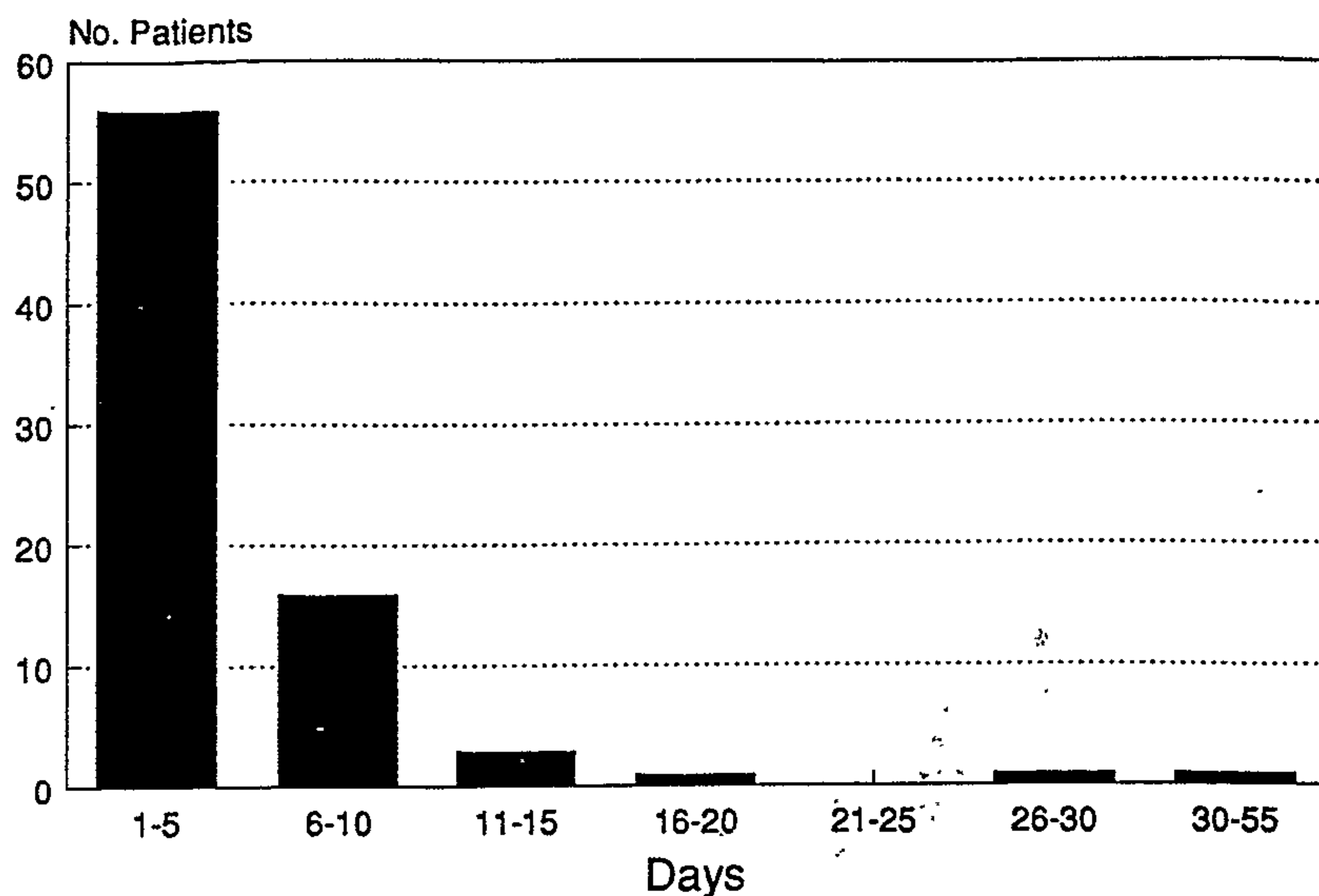


Fig. 4. Distribution of the operation times (hours).



2 pts. not admitted

Fig. 5. Period of hospitalisation in days.

Table 4. Incidence of complications

Complications	1 Month	~6 Months
Malocclusion	13	2
Dysaesthesia	32	2
Delayed union	—	1
Infection	nil	nil
Wound dehiscence	2	nil
Facial nerve weakness	3	nil
Periodontal defect	—	1
Resorption of tooth in fracture line	—	1

Total complications = 6 patients (8%)

* 5 patients unable to be reviewed ($n=75$)

Table 5. Comparison of results with other studies

Complication	Cawood 1985 $n=50$	Champy 1978 $n=100$	Ikemura 1988 $n=66$	Wald 1988 $n=61$	Sydney $n=75$
Malocclusion	8	4.8	3	1.9	2.6
Infection	6	3.8	3	7.4	nil
Dehiscence	12	—	7.6	—	2.6
Delayed union	—	0.5	—	—	1.3
Sensory disturbance	8	—	—	3.7	2.6

Figures expressed as percentages

Plates have greatly reduced the need for post-operative intermaxillary fixation, as indicated by 89% of patients in this study not requiring this additional fixation. Intermaxillary fixation is associated with a number of problems, the most important being the restricted access to the airway in unconscious patients. It is also unsuitable for epileptics, alcohol and drug abusers, patients with chronic obstructive airway disease, those unable to attend for regular re-

view, pregnant women and patients whose health would be adversely affected by the decreased nutrition associated with a liquid diet^{5,15,26}. Intermaxillary fixation frequently requires adjustment or replacement of wires²⁰, which suggests the stability of the fixation may be compromised as well as requiring an increased number of outpatient visits. Periodontal problems and residual trismus may also be undesirable sequelae²⁰.

It has been suggested that the use of

metal plates for mandibular fractures increases the incidence of infections. Conversely, a number of studies have shown low rates of infection associated with the use of miniplate osteosynthesis^{5,6,11,25}. Alcoholics have been shown to have an increased incidence of post-operative infections and delayed healing following facial fractures^{4,21}. In this study, however, there were no cases of post-operative infections despite the high proportion of alcohol abusers treated. There was also evidence to support JOHANSSON et al.¹² who showed the effectiveness of miniplate osteosynthesis in treating mandibular fractures that were initially infected.

Reported disadvantages include the necessity for hospital admission, general anaesthesia, increased operating time and greater cost of materials. JOHANSSON¹² stated that it is possible to perform miniplate osteosynthesis with local anaesthesia alone and thus reduce hospitalisation time. In the current study 4 patients were treated in this manner, with 2 managed on an out-patient basis. Following admission, in-patient time was generally found to be brief, 3 days being the most common. In no case was an extended period of hospitalisation related to the mandibular fracture or its treatment. The cost-efficiency of plating versus traditional techniques is also an important issue. Theatre time in the majority of cases varied between 1 and 2 h, which is only slightly longer than usually required for closed reduction techniques. However, the majority of patients do not require post-operative intermaxillary fixation, therefore intensive-care nursing is not required in the immediate recovery period. TAYLOR et al.²³ have quantified the average cost of managing a fractured mandible with miniplate osteosynthesis and found that it is approximately 25% less than for treating a fracture with intermaxillary fixation.

Some authors have raised doubts as to the functional stability of Champy plates¹⁷. This study, which demonstrated low levels of complications and occlusal problems does not support these fears. OIKARINEN et al.¹⁵ have suggested that miniplate osteosynthesis is a complicated technique unsuitable for a small treatment unit. This is contrary to the experience in our own unit where approximately one third of the cases were treated by junior registrars. The intra-oral approach, which avoids skin scars, and the easy manipulation of the

plates contribute to the suitability of this technique for a teaching unit. Subsequent removal of miniplates is also a simple procedure requiring only local anaesthesia. However, the necessity of routine plate removal after healing is yet to be resolved. Although theoretical indications may exist⁵, there is little clinical or experimental evidence yet available to indicate any risk associated with the long-term retention of titanium or stainless steel plates. In this series the plates have been removed in 29% of cases, predominantly for research purposes. No local or systemic adverse effects from the retention of the plates have been noted thus far.

Acknowledgements. We would like to thank Sydney Hospital, the United Dental Hospital and the staff of the medical records department for their assistance in gathering the data for this study. We also extend our thanks to Dr Russell Vickers for his technical advice.

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